The Iron Gates Mesolithic in a regional context

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ABSTRACT – *The specific character of the Iron Gates Mesolithic material culture derives from the geomorphological and ecological features of the Iron Gates gorge in the Early Holocene. However, the Mesolithic of this geographic area can be entirely linked to the general flows of Mesolithic development in Europe as well as to the phenomena observed in the Adriatic-Ionian and Aegean zones. This demonstrates that the cultural, technological and economic changes which occurred during the Early Holocene were influenced by the same or similar factors as the entire area of the Balkan Peninsula. The absence of Mesolithic settlements outside the Iron Gates raises the question of whether the interior parts of the Central Balkans were inhabited during the Early Holocene. As hinted by the research in the Iron Gates and the Adriatic hinterland, Mesolithic settlements were probably located outside the denser forested areas (in the littoral and high-altitude zones) but this remains to be confirmed. Based on the assessment of the demographic potential of Mesolithic and Neolithic communities, four scenarios of Neolithisation of different parts of the Balkan Peninsula have been proposed.*

KEY WORDS – *Mesolithic; Balkans; Iron Gates; Neolithisation; population movements*

Mezolitik na območju Železnih vrat znotraj regionalnega konteksta

IZVLEČEK – *Posebnost mezolitske materialne kulture na območju Železnih vrat izhaja iz geomorfoloških in ekoloških značilnosti te soteske v zgodnjem holocenu. Lahko pa mezolitik na tem geografskem območju v celoti povezujemo s splošnimi tokovi mezolitskega razvoja v Evropi, kakor tudi s pojavi na območju Jadranskega in Jonskega ter Egejskega morja. To dokazuje, da so na kulturne, tehnološke in gospodarske spremembe v zgodnjem holocenu vplivali enaki ali podobni dejavniki na celotnem območju Balkanskega polotoka. Zaradi odsotnosti mezolitskih naselij izven območja Železnih vrat ostaja vprašanje, ali so bila območja v notranjosti osrednjega Balkana v zgodnjem holocenu sploh poseljena. Raziskave na območju Železnih vrat in v zaledju Jadranskega morja kažejo na to, da so bila mezolitska naselja verjetno izven gostejših gozdnih območij (v primorskem in visokogorskem pasu), kar pa bi bilo potrebno še dokončno potrditi. Na podlagi ocene demografskega potenciala mezolitskih in neolitskih skupnosti predlagamo štiri možne scenarije neolitizacije različnih delov Balkanskega polotoka.*

KLJUČNE BESEDE – *mezolitik; Balkan; Železna vrata; neolitizacija; selitve prebivalstva*

Introduction

In Serbia, the Mesolithic has so far been confirmed only in the area of the Iron Gates, where detailed surveys and archaeological excavations were undertaken during the 1960s and 1970s, due to the construction of hydroelectric power stations on the Danube. A large number of Mesolithic sites were thus discovered and explored in a very short period of time (Fig. 1). The remains of distinct architecture

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and graves were discovered at many locations, while the site of Lepenski Vir yielded stone sculptures (Fig. 2) which still represent a unique phenomenon within the Mesolithic (*Srejović 1969; Radovanović 1996*). These discoveries caused a strong interest in the Iron Gates Mesolithic, which continues today.

The research that followed was initially focused on determining the cultural-stratigraphic sequence and correlation of phenomena observed at different sites, while later research focused on anthropological and bioarchaeological studies, as well as archaeometric studies of samples and materials (*Cook* et al. *2002; Borić, Miracle 2004; Borić, Dimitrijević 2007; Borić* et al. *2018; Bonsall* et al. *2004; 2015a; 2015b; Nehlich* et al. *2010; Jovanović* et al. *2019*). After dating numerous samples from almost all of the known sites, the issue of the chronology of the late phase of the Iron Gates Mesolithic was largely resolved, while genetic and isotopic studies (*Borić, Price 2013; Mathieson* et al. *2017*) enabled a good insight into the nature of interactions Mesolithic and Neolithic populations.

However, despite the fact that recent years have brought significant progress in the research of the Iron Gates Mesolithic, there have been few attempts to examine this phenomenon in a regional context (*Radovanović 1996; Merkyte 2003; Mihailović 2007a*). The discrepancy in the intensity of the research conducted in the Iron Gates and the neighbouring areas only increased over time, which strengthened the initial impression that the Iron Gates Mesolithic represented an exceptional but rather solitary phenomenon.

To mitigate this impression, we considered the issues that we believe best reveal the connections of the Iron Gates with the surrounding areas. These questions refer to (a) the causes and consequences of the settlement of littoral areas in the Early Holocene, (b) the factors which led to the establishment of a linear settlement system and intensification in the procurement of aquatic resources in the Late Mesolithic, and (c) understanding of cultural transformations and interactions at the Mesolithic-Neolithic transition. Although these represent rather general issues, we believe that the Mesolithic of the Iron Gates cannot be approached without looking at the regional scale. We are also convinced that the nature of the Mesolithic-Neolithic transition in Southeast Europe cannot be understood until there is sufficient archaeological evidence on the distribution and size of the local Mesolithic population.

Geographical position and ecology of the Iron Gates

The Iron Gates (Đerdap) gorge represents the largest and longest gorge in Europe. It separates the northern from the southern part of the Carpathian-Balkan Massif, connecting the Pannonian Basin with the Wallachian Plain. In the past, however, the gorge was more of an obstacle than a communication route, especially when it comes to the right bank of the Danube. The narrow parts of the gorge were almost impassable before the flooding by the artificial Lake Đerdap, while communication with the mountainous hinterland, with rare exceptions (*e.g.*, the Cerna valley in Romania) was significantly limited. Due to this, the mobility of the communities that inhabited the Iron Gates was focused on the use of resources within the gorge itself, as evidenced by the low population of the gorge in earlier periods.

There are indications that the Iron Gates represented a refugium for flora and fauna, and, presumably, human populations, during the Last Glacial Maximum (*Mišić 1981*). The climate (which today belongs to the Danube variant of the continental pluviometric regime) is milder than in the neighbouring areas and is characterized by increased humid-

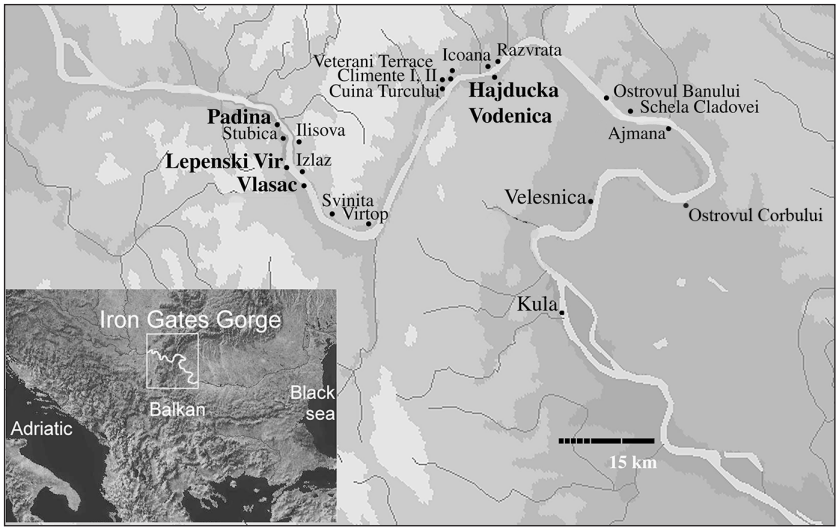

Fig. 1. Map of the Iron Gates with Mesolithic sites.

ity and smaller annual temperature deviations (*Radovanović 1996; Boroneanţ 2011*). A similar situation probably prevailed in earlier periods, although direct evidence of a human presence in the Iron Gates is lacking. In contrast, the Climente II, Cuina Turcului (layer I) and Hoţilor Caves in Romania yielded rich palaeontological material dated to the Late Glacial (Bølling-Allerød oscillation), allowing insights into the palaeoecology of the period (*Boroneanţ 2011; Bonsall* et al. *2016*). The material from these sites mostly consisted of warmth-loving fauna (deer, beaver, wild boar), but cold-loving species (*e.g., Pyrrhocorax graculus*) were also found. The layer II of Cuina Turcului, recently dated to the very beginning of the Holocene (*Bonsall* et al. *2015a*), also contains mixed fauna, which, along with the results of pollen analyses (*Pop* et al. *1970; Carciumaru 1985*), indicates that the Pleistocene-Holocene transition in the Iron Gates may not have been as abrupt as in the neighbouring areas.

The faunal remains found at the Iron Gates archaeological sites testify to the high ecological capacity of this region in the Early Holocene (*Radovanović 1996*). However, one of the defining ecological characteristics of the Early Holocene of the Iron Gates is a richness of fish stock, which included cyprinids (especially the European carp), catfish, pike, perch and salmonids (*Dinu 2010; Živaljević 2017*), but also anadromous species (beluga sturgeon) which swam upstream from the Black Sea into the Danube for spawning. There is little data on climate and ecological changes in the Early Holocene, but it is assumed that the sudden decrease in global temperatures at approx. 8200 cal BP (*Berger, Guilaine 2009*) may have caused the temporary abandonment of previously inhabited sites (*Bonsall* et al. *2002*).

Iron Gates Mesolithic

Early Mesolithic

The earliest evidence for the settlement of the Iron Gates gorge following the Last Glacial Maximum comes from sites located in present-day Romania. Numerous artefacts, fireplaces and graves, as well as engraved bone tools and perforated mollusc shells were documented at the Climente II Cave and the Cuina Turcului rock shelter (*Păunescu 1979; Boroneanţ 2000; Bonsall* et al. *2016*). The remains of fauna testify to the hunting of various animal species, including ibex, which was intensively hunted in the Cuina Turcului II phase (*Bolomey 1970; 1973*). Recent analyses show that fishing already played a significant role at that time. This is evidenced not

Fig. 2. The 'Progenitor' stone sculpture from the site of Lepenski Vir.

only by the fish bones recovered from Cuina Turcului (*Dinu 2010*) but also by the elevated nitrogen stable isotope ($\delta^{15}N$) values recorded for the human remains from Climente II (*Bonsall* et al. *2016*).

Other evidence of the early settlement of the banks of the Danube is rather scarce. The lower layers (I-II) of the Ostrovul Banului site, which yielded a characteristic Epipalaeolithic industry, were once thought to be of Early Mesolithic age, but are now dated to the end of the 8th millennium BC (*Boroneanţ 2011*). Similar material comes from the lower stratigraphic levels of the Veterani terrace, but these are not dated yet. On the other hand, dates for individual samples from the sites of Padina, Lepenski Vir and Vlasac showed that the territory of Danube's right bank was inhabited as early as the end of the 10th and the beginning of the 9th millennium cal BC (*Borić 2011; Bonsall* et al. *2015a*). The dates obtained for human bones confirmed that a specific funeral ritual (*i.e.* burials of individuals in lotus position) was practised in the Iron Gates at that time, but other samples could not be linked to the defined archaeological horizons or material found in them (*Borić 2011*). Therefore, it is currently not possible to understand the character of settlement and material culture in this period.

The situation observed at Padina is somewhat more favourable. Horizon A in sector II of Padina yielded stone and pebble platforms (work surfaces or house

bases) with numerous stone and bone artefacts, while a stone structure with graves was recorded in sector III (*Jovanović 2008*). Samples from both sectors were dated to the end of the 9th and the beginning of the 8th millennium cal BC. We believe there is little reason to doubt that the industry from sector II indeed corresponds to the obtained dates (*Borić 2011*), due to the fact the samples came from the vicinity of the zone where the highest concentration of artefacts have been recorded, and for which very few finds from later periods are recorded (*Radovanović 1981; Jovanović 2008*). However, it would certainly be desirable to date samples from the zone's surface as well.

Regardless of the small number of recorded sites, it seems there are enough elements to understand the settlement pattern of the late Upper Palaeolithic and Early Mesolithic, which has already been discussed (*Radovanović 1996; Bonsall 2008; Borić 2011*). Recent analyses have confirmed that the activity focus, even in the earliest (Bølling-Allerød) phase of settlement, was on the river and its immediate hinterland; in some phases (Cuina Turcului II) even ibex was intensively hunted (*Mihailović 2008*). In the final Palaeolithic, however, communities episodically inhabited the interior of the Iron Gates (*e.g.*, Hoţilor Cave), which was not the case in the Early Mesolithic. The question remains why no more settlements from this period have been discovered. Although there are different opinions regarding this question, most authors agree that the layers with Early Mesolithic remains at most sites were either washed away by erosion or disturbed by the activities of subsequent communities (*Radovanović 1996; Bonsall 2008; Mihailović 2008; Borić 2011; Boroneanţ 2011*).

The industry from the Climente II site was attributed to the so-called Clisurian (*Boroneanţ 2000; Bonsall* et al. *2016*), which is in no way different from the final Epigravettian known from the southwestern Balkans and the Apennine Peninsula. On the other hand, artefacts from the Early Holocene strata of Cuina Turcului and Padina were attributed to the Epipalaeolithic (*Radovanović 1981; 1996*), that is, to the Epigravettian of the Holocene. These industries display a technological decline which is manifested in the reduced presence of Epigravettian elements and the ever-increasing presence of tools made on flakes struck from irregular and bipolar cores (*Mihailović 2001*). This phenomenon, which can be entirely linked to the so-called expedient technology (*Binford 1979*), was initially explained by territorial and social isolation (*Radovanović 1981*), while later interpretations linked it to environmental factors, *i.e.* changes in mobility and resource procurement patterns (*Mihailović 2001*). Regardless of that, the cultural and social closure within this period is not disputed at all (*Mihailović 2007a*), and is actually evidenced by the fact that Early Mesolithic sites show very little evidence of the long-distance exchange of non-utilitarian objects (*Borić 2011*).

Late Mesolithic – early phase

The beginning of the Late Mesolithic in the Iron Gates around 7200 cal BC (*Bonsall 2008*) is marked by the appearance of a number of settlements with house structures, graves and numerous archaeological finds, mainly concentrated in the Lower Gorge (Icoana, Răzvrata, Hajdučka Vodenica) and downstream from the gorge (Schela Cladovei, Ostrovul Banului, Ostrovul Corbului, Kula), while the Upper Gorge records only two settlements – Vlasac and Lepenski Vir (*Radovanović 1996; Jovanović 2008; Bonsall 2008; Borić 2011*). The intensity and continuity in the settlement of the Iron Gates in this period were probably mainly influenced by environmental and perhaps demographic factors. Settlements were built on locations suitable for fishing (*Bartosiewicz* et al. *2008; Dinu 2010; Živaljević 2017*), and fish played an extremely important role in the nutrition of Mesolithic communities, as inferred by the results of archaeozoological and isotopic analyses (*Jovanović* et al. *2019*).

There have been few attempts to reconstruct the settlement system in this period (*Radovanović 1996*). The lack of sites in the hilly-mountainous hinterland, confirmed by recent field surveys (*Radovanović* et al. *2014*), indicates that the activities of human communities in this period were focused exclusively on riverbanks. However, it remains unclear for how long the communities stayed in particular locations, that is, whether they moved along the river coast depending on the seasonal availability of resources. The abundance of remains, graves and various indicators of seasonality suggests, however, that most of these sites were inhabited during different seasons and that there is reason to assume that a relatively sedentary lifestyle developed in the Iron Gates at that time (*Dimitrijević* et al. *2016*). This settlement model probably followed the achievement of a certain level of social and cultural complexity, as indicated by organized and systematic big-game fishing, indirect evidence of storage, evidence of dog domestication and the complexity of the funeral ritual.

The knapping technology displays a continuation of the trends from the previous period: the industry from Vlasac (*Kozłowski, Kozłowski 1982*) is very similar to the industry from Padina, the Epigravettian component is weakly expressed (except within the lower layers of Ostrovul Banului, if these strata were really deposited in the Late Mesolithic), while the industries from the sites in the Lower Gorge take on an almost entirely quartz character (*Radovanović 1996; Boroneanţ 2000; Mihailović 2001; 2008*). However, there are also some changes, primarily manifested in the emergence of bladelet technology (including micro-retouched bladelets of the 'Pontic' type) and microlithic trapezoid tools (*Kozłowski, Kozłowski 1982*). The bone tool industry also blooms during this phase (*Radovanović 1996*), and various tools made of horn are numerous at most sites. Massive pebble tools (mallets, 'sceptres', weights, *etc.*) which were probably used in fishing are also characteristic (*Srejović, Letica 1978; Antonović 2008*).

There is a revival of social contact, as evidenced not only by the changes in technology but also by the exchange of non-utilitarian objects such as *Cyclope neritea* marine gastropod shells, which might have originated from the Black Sea and are recorded at the sites of Vlasac and Ostrovul Banului (*Borić 2011*). Numerous similarities in the organisation of settlements, burials, sculptures, and habitation construction have been observed between the sites in the Iron Gates and those of the Pre-Pottery Neolithic (*Mihailović 2007a*), some of which are elaborated in detail (*Borić 2007*), demonstrating that the connections between the Balkans and Anatolia might be much older. Connections with the Aegean coast of Turkey are also indicated by the recent analysis of domesticated cereal starch grains entrapped in the dental calculus of human individuals buried at Vlasac and Lepenski Vir (*Cristiani* et al. *2016*). However, it is difficult to make any definite conclusions given the geographical distance between these two regions.

Late Mesolithic – late phase

After obtaining an entire series of AMS dates, it seems that most of the settlements in the Iron Gates became abandoned about 6200 cal BC. This abandonment is explained by the floods that occurred because of global climate deterioration (*Bonsall* et al. *2002*), but this is not confirmed yet. The period between 6200 and 5900 cal BC is represented by the trapezoidal buildings at Lepenski Vir I-II and Padina B, a few graves at Vlasac and the remains from Alibeg (Romania) for which there is currently only one absolute date available (*Boroneanţ 2011*). It was found that there is only a brief chronological overlap with the earliest Neolithic settlements downstream from the Iron Gates gorge (*Bonsall* et al. *2015b*), but it is also possible that older settlements do exist in this area due to the presence of pottery in the Lepenski Vir horizon I (*Garašanin, Radovanović 2001*) and the fact that several Neolithic sites older than 6000 cal BC have in fact been recorded in the region (*Whittle* et al. *2002*).

Understanding of the Late Mesolithic chronological relations did not resolve the dilemmas regarding the cultural attribution of Lepenski Vir. While most authors continue to treat Lepenski Vir as a Mesolithic settlement, some are still inclined to associate the site with the Neolithic (*Perić, Nikolić 2016*), while others avoid the issue by classifying it as a transformational/Early Neolithic (*Borić 2011*). Regardless of how we describe this period (transformation or contact phase, *etc.*), Lepenski Vir can undoubtedly be associated with the Mesolithic in almost all elements (settlement organisation, funerary ritual, economy, symbolism), while the Neolithic aspects appear only in the technological domain (*Mihailović 2004; Antonović 2008*). This phenomenon seems to be rightly attributed to the interactions between the local population and the neighbouring Neolithic communities (*Radovanović, Voytek 1997; Radovanović 2006*).

The function of the Lepenski Vir settlement is difficult to understand given the specific character of the remains and a small number of contemporaneous sites. The settlement at Lepenski Vir filled the entire cove, where large numbers of trapezoidal buildings, graves and stone sculptures were discovered (*Srejović 1969*). Exhaustive discussions regarding the organisation of settlement and the simultaneity and manner of habitat construction were conducted in the past, and more recently the discussion has shifted from the sphere of stratigraphic considerations and relative-chronological correlations to that of dating individual contexts (*Radovanović 1996; Garašanin, Radovanović 2001; Borić 2002; 2011; 2019; Perić, Nikolić 2016; Borić* et al. *2018*). These discussions gave rise to many original ideas about different aspects of the site of Lepenski Vir. Eventually, however, it turned out that partially published documentation, regardless of the number of obtained absolute dates (almost on a decade scale), does

not actually provide insights into the rhythm of construction activities and the appearance and duration of buildings from individual phases.

It is now clear, however, that Lepenski Vir was intensively inhabited for about 200 years (*Borić* et al. *2018*), that burial took place within the settlement (inside and between the houses) and that the sacral component (most convincingly evidenced by funeral rituals and stone sculptures) was very pronounced (*Srejović 1969; Radovanović 1996; Borić 2016*). In this context, the question arises as to what gave rise to such a specific form of religious expression at Lepenski Vir, which led some researchers to treat the site as a religious centre (*Roksandic 2012*) and the habitations within it as sanctuaries (*Srejović 1969*), regardless of the evidence that everyday activities were also conducted at the site (*Radovanović 1996; Dimitrijević 2008*). Reasons for this may lie in the general uncertainty caused, on the one hand, by the disturbance of ecological stability of the Danube and the floods at 6300 cal BC (*Bonsall* et al. *2002*), and on the other, by the endangerment of the identity of Iron Gates communities after the influx of the Neolithic population (*Radovanović, Voytek 1997*). Material remains show evidence of strict social control over the key elements of social and cultural identity during this period, including the construction of trapezoidal buildings, a clearly defined funeral ritual and religious symbolism.

Leaving aside the ideological aspects of Lepenski Vir not directly related to the topic of this study, we will only say that the research results also show that fishing (including big-game fishing) played a significant role in this phase as well (*Bartosiewicz* et al. *2008; Dinu 2010; Živaljević 2017*), and that there is no evidence of domesticated plants and animals in the diet prior to the beginning of the 6th millennium BC (*Borić, Dimitrijević 2007; Jovanović* et al. *2021*). However, a different situation has been observed in the field of toolmaking technology: classic Neolithic blades, including those made of the so-called Balkan flint (*Mihailović 2004*) were found along with bipolar pieces and tools on flakes; in addition to massive stone tools, tools with the Neolithic-type cutting edges were also found (*Antonović 2008*); typical Neolithic spatulas were recorded along with characteristic tools made of bone and horn (*Radovanović 1996*). All this underlines that there was a significant degree of interaction between the Mesolithic and Neolithic populations, which is also evidenced by the presence of individuals of non-local origin in the Iron Gates in the period before 6200–6000 cal BC (*Borić, Price 2013; Mathieson* et al. *2017*).

Regional context

Postglacial adaptation

Recent research into the Palaeolithic of the Central Balkans has shown that hunting and gathering communities episodically inhabited gorges and canyons before, during, and after the Last Glacial Maximum (Fig. 3), sometimes due to specialised activities (*Gamble 1997; Borić, Cristiani 2016; Hauck* et al. *2016*). Their exploitation continued during the Late Glacial, when the settlement system was probably residential in character, as evidenced by numerous sites in the Adriatic-Ionian region and its immediate hinterland (*Mihailović 2007b*). All this shows that the settlement of the Iron Gates gorge at the end of the Late Glacial and beginning of the Holocene was not related to the exploitation of water resources, but rather that it has roots in the previous period.

However, the question arises as to why there are no confirmed Mesolithic sites in the interior of the Balkans (apart from those in the Iron Gates). It was assumed that this was due to poor research, but even after intensive field surveys and numerous archaeological excavations (only rarely thematic in character; *Radovanović* et al. *2014*), Mesolithic finds were recorded only at one site: Bukovac Cave near Despotovac. The remains of fauna (including fish bones) were found in the partially preserved layer dated to the Early Holocene (*Živaljević* et al. *2018*). Therefore, it should come as no surprise that some authors have concluded that the Balkan Peninsula was very sparsely populated in the Early Holocene and that Mesolithic communities probably erected ephemeral camps which left little trace in the archaeological record (*Perlès 2003; Runnels 2003; Pilaar Birch, Vander Linden 2017*).

Different interpretations have also emerged, among which the one of Maria Gurova and Clive Bonsall (*Gurova, Bonsall 2014*) stands out. These authors pointed to the fact that dense forest vegetation (up to a height of 700m) developed in the Balkans at the beginning of the Holocene, which complicated the resource supply and communication, thus leading to an increased settlement of coastal areas. According to the same study, the Balkans did not provide favourable conditions for human settlement because the Peninsula included only a few large and navigable rivers and lakes (*Gurova, Bonsall 2014*). However, we do not completely agree with this in-

terpretation. The hydrographic network of the Balkans was very developed at that time, so the aggregation of human populations in the river valleys (Danube, Sava, Velika Morava; Fig. 4), cannot be excluded. As indicated by the position of the oldest settlements in the Iron Gates (*Srejović 1969; Jovanović 2008*), probably only a narrow coastal belt was inhabited, and this had to be preceded by vegetation clearing. The remains of these settlements are today probably submerged, eroded, or covered with a thick alluvium layer – as Clarke (*1976*) pointed out – so it is not realistic to expect that they should have been noticed in the archaeological record by now (*Perlès 2003*). To discover these sites, it would be necessary to undertake thematic field surveys that would include the lowest terraces and profiles of riverbanks. This kind of research, however, has not been conducted so far.

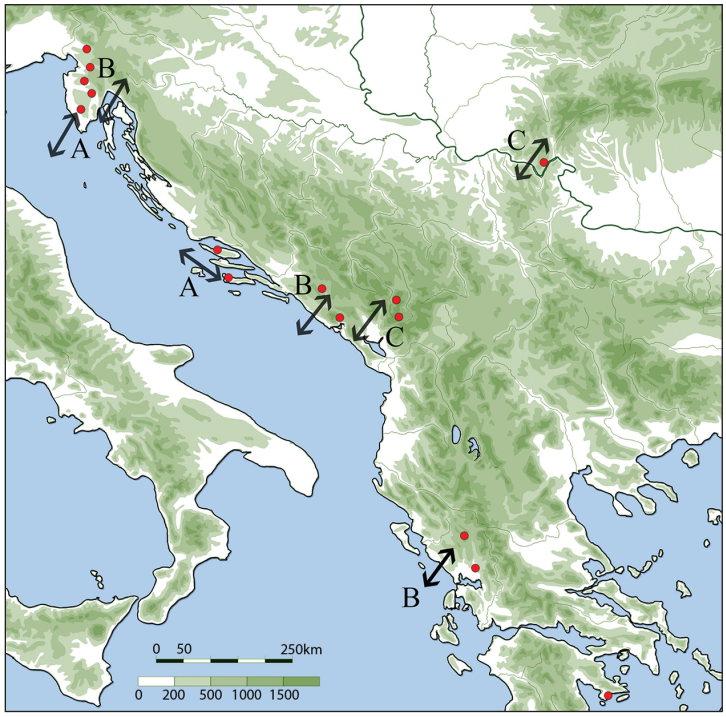

***Fig. 3. Possible routes of residential movements during the Final Palaeolithic in the Balkans:* A *between the coast and the palaeo-Adriatic plain;* B *between the coast and the mountainous interior;* C *between the river valleys and the mountainous zone. The distribution of sites follows* Mihailović 2009.**

Previous research has undoubtedly shown that hunting of predominantly forest fauna played a significant role during this period, but the use of alternative terrestrial resources (especially molluscs) has been recorded at almost all the sites (*Lubell 2004*). Evidence of fishing has been confirmed in the Iron Gates (*Dinu 2010; Živaljević 2017*), the cave Zala in the Dalmatian hinterland (*Karavanić* et al. *2015*), as well as on the Greek islands (*Sampson 2014*), but not in Franchthi Cave (*Perlès 1999; Stiner, Munro 2011*), or on the Adriatic islands (the Vela Spila, Kopačina and Vlakno Caves) which were connected to the mainland at that time (*Miracle 2007; Pilaar Birch, Vander Linden 2017*).

Reduced mobility and changes in the procurement of resources seem to have left a mark in the technological domain as well. Many industries attributed to the Holocene Epigravettian show a tendency towards a technological decline, reflected in the gradual decrease of Epigravettian elements, deterioration of the quality of raw materials used for knapping and in an increased presence of flakes and formal tools on flakes. Initially, this phenomenon could be observed only at Franchthi Cave (*Perlès 1990*) and at the sites in the Iron Gates (*Radovanović 1981*). Later, however, it was found that the phenomenon was widespread (*Mihailović 2001*), and can be traced to all the Early Holocene sites in the Balkans: in the central Adriatic, Montenegro, Greece and even in Slovenia (*Kavur 2006; Vukosavljević* et al. *2011; 2014*). Certain regional differences were also observed between the industries found at these sites, which are mainly manifested as different degrees of representation of Epigravettian and Sauveterrian elements, and the presence/absence of microblade technology (*Komšo 2006; Mihailović 2009; Kaczanowska, Kozłowski 2014*).

The question remains to what extent cultural regionalisation in the Early Holocene was influenced by social closure, which could have occurred due to geographical isolation (*Radovanović 1981*) or reduced mobility, *i.e.* difficult communications (*Mihailović 2007a*). Although, for now, there is little evidence of contact between more distant communities in the interval from the beginning of the Holocene to the middle of the 8th millennium, we still believe that the technological decline of the Early Holocene industries in the Balkans was more likely related to changes in the settlement and resource supply patterns than to cultural and social isolation.

Social complexity and contacts

Even though the Iron Gates Mesolithic still cannot be linked to any particular model of social comple-

xity (*Price, Brown 1985*), there are undoubtedly many elements that point to both organisational complexity and complexity that arose to preserve social stability and implementation of activities related to the procurement of resources (*Binford 2001*). The question as to how much social complexity can be related to sedentarisation (which by itself represents a rather debatable concept) remains unresolved (*Kelly 1992; Whitecross 2016*). In this context, however, it must be pointed out that intensive fishing (especially of large fish) implies a longer duration of settlements. In such circumstances, the number of community members might have risen, as indicated by the numerous graves within settlements, at least in the Iron Gates region. Rather than looking at these cultural phenomena from an evolutionary standpoint, we are inclined to observe them from an ecological perspective, having in mind the ecological stability during the Boreal, which enabled intensive and continuous fishing, not only in the Iron Gates but in the marine coastal zone as well.

The Late Mesolithic in most parts of Europe was marked by technological innovations (the pressure knapping technique, appearance of trapezoids) and new techniques of resource procurement, the causes and expansion directions of which cannot be precisely characterized (*Kozłowski 2009; Binder* et al. *2012*). Unlike Sauveterrian, which has not been recorded south of Istria (*Komšo 2009*), Castelnovian of the Adriatic coast spread all the way to the southern Adriatic, while Greece records industries which (in addition to Epigravettian and Sauveterrian elements) display bladelet technology and a specific microlithic repertoire – a unique feature of the region (*Kaczanowska, Kozłowski 2014*). On the other hand, micro-retouched bladelets were recorded in the Iron Gates Mesolithic, but many other elements characteristic of the Black Sea region (*e.g.*, bullet cores) were not (*Kozłowski, Kozłowski 1982; Kozłowski 2009*).

Along with the spread of technological innovations, the exchange network for non-utilitarian objects was being revived, as evidenced by numerous finds both in the Iron Gates and the Adriatic zone (*Borić, Cristiani 2019*). Within the latter, Vrbička Cave in Montenegro documents worked cyprinid teeth which originated from the Danube (*Borić, Cristiani 2016; Borić* et al. *2019*). Intensive (maritime) communication has also been confirmed in the Aegean (*Sampson 2014*), so we should not rule out the possibility that the Eastern Mediterranean communication zone at one point included the Balkans, as suggested (but still not confirmed) by data from the Iron Gates Mesolithic.

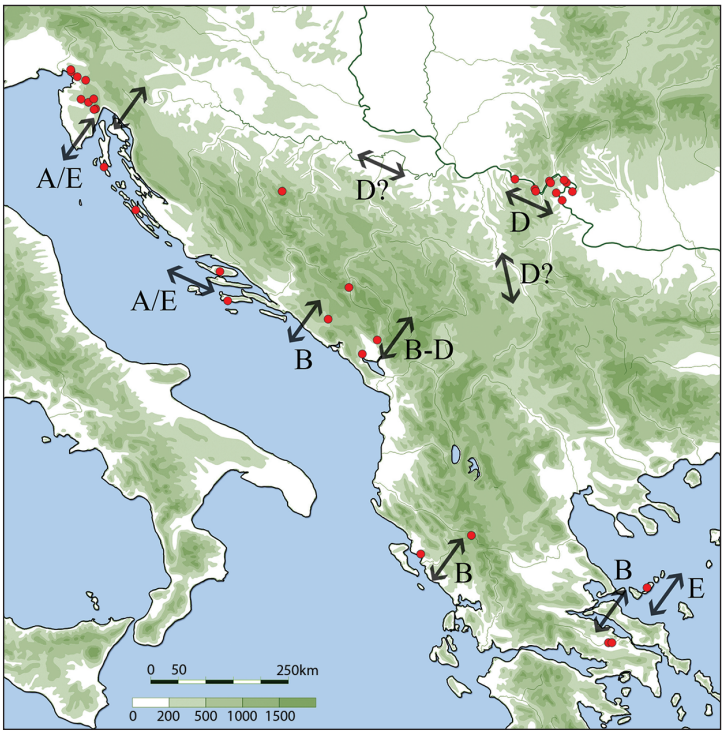

***Fig. 4. Possible routes of residential movements during the Mesolithic in the Balkans:* A *between the coast and the palaeo-Adriatic plain;* B *between the coast and the mountainous interior;* C *between the river valleys and the mountainous zone;* D *along rivers and lakes;* E *along maritime routes. The distribution of archaeological sites follows* Pilaar Birch, Vander Linden 2017.**

The Mesolithic-Neolithic transition

As inferred by the available absolute dates, a sudden expansion of the Neolithic from Anatolia occurred around 6500 cal BC (*Brami, Zanotti 2015*). On the stretch from the Aegean to the southern part of the Pannonian Basin alone, the Neolithic progressed more than 1000km in 200–250 years (*Weninger* et al. *2014; Fort 2015*). When it became clear that the rate of expansion could not be explained by classical models of progression, whether it be colonisation (*Ammerman, Cavalli-Sforza 1971; Van Andel, Runnels 1995*) or agricultural frontier mobility (*Zvelebil 1986*) models, it became obvious that the initial expansion must have been caused by some major event, as was previously assumed (*Cauvin 2000*). More recently, climate and environmental changes – not only those of the so-called 'Hudson Bay' 8.2

ka cal BP cooling event (*Berger, Guilaine 2009*) but also those of the entire Rapid Climate Change (RCC) interval, which lasted from *c.* 6600 to *c.* 6000 cal BC (*Weninger* et al. *2014*) – are considered to represent the main causes for the rapid expansion of the Neolithic. It is quite possible, however, that the pace and directions of expansion could have been greatly influenced by demographic, economic, and social factors (*Orton* et al. *2016; Vander Linden 2011*).

So far, the problem of Neolithisation of the interior of the Balkan Peninsula has been mainly studied from the aspect of colonisation, within the framework of traditional models (*Jovanović 1968; Garašanin 1979*), while the possibility that local communities participated in the process has been discussed only in regard to the Iron Gates (*Srejović 1969; Radovanović, Voytek 1997; Radovanović 2006; Borić 2011*), with rare exceptions (*Whittle* et al. *2002*). In this context, the recent attempt by Marko Porčić *et al.* (*2016*) to use the summed calibrated radiocarbon probability distributions (SCPD) to gain a broader view of the demographic situation in the Balkans in the Early Neolithic must be mentioned. According to their study, there was a significant population growth after *c.* 6200 cal BC, which is in accordance with the Neolithic Demographic Transition (DMT) model formulated by Jean-Pierre Bocquet-Appel (*2008*). Without going into the main objections to the application of this model (*Weninger* et al. *2014*), we would only point out that it cannot be successfully applied to the process of Neolithisation in the Balkans due to uneven archaeological pressure (*French, Collins 2015*), *i.e.* due to scarce evidence for the presence of Mesolithic populations in the southern part of the Pannonian Basin and the interior of the Balkans (*Živaljević* et al. *2018; 2021*).

Several Mesolithic sites have been recorded in the Adriatic zone. In contrast to the Iron Gates, there is a significantly higher number of Early rather than Late Mesolithic sites in this area (*Komšo 2009*). According to previous interpretations, the scarcity of Late Mesolithic sites and discontinuity in settlement relative to the Neolithic could be explained by changes in the settlement pattern (*i.e.* cessation of life in caves and building of open-air settlements) rather than a demographic crisis (*Forenbaher, Miracle 2006*). Continuity in settlement, as detected at the southern Adriatic sites, could indicate the gradual adoption of elements of the 'Neolithic package' in accordance with Marek Zvelebil's predictions (*Zvelebil 1986; Zvelebil, Lillie 2002*). According to Stašo Forenbaher and Preston Miracle (*2006*), the initial colonisation was probably a maritime one, when research expeditions of the Neolithic communities inhabited the coastal zone; Neolithisation of the local communities in the hinterlands only occurred later, after the Neolithic peoples established their first coastal enclaves.

The central parts of the Balkans were probably populated from the direction of the Morava valley (Pomoravlje), and perhaps from the direction of the Danube, as indicated by the absolute dates obtained for the initial Neolithic of this area (*Whittle* et al. *2002; Weninger* et al. *2014*). Judging by the numbers of sites and finds, but also by the estimated rates of progress, the first wave of colonisation possibly had greater demographic potential, but this is difficult to demonstrate as absolute dates are lacking for most sites. Therefore, several scenarios should be kept in mind when considering the Mesolithic-Neolithic transition in the Central Balkans (Fig. 5):

(a) If the population density of the Balkan Mesolithic groups was low and that of the first wave of Neolithic groups was high, there is no doubt that rapid assimilation of local communities could have occurred. This could be especially true for the valleys of large rivers (Velika Morava, Danube) which are suitable for agriculture (*van Andel, Runnels 1995*).

Mesolithic population size	Large	Early phase • infiltration of Neolithic groups; acculturation according to the 'availability model' • Iron Gates, possibly coastal areas	Middle and late phase • territorial competition; possible conflicts; withdrawal of hunter-gatherers; return in the late phase due to attraction factors • Iron Gates, possibly Velika and Zapadna Morava River valleys
	Small	Early phase • acculturation according to the 'availability model' • coastal areas	Late phase • consolidation/assimilation • Danube (Podunavlje) region and marine coastal zone
		Small	Large
		Neolithic population size	

Fig. 5. Possible forms of interactions between Mesolithic and Neolithic communities.

However, if the Mesolithic groups in those areas had higher population densities (as discussed previously) there was certainly a territorial competition, which could have resulted in a short-term withdrawal of Mesolithic peoples to the hilly hinterlands (Fig. 6). If that was in fact the case, the acculturation occurred later, via the so-called push-and-pull factors (*Radovanović 2006*).

(b) If the demographic capacity of Neolithic groups was small and progress was slow or successive, the tempo of Neolithisation could have largely depended on the size and geographical distribution of local communities (*Guilaine 2000; Zvelebil, Lillie 2000*). In the case that the local population was larger, the acculturation process could have lasted longer and included all stages of the so-called availability model. If, however, both populations were small, the attraction factors could have had a decisive influence, in line with the 'psycho-cultural' consequences of contact between the Mesolithic and Neolithic groups (*Cauvin 2000*). These factors could have been especially important after the formation of the first Neolithic settlements.

For now, it seems that the conditions for a rapid advance of Neolithic populations existed primarily in the Morava (Pomoravlje) and Danube (Podunavlje) valleys, regardless of the population density of the Mesolithic groups living in those regions. The withdrawal of local populations is indicated by the situation observed in the upper part of the Iron Gates gorge, where there was a concentration of Mesolithic sites dated to 6300–5900 cal BC; we cannot exclude the possibility that similar processes took place in the Adriatic coastal zone, as data for Crvena Stijena, Odmut, and Vrbička Caves (*Kozłowski* et al. *1994; Mihailović 2009; Borić* et al. *2019*) suggest an Early Holocene recolonisation of the mountainous hinterland of the Dinaric Alps. Yet, for now, there is no conclusive evidence of a greater presence of Neolithic groups in both regions at such an early period.

The second scenario (where there was low-intensity colonisation) is indicated by the presence of pottery and other Neolithic artefacts at Lepenski Vir and various (for now few) testimonies of cultural interactions at the Mesolithic-Neolithic transition both in the Iron Gates and the Adriatic zone. Within the Iron Gates, all three stages of acculturation of local communities (*Zvelebil 1986*) are well represented: availability (Vlasac), substitution (Lepenski Vir, Padina B), and consolidation (Velesnica, Padina and other sites). Similar phenomena have been recorded in the Adriatic coastal zone as well (*Zvelebil, Lillie 2002*), but there are issues regarding the stratigraphic integrity of the layers containing Mesolithic and Neolithic artefacts or domesticated animal remains (*Mihailović 2009*).

Even if acculturation did in fact take place, the question arises as to how it could have been so rapid and why it did not leave more traces in the archaeological record. The only possible explanation is that the emergence of Neolithic populations led to the fragmentation of Mesolithic groups, which could have survived only in the geographically isolated area of the Iron Gates, where there were optimal conditions for their survival and where strong social

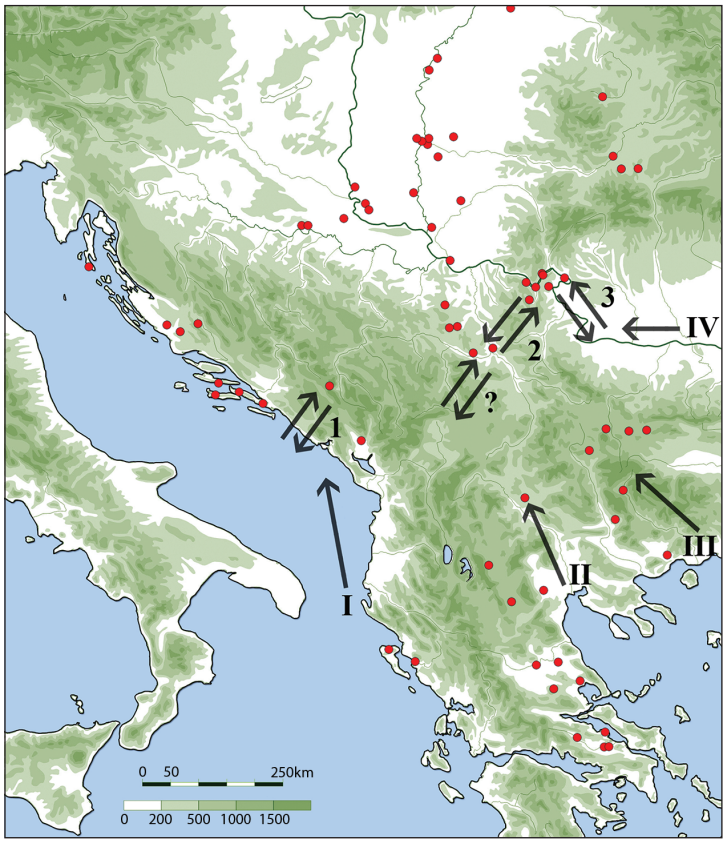

Fig. 6. The possible directions of the advance of the Neolithic (I-IV) and the zones of interaction between the Mesolithic and Neolithic communities. Within the zones of interaction push factors could have been active during the early phase of Neolithisation and pull factors could have been active during the late phase. The distribution of archaeological sites follows Pilaar Birch, Vander Linden (2017).

and ideological integration took place earlier. However, the final transformation and full integration into the Neolithic cultural *koiné* could have taken place only with the acceptance of Neolithic values, which may have occurred because of population outflow (due to the action of pull factors). Ultimately, only future research can show which of these scenarios is the most appropriate to explain Neolithisation of the different parts of the Balkans.

Conclusion

The Iron Gates sequence holds the most complete Balkan record of climatic, ecological and cultural changes of the Late Glacial to the Early Neolithic interval, and is unique in the Balkans in terms of evidence of Mesolithic adaptation and (partial) chronological overlap with the onset of the Neolithic. The peculiarity of the Iron Gates Mesolithic largely derives from the geomorphological and ecological specifics of the area. The Iron Gates is the only gorge in Europe in which a linear settlement system could have been developed and where, among other things, it was possible to catch large anadromous fish. Therefore, it should come as no surprise that the Danube River played a significant role not only in terms of the economy, but also in the ideological sphere, including funerary rituals.

However, the phenomena within the Iron Gates Mesolithic only reflect the changes that also took place in many other parts of Europe (and the Balkans itself) at the beginning of the Holocene, which underlines the inseparable connection of climatic and ecological factors, settlement models and patterns in techno-economic behaviour. The settlement of gorges did not start suddenly but has its roots in the earlier periods; in the Early Holocene, it was undoubtedly related to fishing, regardless of the importance of fish in the survival of human communities (*Radovanović 1996*). It is not realistic to assume that this settlement pattern was limited to the Iron Gates and that large parts of the Balkan Peninsula and the southern part of the Pannonian Basin were uninhabited at the time. We believe that the settlements were probably concentrated on the edges of the river and lake basins and former wetlands, and thus are likely to remain 'hidden' (*Živaljević* et al. *2021*) until detailed field surveys of lake and river terraces are undertaken.

Changes in the procurement of resources are also indicated by changes in technology, which definitely takes on an expedient character during this period and where there are actually very few differences between the Iron Gates industries and those of the marine coastal zone. Although the association between expedient technology and reduced mobility/sedentary lifestyle is hard to establish (*Vaquero, Romagnoli 2018*), the data from the Balkans, and above all from the Iron Gates, is perhaps best at demonstrating this (*Mihailović 2001*).

Research in the Iron Gates confirmed that social factors and demographic trends significantly influenced cultural changes during the Late Mesolithic. Evidence for the renewal of social networks dates back to the end of the 8th millennium cal BC and reaches its peak after the middle of the 7th millennium cal BC (*Mihailović 2007a; Borić 2011*). It is still unclear to what extent the ideological integration in the Iron Gates became influenced by the general insecurity caused by the 8.2 ka cal BP cooling event and to what extent by the possible presence of Neolithic communities in the area (*Bonsall* et al. *2002; Radovanović 2006*). The distribution and chronology of sites from this period indicate that the emergence of the Neolithic in the Balkans was accompanied by the withdrawal of local communities and the fragmentation of the territory they inhabited. The Iron Gates shows evidence that a brief period of interaction with the newcomers was followed by complete assimilation of the local groups into the Neolithic population – although the procurement of aquatic resources continued to play a significant role (*Cramp* et al. *2019*). However, it became obvious that the Mesolithic-Neolithic transition did not follow the same pattern everywhere, which necessitates the need for archaeological testing of different models of Neolithisation in each of the individual regions.

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