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Modelling Yamna distribution in the west area: towards an economic reasoning

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Abstract

The landscape of Yamna (Yamnaya) studies has undergone a change lately. Nobody would be able to deny the fact of Yamna migration in the Balkans and Carpathian Basin. However, the drivers of this major population movement (or rather movements) need to be clarified. The interpretation is usually built from the possible crucial advantages that the Yamna way of life could propose: horseback riding, wheeled wagons, advanced metalworking, etc. Another variant is based on the drastic climatic deterioration that would force Yamna groups to seek new lands with a milder climate. We propose to take another perspective and study what could attract Yamna people in the West. This migration was not driven by overcrowding, as there was land to spare. Instead, social factors such as prestige or curiosity were likely an incentive to find new lands. In order to carry out this analysis, we suggest a cartographic approach by parallel mapping of prominent metal ores outcrops and Yamna enclaves.

Keywords: Early Bronze Age, silver decorations, aridization, Budzhak culture

4.1 Introduction

Prof. Heyd's scholarship has made a significant contribution to the European archaeology of the Bronze Age. Issues related to the spread of the Yamna (Yamnaya) culture into the territory of southeastern and central Europe attracted the researcher's attention even before this topic became so popular, thanks to the works of geneticists (Harrison & Heyd 2007). Prof. Heyd has also studied the relationships in the multicultural prehistoric society (Heyd 2021), which is also closely related to the distribution of the Yamna culture population. Against the background of these studies, we propose to consider the possible reasons for the migrations of the Yamna culture in the western direction.

4.2 Routes and travelers

The kurgans of the Yamna culture mark the paths of the steppe population to the West. The most frequented route was along the Danube: numerous sites of the Balkan-Carpathian region confirm this statement (Fig. 1). There were other possible routes. To reconstruct the possible variants, one can refer to the data of later historical epochs, for example, the advance of medieval nomads. The Kipchaks mastered three routes from the South Ukrainian steppes to the Great Hungarian Plain, to Pannonia: the first one through the Iron Gate, the second one through the southern Carpathians along the upper reaches of the Olt, Mureş, and Someş Rivers, and the third one from the upper reaches of Siret and Prut to Tisa (Rasovskiy 1933: 3). The first two ways are connected with the crossing of the Prut River, the third way does not require crossing major water obstacles. The Danube has numerous tributaries (Jiu, Olt, Argeș, Ialomița, Siret, etc.). Nevertheless, the Lower Danube Plain served for many centuries as a transit route for the ancient population in its movement westwards. Moving north and northwest along the Dniester and Prut Rivers and

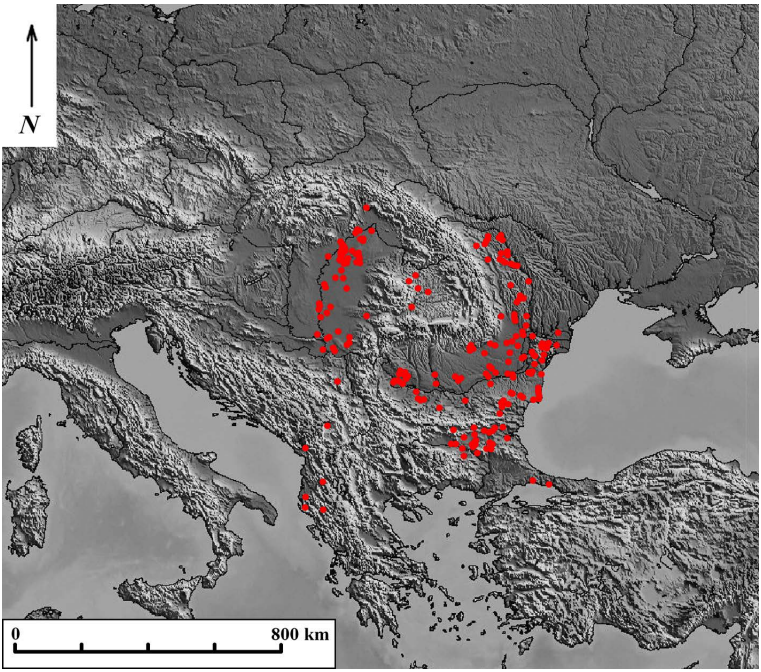

Figure 1. Map of excavated Yamna mounds in southeastern Europe (after Heyd 2021). Illustration S. Radchenko.

north of the Carpathian Mountains (the second and third routes) are marked only by a few burials or complexes. The Podillian route (north and northwest of Dniester), used by the Mongols, was probably known to the Yamna population. Excavations of the Ukrainian-Polish Expedition near Yampil (Vinnytsia region) allowed identification of a cultural and social center, with a special 'Podillya variant' of the Yamna culture (Wlodarczak 2014).

The reasons for Yamna expansion towards west were understood in a very different ways. The first (historically) line of interpretation can be called political and lies in the model of military invasion of horseback riders drawn mostly by political factors (Childe 1926; Gimbutas 1956). Some modern

models side with these ideas. Namely, the model of charismatic leaders directing migrations when the conflicts with neighbours made it impossible to stay for a large part of the society (Anthony 2021). Alternative views include a socio-economic model, when wheeled wagons are thought to be the main tool of migration under conditions of steppe aridization. In a quest for available pastures, Yamna groups were driven westwards following climatic trends (Heyd 2021). The secondary animal products revolution could be another 'adaptive advantage' that enabled the pastoralists' expansion (Wilkin et al. 2021). As well as ideological factors 'ideology of travellers' could be important in launching a full-scale migration (Wentink 2020). Here we develop a socio-economic line of reasoning drawing attention to connections between outcrops of metallic ores and Yamna enclaves in the Balkans and Great Hungarian Plain.

The western area of the Yamna cultural-historical community has several differences in the material culture from the 'classic' eastern area (the territory of the circulation of the classic Yamna pottery with an oval bottom and where the Yamna population is predominant). The peculiarities of the geographical distribution of these features could be detected not from the borders of the former USSR but still somewhere to the east. In particular, the northwestern Black Sea region corresponds to the features of the western area. In the Yamna period, the Budzhak culture was widespread here. This culture is characterized by 1) flat bottom of the vessels (in contrast to the oval bottom on the vessels of the rest of the Yamna culture); 2) some types of pottery shared with the European Bronze Age cultures. Considering the geographical position of the northwestern Black Sea region, it served as a 'bridge' between the eastern and western areas of the Yamna culture. The multiplicity of Yamna/Budzhak burials (more than ten thousand mounds in the Dniester-Prut interfluve) here indicates a significant demographic potential, which could play a significant role in the colonization process. For example, there are only about 200 Yamna burials in the Volga-Ural region. In our opinion, the latter was proclaimed a source of Yamna expansion prematurely (Morgunova 2014: 36). The supposed Repin–Yamna succession can be traced in other territories to

the west of the region mentioned above as well. When the Repin dates are disregarded, then the Yamna radiocarbon chronology of Volga-Ural region does not seem too early compared to the rest of Yamna distribution (Chernykh & Orlovskaya 2004; Biagi et al. 2022: 327).

4.3 The phenomenon of the Budzhak culture

The Budzhak culture is rooted in the local Eneolithic, from point of view of material culture (Ivanova 2021). The role of newcomers from the East can be doubted, however, evidently the locals had to adopt some foreign cultural traditions. Parallels in the funeral rites and material culture of the northwestern Pontic population of the Late Neolithic-Early Bronze Age, the proximity of ideology expressed in the funeral rites (Ivanova 2014) testify to the certain regional continuity between pre-Budzhak and Budzhak groups.

Most artefacts from the Budzhak burials, stylistically similar to some synchronic cultures, are imitations, imports, or derivatives. Nevertheless, determining the origin of these ceramic traditions allowed us to characterize the material culture of the early (most likely 3100/2900–2700/2600 BC) and late (most likely 2600/2500–2200/2100 BC) stages of Budzhak culture. The differences between the stages are associated not only with a change in the cultural situation in the northwestern Black Sea region but also with a change in the cultural environment and, accordingly, with a change in the direction of the relationships (Ivanova 2021).

The main content of the early stage was the formation of the Budzhak culture, coexistence with the Late Eneolithic cultural groups, and perception of foreign cultural influences that determined its peculiar shape and advancement to the neighbouring territories of southeastern Europe. From point of view of material culture (Ivanova 2021), the early stage of the Budzhak culture is related, first of all, 1) to the local Eneolithic and Early Bronze Age cultures; then to 2) the Dnieper-Southern Buh area of the Yamna culture, and 3) the

southeastern and central European cultures (Coţofeni, Cernavodă II, Ezerovo II, Ezero, Globular Amphora culture, Corded Ware culture).

The restructuring of the relations characterizes the late stage, as well as new directions of contact and the appearance of the Catacomb population from the East in the northwestern Black Sea coast area. Connections with the cultures of corded ceramics continue, for a short time – with the Globular Amphora culture (until 2350 BC). There are distant parallels in some pottery forms with the cultures of Glina III – Schneckenberg, Makó–Kosihy–Čaka, Livezile, Somogyvár–Vinkovci.

Thus, the material complex of the Budzhak culture changed from the early to late stage, together with the changes in the character of its external relations. The demise of the Budzhak culture is associated with the last quarter of the 3rd millennium BC when about 2200 BC (also from the East), a new cultural impulse came, namely those of the Babyne Culture. The history of the new societies in Budzhak, as well as the history of the new cultural formations of Europe, is connected with the 2nd millennium BC.

4.4 Climate aridization as a factor in the development of steppe societies

The chronological period we consider (late 4th – 3rd millennium BC) is characterized by climatic changes — increased aridization of the climate and eustatic fluctuations of the Black Sea (Yanko et al. 2014; Lobanova et al. 2021). Nevertheless, there was an increase in the region's population against the background of transformations in living conditions, indicating an increase in its adaptive capacity (Ivanova 2021).

The Late Eneolithic population successfully adapted and increased its numbers due to the inflow of migrants from the area of the late Trypillian culture (i.e. from the forest-steppe to the steppe). It indicates their adaptation

to the ecological conditions of the northwestern Black Sea coast as favourable for resettlement and an inevitable transformation of the producing economy from agricultural to agricultural-pastoral and cattle-breeding economy. Nevertheless, the population during this period was significantly lower than during the Budzhak culture period in the region.

The Budzhak culture originated in the formed steppe zone and relatively arid conditions, so this ecological situation was partly habitual and natural for its population. The development of the Budzhak culture (a significant increase in the population and its westward expansion) indicates not only the high adaptive capabilities of its population to the changing natural environment (increasing aridization), but also changes in various spheres of life activity (Ivanova 2014). This statement finds confirmation in 1) the social sphere (formation of a complex society, institutionalization of leadership), 2) the technological sphere (mastering the processes of metalworking, as well as the development of innovative techniques; mastering various types of craft activities), 3) the economic sphere (flourishing of the productive pastoral economy, the establishment of exchange relations with southeastern and central Europe).

These data testify to the high adaptive capacity of the population and suggest that not natural cataclysms, but new economic opportunities were the factor that conditioned the movement of the population from the northwestern Black Sea coast to the territories of southeastern and central Europe.

4.5 The northwestern Black Sea region and the Balkan-Carpathian area: possible relationships

The parallel development in the Early Bronze Age of the two regions, the northwestern Black Sea area and Balkan-Carpathian area, bilateral contacts in various chronological periods, rather high social and economic levels, expan-

sion of the borders of the habitat indicate the stability of the Budzhak culture society. In such a situation, society is interested not only in food (forage for livestock) but also in other attractors for the advancement to new regions.

Apparently, metals and their products occupy a special place in the life of Budzhak society. The advance of the population to the west could be connected with the need for copper and silver and the movement to the areas of ore outcrops. In the Balkan-Carpathian area, the appearance of silver ornaments in the local cultures is also connected with the advance of the Yamna culture. Therefore, in addition to the expansion of territories for mobile cattle-breeding, we can also speak about the trade orientation of the development of the Balkan-Carpathian area in the Early Bronze Age, about the construction of trade and trade routes and active participation of Budzhak tribes of the region in exchange operations with the synchronous population of the western lands. Consequently, climatic changes and the search for new pastures could not have caused a forced migration of Budzhak groups to the west already at the turn of the fourth and third millennium BC.

The long-term character of these relations is underlined by the discovery of pre-Yamna horizon of burials in many kurgans in the southeastern Europe. Pre-Yamna burials were known before, but they were few in number, e.g. Czongrad (Anthony et al. 1986). In the last decade, burials under barrows, which preceded the Yamna burials, have been identified. They were excavated earlier but have been identified as Yamna. Such burials are known in Bulgaria (Kaiser & Winger 2015), in the Lower Danube region (Frînculeasa et al. 2015), and in Transylvania (Diaconescu 2020). However, the exact source of these burials has not yet been identified in the Pontic-Caspian Steppe, raising an interesting and unsolved problem.

Nevertheless, having metal products and not possessing their copper-ore base, the Budzhak population could obtain copper and silver ore (or products) only through an exchange. This process is two-way: there had to be another object of exchange, which originated from the Budzhak environment. In the regions where connections with the Budzhak culture are attested, no worthy equivalents of metal and ore are found among the authentic Budzhak imports.

We assume that the Budzhak population supplied a commodity that may not have survived; nevertheless, it was valuable in any historical era, namely, it could be salt. Special climatic conditions in the region promoted natural processes of salt formation, thereby increasing its 'profitability' and facilitating extraction.

The territory of the northwestern Black Sea is a unique region where salt limans are concentrated, thus, providing an opportunity to obtain salt by the most economically and technically cost-effective method. Unlike most parts of Europe, its extraction in the northwestern Black Sea region requires neither the organization of complex production (mines) nor special technological processes (evaporation). Therefore, it does not need the use of wood for evaporation. Another component of the exchange could be livestock, a common object of exchange in different eras by different peoples.

The emergence of syncretic Yamna enclaves in different localities of the Balkan-Carpathian area could be connected with the advance to the sources of metals and the establishment of close contacts with the local population (as reflected in the funeral rites), but also relations of exchange of natural resources. The settlement process was slow and gradual, involving relatively small population groups dominated, anthropologically speaking, by men. The latter sexual asymmetry defined the inclusion of migrants in the social life of local cultures, probably through marital ties.

The 4200 calBP climatic event proved to be devastating for the whole suite of pastoral cultures of the Early Bronze Age. It led to an unavoidable degradation of the northwest Black Sea region's population, to a crisis.

4.6 Metal as an attractor of steppe invasion

Mapping of burial mounds and cemeteries of the Yamna culture reveals a tendency of their clustering near metal ore zones (Fig. 2). In our opinion, it was the metal that was the main attractor that determined the direction of colonization of the Balkan-Carpathian area by the population of the Yamna

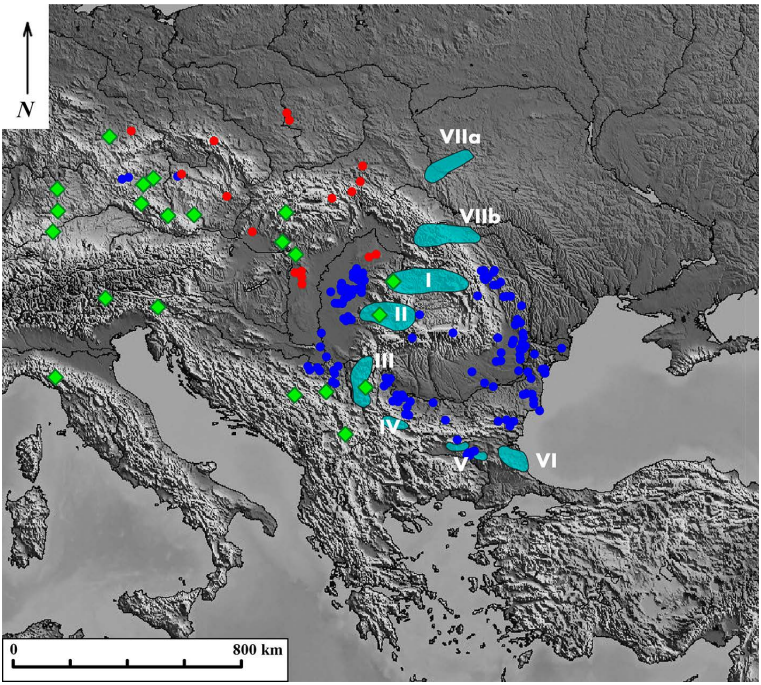

Figure 2. Outcrops of copper and silver ores and Yamna enclaves in southeastern Europe. Blue dots: Yamna tumuli; red dots: graves with Yamna traits; green diamonds: silver mines; teal polygons with Roman numbers: copper mines. Elaboration S. Ivanova, illustration S. Radchenko.

culture. It also determined the nature of contact between the newcomer and autochthonous population.

A special stop should be made on the territory of Transylvania. A small number of Yamna burials excavated here is due to insufficient knowledge. However, the role of this region can hardly be overestimated. Many aspects of the historical development of Transylvania are due to the presence of rich natural resources (copper, gold, silver; Fig. 3). Relations between the population of Transylvania and the Eneolithic tribes of the northern Black Sea region can

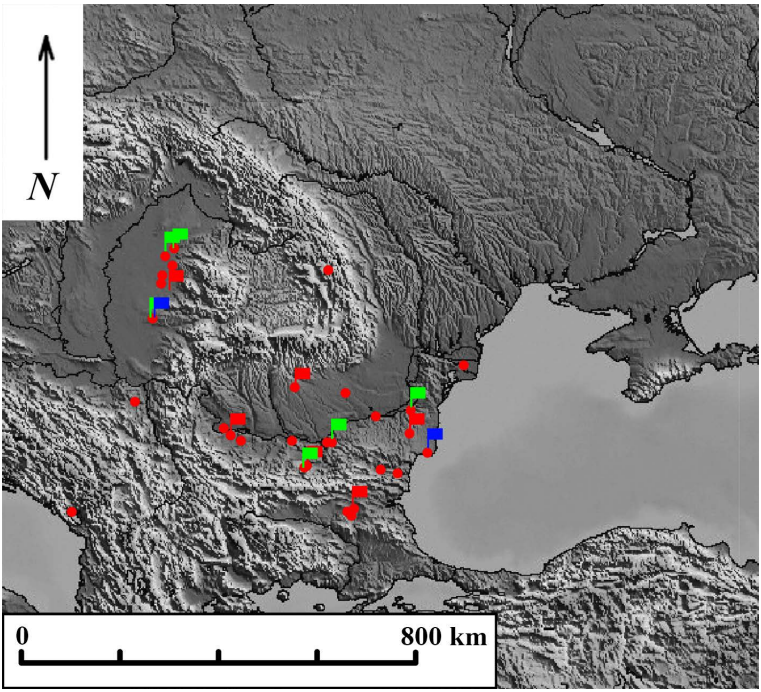

Figure 3. Burials with silver decorations in the Carpathian-Danubian region. Blue flags: wagons; green flags: silver pendants of Zimnicea type; red flags: silver spiral hair-rings. Elaboration S. Ivanova, illustration S. Radchenko.

be traced from the middle of the fifth millennium BC. Researchers assume various kinds of contacts at this time, including trade and bilateral local migrations and migrations, which continued into the Bronze Age (Gogâltan & Ignat 2011: 36–37). Summing up, these data give us reason to reconsider the role of Transylvania not only as a transit road to Alföld but also as a possible target for the advance of the Yamna groups.

An essential condition for the smelting of ores is the presence of forests; additional fuel is also necessary for preparation for the smelting of sulfide

copper ores (they require preliminary roasting). In this context, the observations and conclusions of researchers about natural changes in the territory of the Great Hungarian Valley in the Subboreal are of interest. It is noted that in the Neolithic, 85% of the territory of Hungary was covered with oak and beech forests; willow and poplar grew near swamps and lakes; at present this figure is 17%. It is believed that natural conditions have changed mainly due to human activities, although climatic fluctuations could also play a certain role. At the same time, deforestation is associated with an increase in metal production in the Copper and Bronze Ages, which is impossible without the presence of fuel (Duffy 2010: 90–97). Therefore, we consider it possible to assume that industrial relations connected Transylvania and Alföld. Researchers note that there are no deposits of essential natural minerals (copper, tin, salt) in Alföld. Despite this, already in the middle of the 3rd millennium BC the territory of Alföld was the most highly developed in the Carpathian basin. In the Late Bronze Age, one of Europe's most important metallurgical centres was formed here.

Raw materials for bronze casting workshops were imported, which is quite natural – it is much more rational to transport ore than wood. In our opinion, the ore was likely transported by the Yamna tribes to Alföld from Transylvania for subsequent smelting. It may explain both the many mounds located here and the regular, over several generations, population movements from the region of the Western Romanian Mountains (Apuseni), which was revealed as a result of the isotopic analysis.

Thus, the study of the skeletal remains of some Yamna mounds from the territory of Alföld demonstrated the following situation. Some of the buried in the Sarretudvari-Orhalom kurgan were local inhabitants, i.e. not the first generation of Yamna settlers. Some came here from Transylvania, from the Western Romanian Mountains (Apuseni). Researchers interpret these results as reflecting a system of distant seasonal pastoralism, using highland pastures in summer and wintering in Alföld (Gerling et al. 2012: 1107–1109). Nevertheless, according to ethnologists, while using the highland pastures in summer, the winter pastures, traditionally, were located in the valleys, and the

settlements were located in intermediate position, on the high promontories of the slope. Such a system is attested in the mountain settlements of the Caucasus, for example (Gamkrelidze 1983; Osmanov 1990: 175–208). The alpine type of cattle breeding is partly similar. The main characteristic feature of alpine cattle breeding is considered to be the economic and geographical unity of summer mountain pastures and winter lowland pastures. And we do not know which variant was used by the people of the Yamna culture who lived in the Apuseni Mountains. Did they live in the valleys or in the plains? According to researchers, it seems most likely that these people grew up in the eastern and southern parts of the Western Mountains (Apuseni), at altitudes between 1100 and 1850 m above sea level (Gerling et al. 2012: 1106).

In this situation, it may refer to a definite and stable relationship between the two enclaves of the Yamna culture (Transylvania and Alföld), which led to the migration of a small part of the population from Apuseni to the West. Their advance was probably due to the needs of metallurgy. Specialists believe that it was natural for steppe herders to move meridionally with their herds (north–south). In addition, such long distances between summer and winter pastures (200 km between Apuseni and Alföld) are characteristic of other natural zones, with low water reserves, low annual precipitation, and a tendency to frequent droughts (for example, in western Kazakhstan).

Silver was another goal of the Yamna culture's westward advance (Fig. 3). It is natural to assume that the Yamna tribes obtained enriched silver ore (or finished ingots) from the deposits of the Carpathian-Transylvanian basin. The extraction of some silver from polymetallic copper-silver ores is proved by the chemical composition – high content of silver in the analyzed spiral pendants found in Budzhak burials of the northwestern Black Sea coast (Olgovskiy 1988: 137) and Yamna sites of Alföld (Dani & Nepper 2006: 39–40). In Transylvania, there are known deposits of copper and polymetallic ores; these are ore areas in Banat (Bihor) and the Apuseni Mountains. At the same time, the Serbian Banat is near the Bor-Majdanpek mining district (Rudna Glava). Both polymetallic ores and silver deposits are known here, and mounds left by the Yamna population have been investigated in Serbia. The pendants

from the Vučedol burial mound in Mala Gruda are also made of silver with a high content of copper (up to 20%), which is comparable with the chemical composition of the pendants from the Sárrétudvari-Őrhalom tumulus graves.

4.7 Invasion as trade colonization

Within the Balkan-Carpathian variant of the Yamna culture, such population movements to the west represented the colonization of new areas. Having mastered one region, part of the population moved to a new one while maintaining ties with its territory. The best evidence is the burials of several generations of people who came to Alföld from the Apuseni Mountains. Indirect confirmation of this principle of settlement of new territories is provided not only by the isotopic analysis data but also by the links between neighboring regions at the level of material culture. An example is the finds of the Makó culture pottery not only in the Yamna burials, which were located in the area of this culture but also in the neighboring eastern territories, for example, in Oltenia. (Vollmann 2009: 272).

The appearance of the Coţofeni culture pottery in the materials of the Yamna graves of other territories is noteworthy. In Thrace, the Yamna population lived together with the Ezero culture, with close interrelations and contacts. However, the pottery of the tombs of the region belonged to the Coţofeni culture, not Ezero (Panayotov 1989: 164). It is possible that this situation could be a result of interrelations of these populations with other areas of the Yamna culture, especially with the west of the Lower Danube (Tarnava), where contacts with Coţofeni culture are very strong.

Let us also pay attention to such a little spread element of the funerary ritual as the lining of pits with stones in the Tarnava cemetery (Panayotov 1989) and in the Yamna mounds near the Lower Tundzha Valley in Thrace (Iliev 2011). These traditions record not only the transfer of ceramic forms, but also the movement of the population and contacts between quite distant

groups of the Yamna people in the Balkans. Similar beaker-shaped vessels were found in northwest Bulgaria (Tarnava) and Muntenia (Brailița). Budzhak-type pottery was found in burials in Romanian Moldovia and Northern Dobrogea.

Consequently, the population, having mastered the new regions, continued contact with the original territory, with time advancing further and further to the west. As a result, the formed structure consisted not of isolated but, to some extent, connected enclaves, which allowed us to unite them within a single cultural variant (Ivanova 2014). At the same time, such a network facilitated the spread of artefacts, connecting the northern Black Sea coast, especially its northwestern region, with the remote territories of southeastern and central Europe.

4.8 Conclusions

The analysis of archaeological sources and the cultural situation indicates that the tribes of the Budzhak/Yamna culture did not experience a crisis during the aridization of the climate because these environmental conditions promoted the development of the productive economy – mobile cattle-breeding, the basis of the economic life of the population.

However, climatic changes in the Early Bronze Age allowed the population of the northwestern Black Sea coast to use more natural resources than before. On the one hand, these resources were the steppe ecosystems; the expansion of the steppe zone and its transformations stimulated the development of pastoralism. Another category of natural resources involved in the economic life of the population was minerals. The population of the Budzhak culture received metals (copper, bronze, silver) from the Balkan-Carpathian region in the form of ore, ingots or finished artefacts. The exchange equivalent in these relations could be salt, which required a hot and arid climate for natural production. In addition, aridization contributed to the formation and development of the routing network, increasing their use periods, stimulating people's movement

over distant distances, developing new territories, and forming trade/exchange routes. Thus, not natural cataclysms but new economic and technological opportunities were the factor that conditioned the population's movement from the northwestern Black Sea region to the territories of southeastern and central Europe.

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References

Anthony, D. W., Bogucki, P., Comşa, E., Gimbutas, M., Jovanović, B., et al. 1986. The 'Kurgan culture', Indo-European origins, and the domestication of the horse: a reconsideration [and comments and replies]. *Current Anthropology* 27(4): 291–313.

Anthony, D. W. 2021. Migration, ancient DNA, and Bronze Age pastoralists from the Eurasian steppes. In D. Megan (ed.) *Homo Migrans: Modeling Mobility and Migration in Human History*: 14–18. Albany: IEMA Distinguished Monograph Series.

Biagi, P., Kiosak, D. & Ivanova, S. 2022. Early Metal Ages burial grounds chronology and cultural transmission: some examples from southern Europe. *Stratum Plus* 2022(2): 323–345.

Chernykh, Y. N. & Orlovskaya, L. B. 2004. Radiouglerodnaya khronologiya drevneyamnoy obshchnosti i istoki kurgannykh kul'tur. *Rossiyskaya Arkheologiya* 2004(1): 84–99.

Childe, V. G. 1926. *The Aryans: A Study of Indo-European Origins*. London: Kegan Paul.

Dani, J. & Nepper, I. 2006. Sarretudvari Őrhalom tumulus grave from the beginning of the EBA in eastern Hungary. *Communicationes archéologicæ Hungaricæ*: 29–63.

Diaconescu, D. 2020. Step by steppe: Yamnaya culture in Transylvania. *Praehistorische Zeitschrift* 95(1): 17–47.

Duffy, P. R. 2010. *Complexity and Autonomy in Bronze Age Europe: Assessing Cultural Developments in Eastern Hungary*. Ann Arbor: University of Michigan.

Frînculeasa, A., Preda, B. & Heyd, V. 2015. Pit-Graves, Yamnaya and kurgans along the Lower Danube: disentangling IVth and IIIrd Millennium BC burial customs, equipment and chronology. *Praehistorische Zeitschrift* 90(1–2): 45–113.

Gamkrelidze, B. V. 1983. *Sotsialno-kulturnye problemy skotovodstva gortsev Tsentralnogo Kavkaza: avtoreferat dissertatsii doktora istoricheskih nauk*. Tbilisi: Tbilisi State University.

Gerling, C. Banffy, E. & Dani, J. 2012. Immigration and transhumance in the Early Bronze Age Carpathian Basin: the occupants of a kurgan. *Antiquity* 86: 1097–1111.

Gimbutas, M. 1956. *The Prehistory of Eastern Europe, Part I: Mesolithic, Neolithic and Copper Age Cultures in Russia and the Baltic Area*. Cambridge: Peabody Museum.

Gogâltan, F. & Ignat, A. 2011. Transilvania şi spaţiul nord-pontic: primele contacte (4500–3500 a. Chr.). *Tyragetia, Serie nouă* V(1): 7–38.

Harrison R. J. & Heyd, V. 2007. The transformation of Europe in the third millennium BC: the example of 'Le Petit Chasseur I+III' (Sion, Valais, Switzerland). *Praehistorische Zeitschrift* 82(2): 129–214.

Heyd, V. 2011. Yamnaya groups and tumuli west of the Black Sea. In E. Borgna & S. Müller Celka (eds.) *Ancestral Landscapes: Burial Mounds in the Copper and Bronze Ages (Central and Eastern Europe–Balkans–Adriatic–Aegean, 4th–2nd millennium B.C.)*: 536–555. Lyon: Maison de l'Orient et de la Méditerranée Hean Pouilloux.

Heyd, V. 2021. Yamnaya, Corded Wares, and Bell Beakers on the move. In V. Heyd, G. Kulcsár & B. Preda-Bălănica (eds.) *Yamnaya Interactions: Proceedings of the International Workshop held in Helsinki, 25–26 April 2019*: 383–414. The Yamnaya Impact in Prehistoric Europe 2.

Iliev, I. 2011. The Pit Grave culture in the Lower Tundzha Valley. *Studia Praehistorica* 14: 381–398.

Ivanova, S. V. 2013. Connections between the Budzhak culture and central European groups of the Corded Ware culture. *Baltic-Pontic Studies* 18: 86–120.

Ivanova, S. V. 2014. Balkano-Karpatskiy variant Yamnoy kul'turno-istoricheskoy oblasti. *Rossiyskaya Arkheologiya* 2014(2): 5–20.

Ivanova, S. 2021. *Istoriya naseleniya Severo-Zapadnogo Prichernomorya v konce IV-III do n.e.* Zhitomir: Buk-Druk.

Kaiser, E. & Winger, K. 2015. Pit graves in Bulgaria and the Yamnaya Culture. *Praehistorische Zeitschrift* 90(1–2): 114–140.

Lobanova, M. A., Matviishyna, Z. M. & Kiosak, D. V. 2021. The issue of the stratigraphy of the site Sabatinovka I and the enviromental settings of the Southern Bug region in the Eneolithic–Late Bronze Age. *Stratum Plus* 2021(2): 31–52.

Morgunova, N. L. 2014. *Priuralskaya gruppa pamyatnikov v sisteme volzhsko-ural'skogo varianta yamnoy kul'turno-istoricheskoj oblasti*. Orenburg: OGPU.

Olgovskiy S. Ya. 1988. O tsvetnoy metalloobrabotke u plemen yamnoy kultury. In O. G. Shaposhnikova (ed.) *Novye pamyatniki yamnoy kultury stepnoy zony Ukrainy*: 135–140. Kiev: Naukova dumka.

Osmanov, M. 1990. *Formy traditsionnogo skotovodstva narodov Dagestana v XIX–nachale XX veka*. Moskva: Nauka

Panayotov I. 1989. *Yamnata kultura v Balgarskite zemi*. Razkopki i prouchvania 21.

Rasovskiy, D. A. 1933. *Pechenegi, torki i berendei na Rusi i v Ugrii*. *Sbornik statey po arkheologii i vizantinovedeniyu* 6: 82–142.

Vollmann, D. 2009. Der Makó-Kosihy-Čaka-Komplex und die früheste Nagyrév-Kultur an Donau und Theiß. In V. Becker, M. Thomas & A. Wulf-Schuler (eds.) *Zeiten–Kulturen–Systeme: Gedenkschrift für Jan Lichardus*: 271–288. Langenweißbach: Beier & Beran.

Wentink, K. 2020. *Stereotype: The Role of Grave Sets in Corded Ware and Bell Beaker Funerary Practices.* Leiden: Sidestone Press.

Wilkin, S., Ventresca Miller, A., Fernandes, R., Sprengler, R., William, T.-T., et al. 2021. Dairying enabled Early Bronze Age Yamnaya steppe expansions. *Nature* 598: 629–633.

Włodarczak, P. 2014. Sekwencja czynności obrzędowych: problem korespondencji tradycji funeralnych kultury jamowej i kultury ceramiki sznurowej na Wyżynie Podolskiej. *Archaeologia Bimaris* 6: 313–340.

Yanko, V., Mudie, P., Kadurin, S. & Larchenkov, E. 2014. Holocene marine transgression in the Black Sea: new evidence from the northwestern Black Sea shelf. *Quaternary international* 345: 100–118.