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FROM PAGANISM TO CHRISTIANITY

BURIAL RITES DURING THE TRANSITION PERIOD

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Baltic Migrants in Ukraine? A Comparative Laboratory Study of the Late Viking Age Ostriv Cemetery

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The Late Viking Age cemetery at Ostriv, located approximately 80 kilometres south of Kyiv in the region of the River Ros', was discovered by a team from the Institute of Archaeology of the National Academy of Sciences of Ukraine (IA NASU) in 2017. By 2022, 100 inhumation graves had been excavated in an area of 1,500 square metres, of which 50% to 60% are analysed in the article. Most of the artefacts from Ostriv are uncommon in Ukraine, but are frequently found in the east Baltic region. This suggests a complex multi-ethnic population. This article provides the results of the 2018–2022 pilot project – one of the first syntheses of the archaeological artefacts and burial rites from Ostriv, informed by the results of 14C dating, stable isotopes, aDNA, physical anthropology and non-destructive metal analyses. It represents an important contribution to the renewed interest in early Medieval migration, ethnic complexity and cultural encounters. Despite the wartime difficulties in Ukraine, joint German-Ukrainian research at Ostriv continues.

Keywords: Balts, migration, radiocarbon dating, stable isotopes, aDNA, metal analysis.

Introduction

Ostriv cemetery was unknown prior to 2017. In October 2017, researchers from the Institute of Archaeology of the National Academy of Sciences of Ukraine (IA NASU) identified a new Medieval cemetery on the right bank of the River Ros' between Ostriv and Pugachivka in the Rokytne district, approximately 80 kilometres south of Kyiv.[1] To date, 100 human inhumation graves have been found in a 1,500-square-metre excavated area on a 65-hectare terrace above the floodplain of the Ros'. A total of 53 of them are analysed typologically and 66 for anthropology in this study. Test excavations at the Old Sukholisy hillfort, 500 metres away on the opposite side of the river, dated the site to the 11th or 12th century (Fig. 1).[2] Artefacts found at Ostriv are markedly different from contemporaneous Kyivan Rus' artefacts, and can be associated with the historical Western Balts of former East Prussia: Prussians, Curonians, Scalvians and Yotvingians. The Ostriv burials, with the head oriented to the north, are also atypical of the burial rites of Christian Kyivan Rus', but are characteristic of some tenth to 11th-century cemeteries associated with the Baltic tribes and early Piast Poland. This paper provides the integrated results of Ostriv pilot study laboratory research, using a range of techniques to evaluate the hypothesis that the Ostriv population was a migrant group.

The first comparative study of the Ostriv cemetery took place from 2018 to 2020 within the framework of the pilot project 'Baltic Migrants in Kyivan Rus'', which began with an analysis of typological features of Ostriv and East Baltic region artefacts, burial rites and tenth to 12th-century written sources (Fig. 2). The Ostriv artefacts were compared with supposed Baltic analogues, largely held in the collections of the Lithuanian National Museum (LNM), the Latvian National History Museum (LNVM), and the Museum of Prehistory and Early History in Berlin (SMB/MVF). Over the past four years of joint work between the ZBSA and IA NASU, there has been a pilot study, the results of which are presented in this article, four excavation seasons, a lot of laboratory research, and several meetings in Kiev, Schleswig and Kiel. Compared to the autumn of 2018, when joint research at Ostriv began, the situation in the first half of 2022, due to Putin's Russia war against Ukraine, has changed completely. In mid-February, a week before the start of the war, the team of the project with the support of Prof. Jens Schneeweiss completed and submitted an ambitious joint German-Ukrainian DFG application for a full-scale survey of Ostriv and the neighbouring hillfort of Sukholisy, which was approved in August 2022 to our delightful surprise. In addition, the ZBSA, on behalf of Claus von Carnap-Bornheim, supported a request from Ukrainian colleagues to fund two months of archaeological excavations at Ostriv in July and August 2022. Thus, the second half of 2022 hopefully will mark a new chapter of full-scale research at Ostriv (Fig. 3).

Ostriv cemetery is located in the Porossya region, on the River Ros' (Rosya). The name Porossya is common for chronicles from the 11th to the 13th centuries, as the 'Primary Chronicle' (The Tale of Bygone Years). Porossya formed as an 'autonomous' Kyivan region in the middle of the 11th century. Features of this territory were the multicultural character of its population, its direct subordination to the Kyivan princes, and its concentration on the need for the defensive line to function. The territory of Kyivan Rus' in the tenth and 11th centuries was a point of

1 The surface of the cemetery was cultivated for many years, and several burial complexes were partially destroyed by grave robbers, most recently in 2011. The cemetery area lies in a multi-period archaeological landscape, dated from the fourth century BC to the fifth, seventh or eighth centuries AD. This chronology complicates the archaeological investigations of the early Medieval graves, which are found in an almost homogenous layer of black soil, and requires a geophysical survey to reveal additional anomalies between the sandy soil of the hillfort/settlement and the black soil of the cemetery. The commencement of scientific research and the creation of an IA NASU base in the nearby village of Pugachivka contributed to halting looting activities.

2 V. Ivakin, V. Baranov, D. Bibikov, V. Gniera, Novoviaevlenni balts'kii mogil'nik XI st na Porossi, *Tezi dopovidiei uchasnykiv mizhnarodnoi naukovoi konferentsii 'Mihratsii ta inovatsii: u poshukakh pervynnosti idei, rechei i liudei,' 8–11 lystopada 2017r.*, Lviv-Vynnyky, 2017, pp. 5–7.

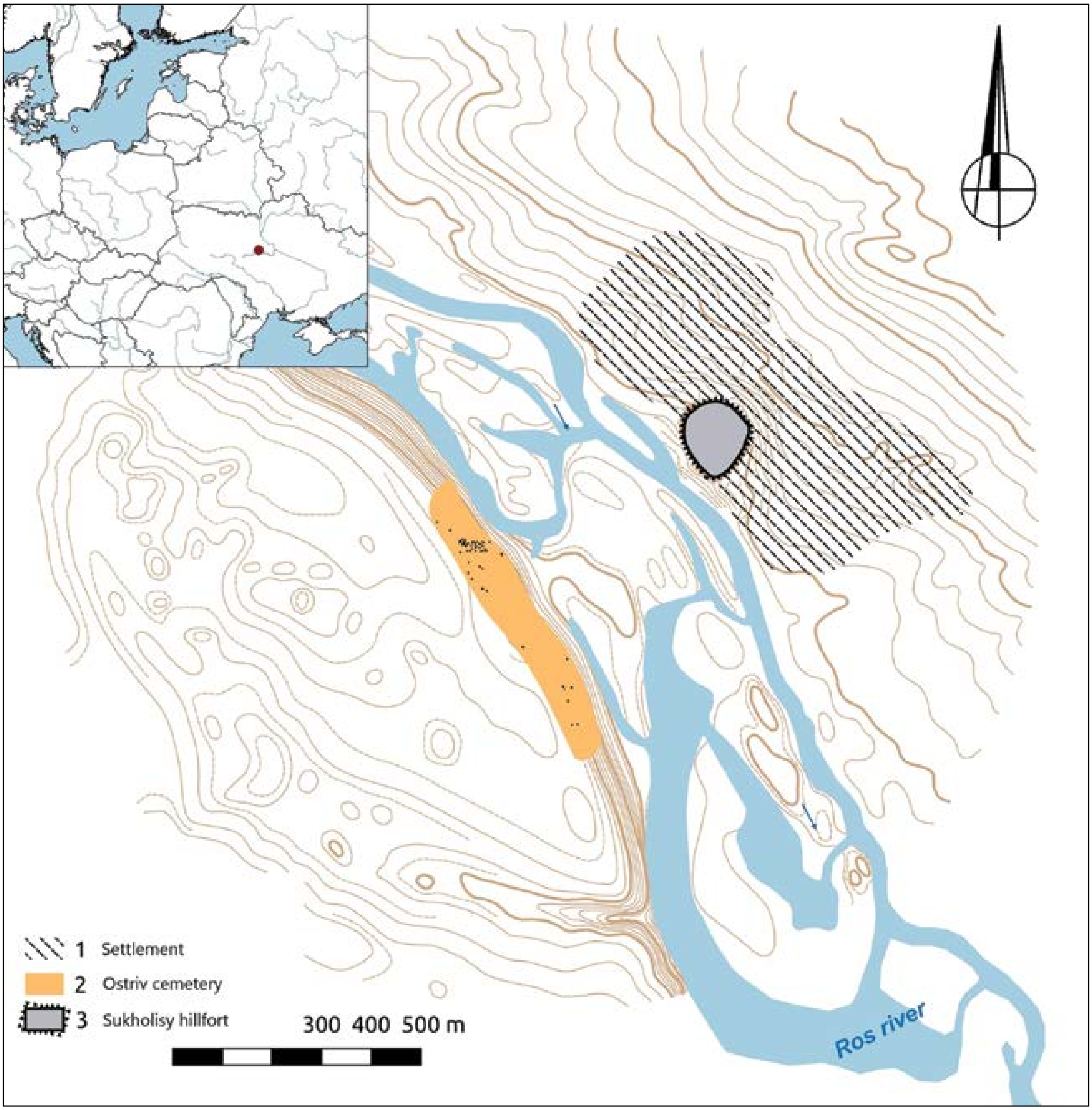

Fig. 1. The location of Ostriv cemetery in relation to the hillfort and settlement of Sukholisy. Drawing by A. Borisov, V. Baranov, V. Ivakin.

Fig. 2. An aerial view of the historical River Ros' micro-region, with the Sukholisy hillfort (1) and Ostriv cemetery (2), in 2020. Photograph by V. Gnera.

Fig. 3. An aerial view of the Ostriv excavation pit, in July 2022. Photograph by V. Gnera.

interaction between the powerful influence of Byzantine civilisation from the south and the accelerating process of urbanisation in the Baltic region in the north. In the southeast, the young Kyivan state faced completely different nomadic cultures. This prompted the princes of Kyiv to build and fortify a new frontier on the River Ros'. The prince of Kyiv, Volodymir Rurikovich, was the first to strength the defence of the principality on its southern boundary at the end of the tenth century by erecting the 'Ros' defence line'.[3] However, scholars disagree on when the defensive line along the Ros' was built, already during the reign of Volodymir, or later under Yaroslav the Wise.[4] As a result, in the second half of the 11th century the southern border of Kyivan Rus' was protected by several defensive lines of strongholds and sets of ramparts situated along the rivers (Fig. 4). Volodymir's successor Yaroslav Rurikovich purposefully settled these lands. The settlement of the Ros' area was achieved through the relocation of people from the interior of the Kyivan state. From the mid-11th century, light corps of cavalry, referred to as 'our own pagans', meaning Turkic-speaking nomads in the service of the dukes of Kyivan Rus' (Torks and Berendei), were stationed near Torchesk.[5] Nomads and other migrants and mercenaries (Masovians/Poles) became part of this defence system in the second half of the 11th century. The abundance of strongholds and unfortified settlements is evidence of the extensive economic development of the region in the 11th century.[6] The evidence from Ostriv cemetery represents the first potential material traces of Medieval migrants in the region.

An initial analysis of the burial rites at Ostriv included 53 burials in different states of preservation, excavated in 2017 and 2018 (Fig. 5).[7] As a result of the shallow depth of the inhumed bodies, the active agricultural use of the area, and systematic looting, a significant number of these burials were completely (15 burials, or 28.3%) or partially (14 burials or 26.4%) disturbed. Approximately one-third (15) of these burials have traces of wooden constructions (perhaps coffins), in the form of individual boards and nails, which points to a good level of organic preservation at the site in general. The deceased were generally laid out supine, mostly with outstretched limbs. The majority of the Ostriv burials are oriented with the head to the north or NW-NE (28 burials, or 52.83%). Burials also face west (nine burials, or 16.98%), and south (four burials, or 9.75%). The northern orientation is not typical of southern Rus' or the Slavic area in general (Fig. 6).[8] The geographically closest analogy to the Ostriv N-S orientation of inhumations is provided by Bodzia cemetery in central Poland. While some Ostriv individuals could be connected to cemeteries like Bodzia, no East Baltic artefacts, which are abundant at Ostriv, were found at Bodzia.[9] The northern orientation of burials is known in

3 D. S. Likhachev, B. A. Romanov, eds., *Povest' vremennykh let, Ch. 1. Tekst i perevod*, Moskva-Leningrad, 1950, pp. 83, 282.

4 P. P. Tolochko, Kyievska zemlia, *Drevnerusskie kniazhestva in the 10th–13th centuries*, Moskva, 1975, pp. 5–56; M. P. Kuchera, L. I. Ivanchenko, Davn'orus'ska oboronna liniiia v Porossi, *Arkheolohiia*, t. 59, 1987, pp. 67–79; Y. Y. Morgunov, K problematike izucheniia pivdenno-russkikh zmievykh valov, *Rus' v IX–XIV vekakh. Vzaimodeistvie Severa i Yuga*, eds. N. A. Makarov, A. V. Chernetsov, Moskva, 2005, pp. 253–268.

5 M. P. Kuchera, L. I. Ivanchenko, Davn'orus'ska oboronna liniiia v Porossi, *Arkheolohiia*, t. 59, 1987, p. 68.

6 A. V. Borysov, *Old Rus' Porossya. Settlement system*. Qualifying scientific work on the rights of manuscripts. Dissertation for the degree of candidate of historical sciences (PhD) in speciality 07.00.04 'Archaeology'. Institute of Archaeology of the National Academy of Sciences of Ukraine, Kyiv, 2019.

7 V. Baranov, V. Ivakin, Burials with weaponry in the Ostriv Baltic graveyard in the Middle Dnieper area (excavated in 2017–2018). Medieval warriors in the Slavic and Baltic area, *Acta Historica Universitatis Klaipedensis*, XXXVII, Klaipėda, 2019, pp. 99–127.

8 O. P. Motsia, *Naselennia pivdenno-ruskikh zemel' IX–XIII st. (za materialamy nekropoliv)*, Kyiv, 1993, p. 120; L. Niderle, *Slavianskie drevnosti*, Moskva, 2015, p. 306; A. Buko, ed., Bodzia. A Late Viking-Age Elite Cemetery in Central Poland, *East Central and Eastern Europe in the Middle Ages, 450–1450*, Bd. 27, Leiden, Boston, pp. 482–492.

9 A. Buko et al., *Bodzia. A Late Viking-Age Elite Cemetery in Central Poland. (East Central and Eastern Europe in the Middle Ages, 450–1450)*, Bd. 27, ed. A. Buko, Leiden, Boston, 2014.

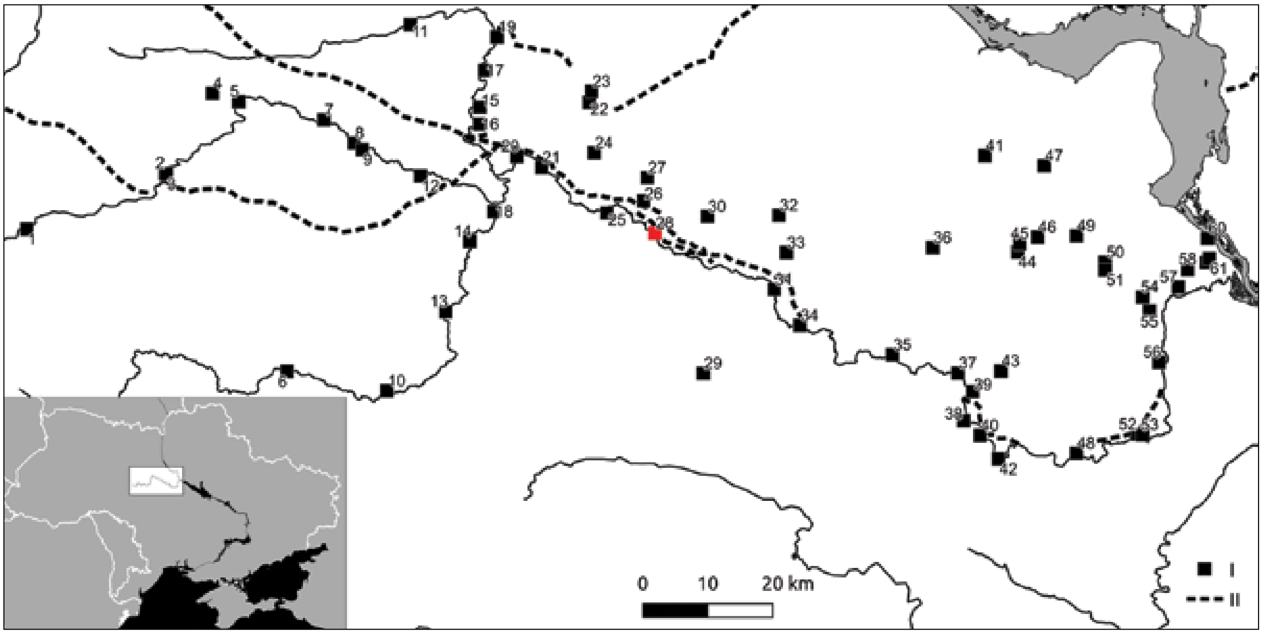

Fig. 4. Strongholds on the Ros' border, the hillfort at Sukholisy under No 28. Drawing by A. Borisov.

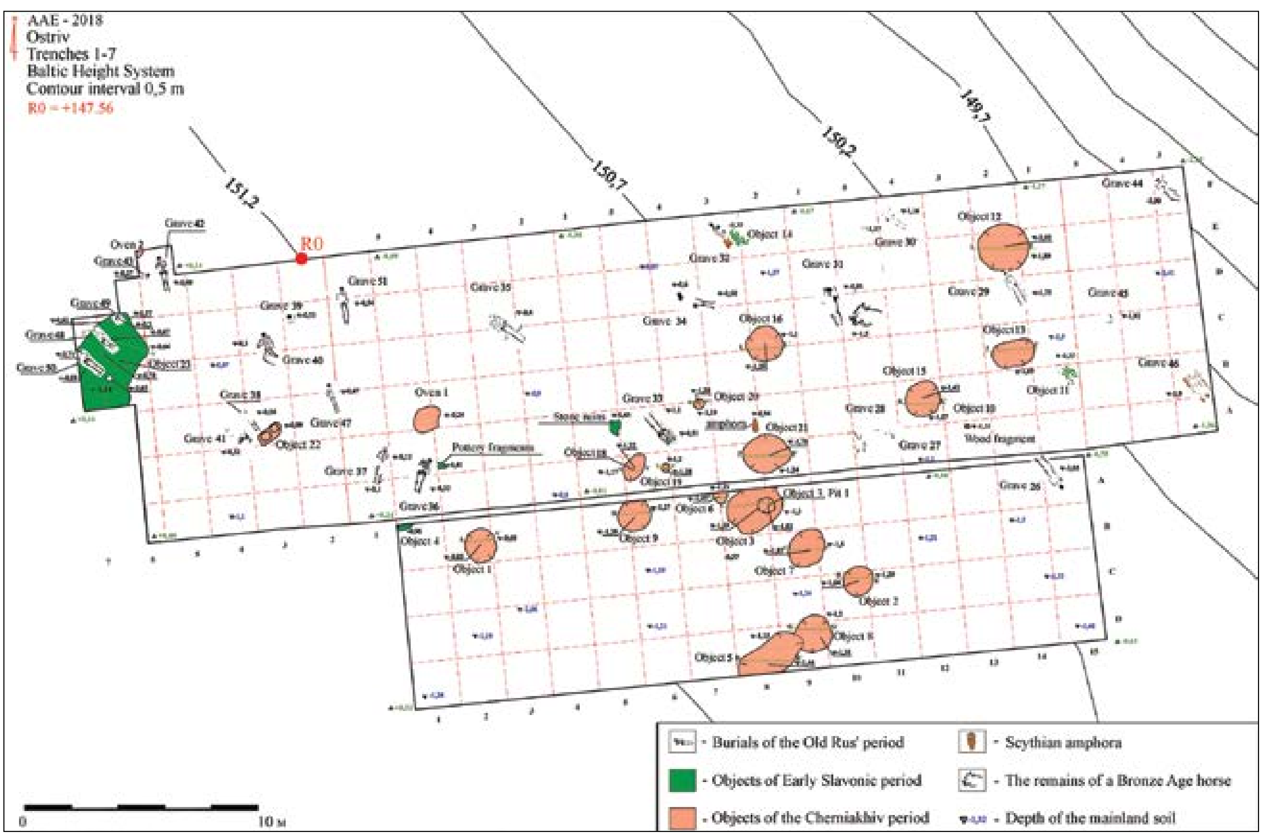

Fig. 5. A plan of the Ostriv area excavated in 2017 and 2018. Drawing by V. Baranov, V. Ivakin, I. Zocenko.

Fig. 6. The graves at Ostriv with the remains of wooden constructions (coffins, etc): 1. grave 19, 2. 12, 3. 16, 4. 46, 5. 40, 6. 42. Drawing by I. Zocenko.

the area inhabited by the Western Balts (Curonians, Prussians) and the Eastern Balts and their neighbours (Semigallians, Lattgalians, Daugava Livs), but is outside the main Western Balt funerary practice in the 11th to 12th centuries, mainly represented by cremation graves.[10]

The skeletal remains of 66 individuals from Ostriv cemetery have been studied anthropologically to date. Summing up, it can be stated that the frequency of sub-acute changes on the bones could be regarded as indicators of the maladaptation of the palaeo-population, and as a cause of the early death of some people from Ostriv. These might be the consequences of a changing environment. This result could support the migration hypothesis of the origin of the group. The high frequency of the anthropological 'aquatic' marker in the adult population allows us to search for the area of their origin near a large water basin (the sea or a river). The Ostriv population looks younger and of a more egalitarian character than that of East Baltic cemeteries.[11] It seems that Ostriv's ancient population is represented by young, relocated individuals, and was poorly adapted to the new climate and diseases (see O. Kozak's article in this volume).

The grave goods recovered from Ostriv were initially compared to analogues from the Baltic region using conventional morphological features: form, size, decoration, traces of repair, etc. Flat ladder brooches, different penannular brooches, including with connected star-shaped, zoomorphic, poppy-seed and spiral terminals, and round brooches with ribbed bow, are typical of the east Baltic region (Fig. 7). The same could be said of other ornaments used by the people of Ostriv, such as spiral neck-rings or zoomorphic bracelets, typical of the Western Balts cultural circle (Fig. 8).[12] All the types mentioned are dated mostly to the 11th century, with some slightly broader chronologies in a few cases. Besides the connections with the territories of the Balts, it is possible to relate some of the artefacts from Ostriv to sites in the Lower Daugava, and the islands of Saaremaa and Gotland. The arms, particularly axes, found at Ostriv are typical of Kyivan Rus', and northeast Europe more broadly. Other elements, such as buckets from two Ostriv male graves, are also found in 11th-century Prussian cremation and Pomeranian and Masovian inhumation cemeteries of military elites.[13] The only obviously Kyivan Rus' artefacts at Ostriv are Ovruch reddish slate spindle whorls, found to date in two graves (2 and 41), together with Western Balts fibula types. In turn, non-local artefacts may be the result of trade or gift-giving. The burial is also not a direct reflection of the social reality. Moreover, in the case of Ostriv, the interpretation may be even more complicated.

Were there migrants at Ostriv? The role of social mobility and migration in the formation of the population at Ostriv is a key question relating to the ethnic diversity of this militarised frontier of the Kyivan principality. To identify the most probable cultural and geographical origin of the Ostriv ancient population, the following techniques were used: electron microscopic analysis of metal artefacts, ancient DNA analysis, dietary stable isotope research, and radiocarbon dating (AMS ^{14}C).

10 R. Širouchovas, Nauji prūsų X–XIII a. kapinynų tyrimai vakarų baltų kultūros kontekste. *Lituanistica*, 57, 3(85), 2011, pp. 285–290.

11 R. Shiroukhov, C. von Carnap-Bornheim, J. Meadows, V. Baranov, V. Ivakin, The Baltic cemetery at Ostriv on the Ros' (Ukraine). The main conclusions from the first five years of interdisciplinary research, *ZBSA Jahresbericht 2021*, Schleswig, 2022, pp. 58–61.

12 V. Baranov, V. Ivakin, Burials with weaponry in the Ostriv Baltic graveyard in the Middle Dnieper area; M. Osypenko, Y. Hrytsik, Shiini hryvni typu ‚Totenkhrone' u zibranni Natsional'noho muzeiu istorii Ukrainy, *Arkheolohiia i davnia istoriia Ukrainy*, 2 (35), 2020, pp. 340–347; D. Diachenko, Baltska zoomorfna bronzova plastyka v pokhovalnii obriadovosti mohylnyka Ostriv, *Materialy naukovoi konferentsii 'Vid yazychnytstva do khrystyianstva: relihiini viruvannia rannoserednovichnoho naselennia Serednoho Podniprov'ia*, D. V. Bibikov ed., Kyiv, 2021, pp. 60–67.

13 V. Baranov, V. Ivakin, Burials with weaponry in the Ostriv Baltic graveyard in the Middle Dnieper area; A. Buko, ed., Bodzia. A Late Viking-Age Elite Cemetery in Central Poland.

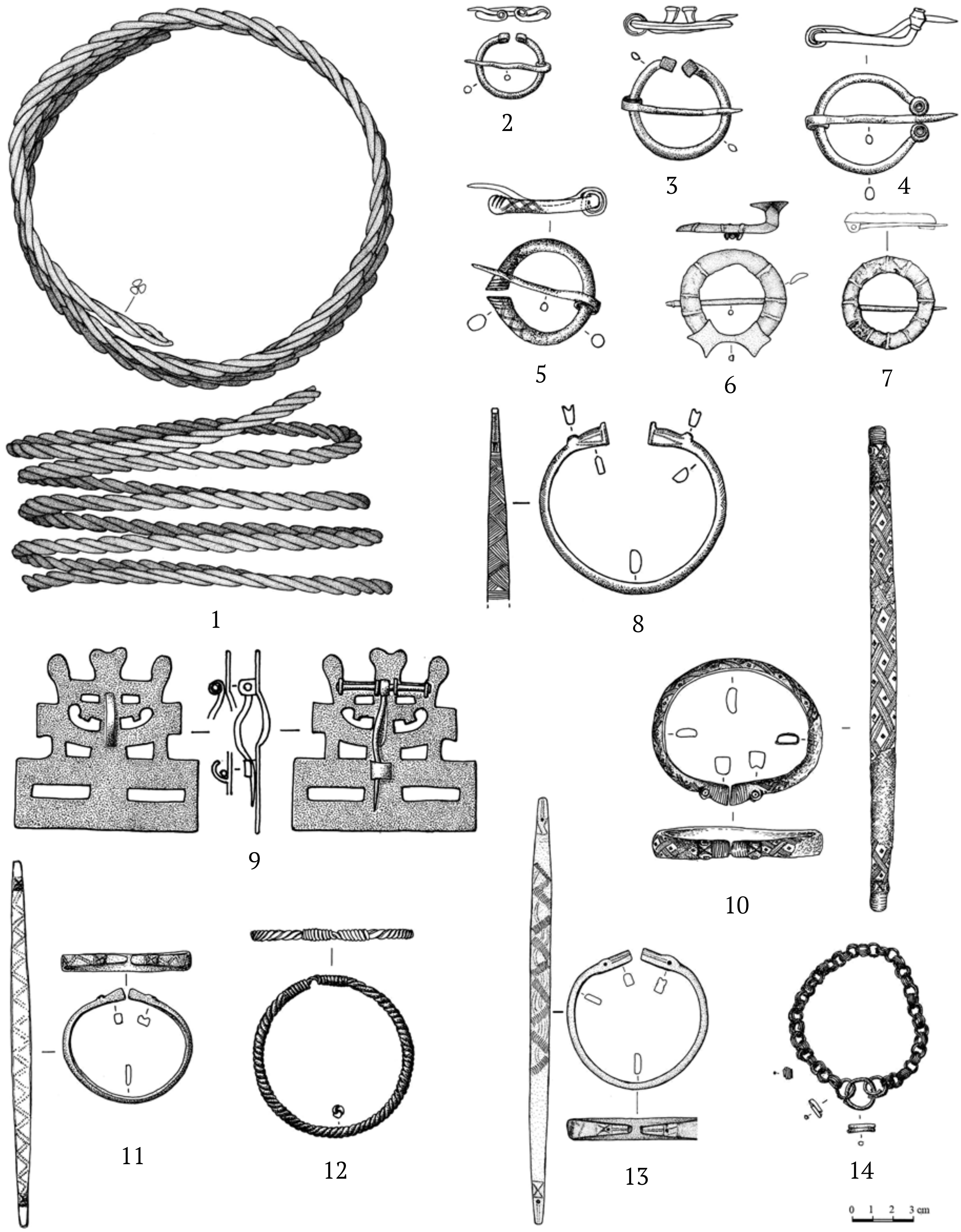

Fig. 7. Artefacts of Western Balts types found at Ostriv: 1. A neck-ring, 2–7. penannular brooches, 8, 10–13. bracelets, 9. a flat ladder brooch, 14. a chain-distributor (1–5, 8–14: bronze, 6–7: bronze with white metal alloy). 1, 13 – grave 53; 2, 11, 14 – grave 2; 3 – grave 23; 4 – grave 13; 5 – grave 35; 6 – grave 41; 7 – grave 51; 8–9 – grave 2; 12 – grave 12. Drawing by A. Sorokun. A. Suprun.

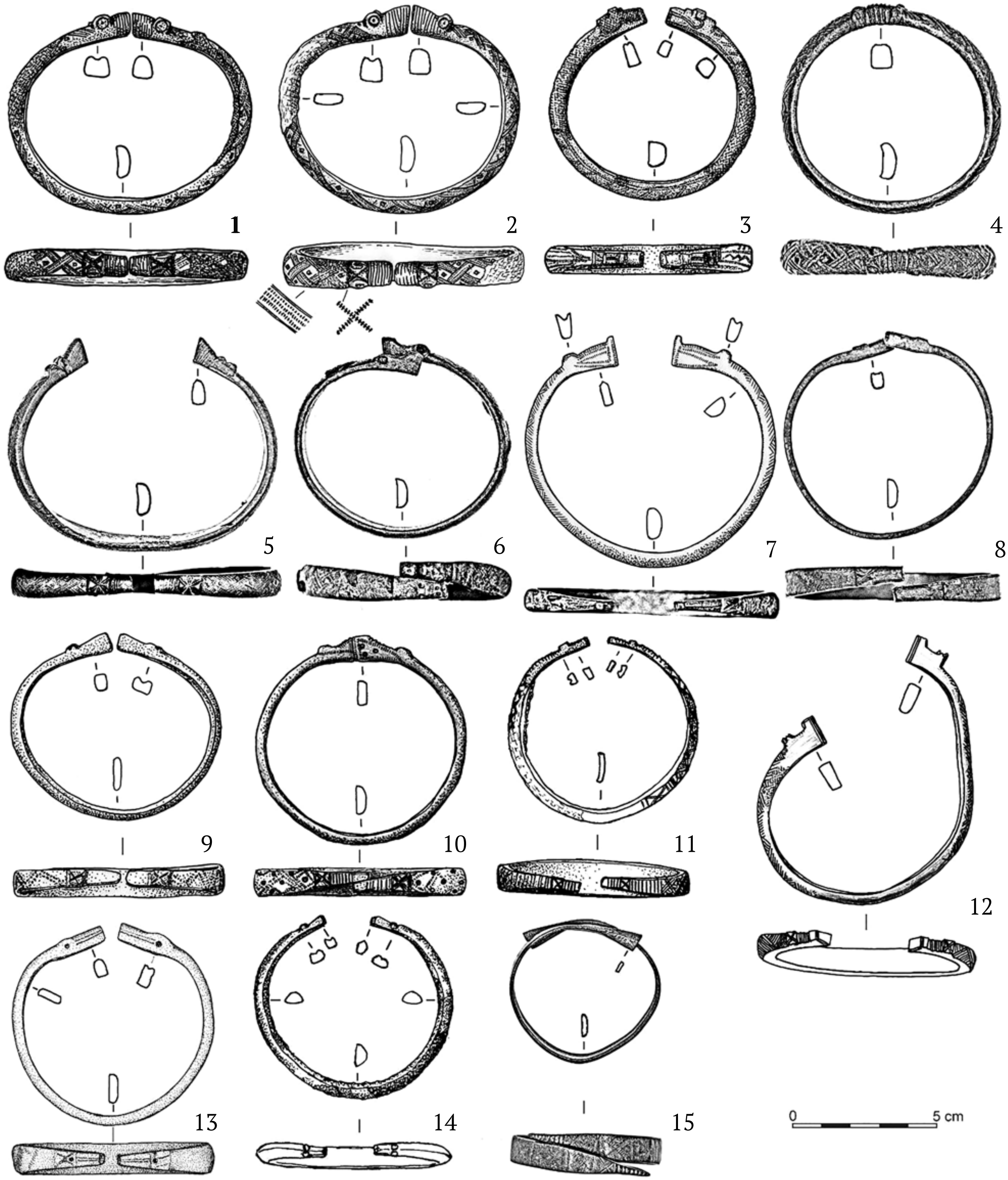

Fig. 8. Bracelets with zoomorphic terminals from Ostriv cemetery: 1–2, 9 – grave 2, female; 3 – grave 23, male; 4, 6 – grave 72, female; 5, 12 – stray finds; 7 – grave 1, female; 8 – grave 70, female; 10 – grave 41, male; 11, 14 – grave 46, male; 13 – grave 53, female; 15 – the cultural layer of the cemetery. After D. Diachenko, 2021, Fig. 1.

Electron microscopic analysis of metal artefacts

To investigate whether brooches and other ornaments at Ostriv have the same regional origin, the non-destructive analysis of typologically identical metal artefacts from southeast Baltic cemeteries and Ostriv was undertaken in order to compare production techniques. Ten metal samples from eight of the tenth to 13th-century cemeteries in the Kaliningrad region of Russia and western Lithuania, from part of the former Prussia Sammlung housed in Berlin (SMB MVF), and eight samples from Ostriv cemetery, were analysed at the CAU Institute for Materials Science laboratory in Kiel (Table 1). The differences observed in their morphology, and the crystal structure of the selected metal artefacts, suggest that there were differences in their manufacturing process. This analysis also revealed major differences in chemical composition, such as the use of bronze or copper, and variations in the content of minor elements such as lead.

Transmission electron microscopy (TEM) and scanning electron microscopy (SEM) were used to perform morphological analysis with high spatial resolution, and, combined with energy dispersive X-ray spectroscopy (EDX), elemental composition data.[14] TEM studies were performed in a FEI Tecnai F30 G^2 STwin equipped with an EDX detector (Si/Li, EDAX). Electron transparent samples needed for TEM were prepared using the focused ion beam technique (FIB). A focused ion beam was used to extract a thin slice (lamella of a thickness between 50 and 100 nm) from a depth of ten micrometres from the surface of the Ostriv flat ladder brooch from grave 2 (Fig. 9). The extracted slice is less than a sixth of a millimetre, and not visible to the naked human eye. EDX point measurements and elemental maps were performed

Table 1. Metal samples from the former East Prussia kept at the SMB-MVF Berlin, used for electron microscopic analysis: ID 2383-2387, 2989 and 2891 – Kaliningrad region of Russia, ID 2388, 2890 and 2892 – west Lithuania (K. Saleem, R. Shiroukhov).

ID TF	ID Museum	Object	Location
ID 2383	Pr. 11150	Ring brooch	Grebieten, Kr. Fischausen
ID 2384	Pr. 16121	Ring brooch	Löbertshof, Kr. Labiaiu
ID 2385	Pr. 16920	Ring brooch	Popelken, Kr. Wehlau
ID 2386	Pr. 12607	Penannular brooch with star-shaped terminals	Ekritten, Kr. Fischausen
ID 2387	Pr. 16719	Penannular brooch with star-shaped terminals	Trentitten, Kr. Fischausen
ID 2388	Pr. 4120	Flat ladder brooch	Ramutten, Kr. Memel
ID 2989	Pr. 4126	Flat ladder brooch	Linkuhnen, Kr. Niederung
ID 2890	Pr.7425/140/1	Flat ladder brooch (fragment)	Ramutten, Kr. Memel
ID 2891	Pr. 17651	Flat ladder brooch (fragment)	Viehof, Kr. Labiau
ID 2892	Pr. 7425/68/13.a	Neckring (fragment)	Ramutten, Kr. Memel

14 Ch. Deeb, R. P. Walter, J. Castaing, P. Penhoud, P. Veyssière, Transmission Electron Microscopy (TEM) investigations of ancient Egyptian cosmetic powders, *Applied Physics*, 79, 2004, pp. 393–396.

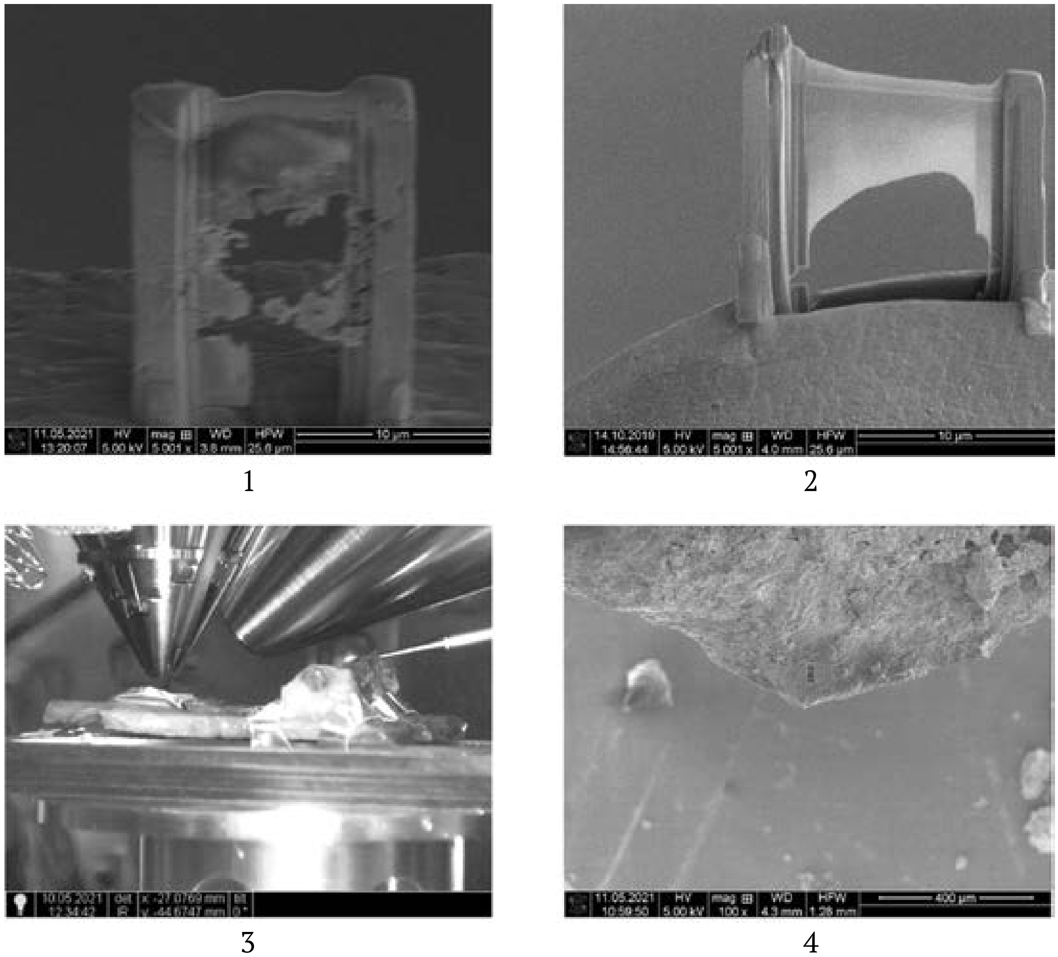

Fig. 9. A thin slice (lamella of a thickness between 50 and 100 nm) from a depth of ten micrometres from the surface of the (1) Ramutten and (2) Ostriv flat ladder brooches. Ramutten flat leddar brooch (3) inside the Focused Ion Beam microscope region (4) from where the FIB lamella is extracted. Photos by L. Kienle, K. Saleem, U. Schuermann.

in scanning TEM mode to directly measure elemental composition and distribution over the sample.

The analytical results from two flat ladder brooches from Ostriv and Ramutten (Lithuania, formerly East Prussia) are displayed in Table 2 (for the brooch type, see Fig. 7.9). The elemental map of the flat ladder brooch from Ostriv shows a homogenous distribution of zinc (Zn) and copper (Cu), with some oxidation. Surprisingly, Zn was not detected in the Ramutten flat ladder brooch. These preliminary results show a difference in the production mechanism of these artefacts, and demonstrate the importance of the FIB for non-destructive sample preparation, and the possibilities of electron microscopy for comparative fabric analysis. Thus, we propose that the fibula from Ostriv was most likely not made in the same workshop as the fibula from Ramutten. Again, considering the potential for recycling and the mixing of raw materials, the lack of Zn might just mean that the Ostriv object was cast at a different moment than the Ramutten one.

Table 2. The average of point measurements taken from different regions on the lamella comparing the composition of the flat ladder brooches from Ostriv and Ramutten (Lithuania, formerly East Prussia) (L. Kienle, K. Saleem, U. Schuermann).

Ets.	Ostriv At.%	Ramutten. At. %
C	5.56	3.31
O	6.06	20.10
Si	0.94	0.16
Cu	70.19	76.36
Zn	17.13	N/A

Ancient DNA analysis

The process of aDNA analysis was used at the Institute of Clinical Molecular Biology in Kiel to compare the ancient population of Ostriv with other contemporary populations of the east Baltic region that are represented by cemeteries with similar artefacts and burial features. Seven samples of petrous bone from six graves (2, 6, 41, 47, 51 and 53) were analysed. For comparison, 12 individuals from the Viking Age cemetery at Haithabu/Busdorf (Germany) were examined (Table 3). DNA was extracted and converted into partial Uracil-DNA Glycosylase (hUDG) libraries[15] following laboratory guidelines for aDNA work.[16] Shotgun sequencing was performed on the Illumina HiSeq 6000 (2x100) platform of the IKMB.

A preliminary analysis of all seven Ostriv samples yielded successful genetic sex determinations (three women and four men). In one case, this determination contradicted the individual's estimated sex

Table 3. Genetic samples from Ostriv used in the study (B. Krause-Kyora).

Lab ID	Grave No	Sample	Archaeological ID	Genetic Sex	Anthropological Sex	1240K-SNPs	Haplogroup
KH190348	2	petrous bone, le	Ostriv -17, gr. 2, temp li	F	F	512	
KH190349	6	petrous bone, le	Ostriv -18, gr. 6, temp li	M	M	6524	
KH190350	6	petrous bone, le	Ostriv -18, gr. 6, temp li	M	M	1858	
KH190351	41	petrous bone, ri	Ostriv -18, gr. 41, temp re	M	M	199	
KH190352	47	petrous bone, ri	Ostriv -18, gr. 47, temp re	F	F? (Child)	15080	
KH190353	51	petrous bone, le	Ostriv -18, gr. 51, temp li	F	F	3403	
KH190354	53	petrous bone, le	Ostriv -18, gr. 53, temp li	M	F (?)	14033	

15 N. Rohland, É. Harney, S. Mallick, S. Nordenfelt, D. Reich, Partial uracil - DNA - glycosylase treatment for screening of ancient DNA, *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 370 (1660), 2015.
16 A. Cooper, H. N. Poina, Ancient DNA: Do It Right or Not at All, *Science*, Vol. 289, Issue 5482, 2000.

based on physical anthropology and grave goods. DNA from three Ostriv individuals (KH190349, grave 6; KH190352, grave 47; KH190354, grave 53) were well enough preserved to perform genome-wide population genetic analyses. The Ostriv samples were analysed together with three individuals (KH190098, KH190101 and KH190103) from Haithabu/Busdorf (Germany), and compared to previous Scandinavian aDNA analyses.[17] The Ostriv individuals cluster with present-day Icelandic and Baltic populations. They are on the edge of the variability of previously published Swedish Vikings and close to Ukraine Vikings, and later dated Medieval individuals from Estonia (Fig. 10). The individuals from Busdorf, on the other hand, show greater diversity and fall more centrally within the variability of the different Viking groups that are published. Other Medieval groups from Central Europe, such as the Saxons, are separated clearly from Viking Age individuals from Scandinavia and Ukraine. Using f3 statistics of direct genetic relationship of populations, the samples show the greatest agreement with individuals from modern-day Lithuania and Estonia, and then Iceland (Fig. 11). Therefore, the aDNA signatures demonstrate that the investigated part of the Ostriv population are closer to the Balts, Fino-Ugrians and Scandinavians.

Stable isotope analysis

The dietary stable isotopes $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ were measured in eight Ostriv human bone samples taken for ^{14}C dating, partly in order to determine whether these individuals consumed significant amounts of marine or freshwater protein (Table 4). Fish are normally depleted in ^{14}C, compared to terrestrial species, giving rise to dietary ^{14}C reservoir effects (DREs) in fish consumers, whereby their ^{14}C ages are misleadingly old.[18] Collagen extracted for ^{14}C dating at the Leibniz Laboratory, Christian Albrechts University Kiel, was analysed by EA-IRMS (elemental analysis-isotope ratio mass spectrometry) at isolab GmbH, Schweitenkirchen, Germany. The results are averaged measurements of up to four aliquots of each sample; measurement uncertainties are probably better than ±0.1 ‰ for $\delta^{13}C$ and $\delta^{15}N$, and ±0.3 ‰ for $\delta^{34}S$. The results also allow us to compare the diets of individuals buried at Ostriv to the diets of individuals buried in contemporaneous east Baltic cemeteries, which were selected first according to analogical artefacts and their similar burial context to Ostriv (Fig. 12, Table 5).

Fish consumption may affect the values of all three isotopes in human collagen, depending on differences in the values of these isotopes between terrestrial and aquatic foods, for which we have no local reference data for the Medieval period (some prehistoric $\delta^{13}C$ and $\delta^{15}N$ reference data for the Dnieper valley have been published).[19] Both $\delta^{13}C$ and $\delta^{34}S$ values are expected to vary geographically, and may overlap between terrestrial and aquatic species, but trophic-level enrichment in $\delta^{15}N$ means that elevated human $\delta^{15}N$ values (often >12 ‰) are usually associated with the longer food chains in aquatic ecosystems regardless of geography. All the Ostriv human $\delta^{15}N$ values are relatively low, however (<10 ‰), and there is no correlation between higher $\delta^{15}N$ values and higher ^{14}C ages (Fig. 13, left), suggesting that

17 A. Margaryan, D. J. Lawson, M. Sikora, Population genomics of the Viking world, *Nature*, 585, 2020, pp. 390–396.

18 M. Lillie, R. Henderson, C. Budd, I. Potekhina, Factors influencing the radiocarbon dating of human skeletal remains from the Dnieper River system: archaeological and stable isotope evidence of diet from the Epipaleolithic to Eneolithic periods, *Radiocarbon*, 58(4), 2016, pp. 741–753.

19 M. Lillie, R. Henderson, C. Budd, I. Potekhina, Factors influencing the radiocarbon dating of human skeletal remains from the Dnieper River system.

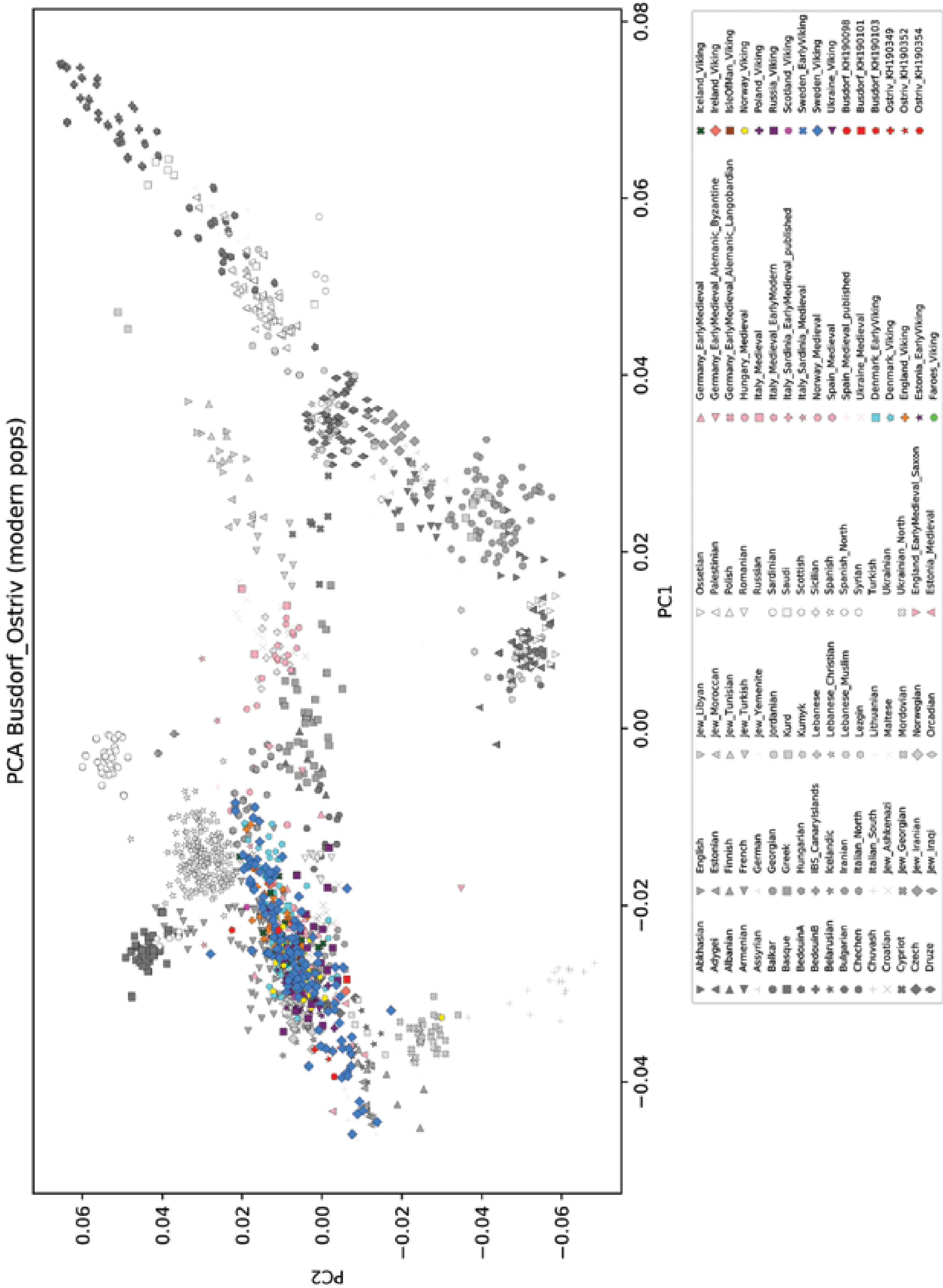

Fig. 10. The principal components analysis (PCA) of Busdorf and Ostriv aDNA data. Drawing by B. Krause-Kyora.

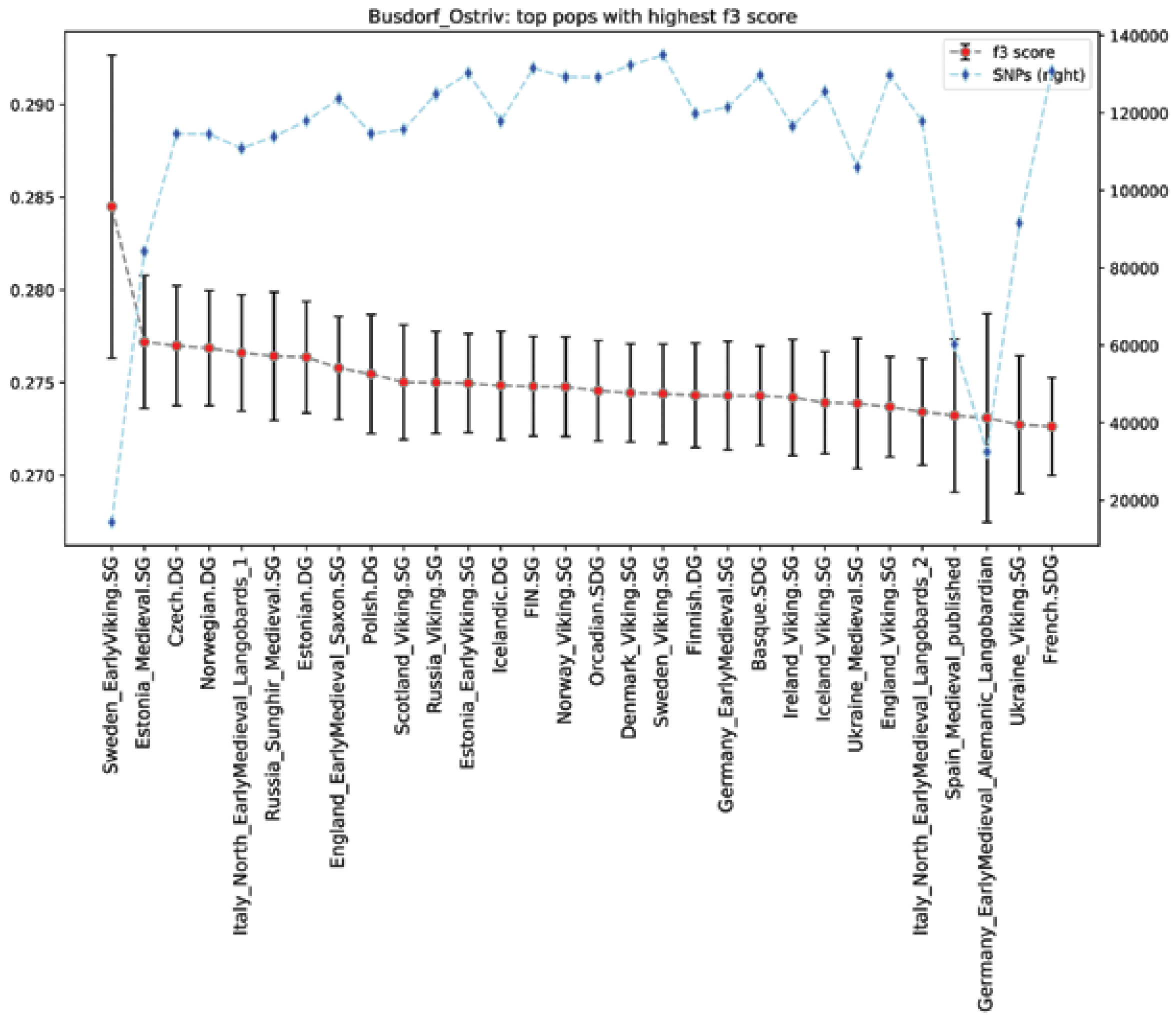

Fig. 11. Outgroup f3 analysis of Busdorf and Ostriv aDNA data. Drawing by B. Krause-Kyora.

Table 4. Ostriv sample stable isotope indicators (C. Hamann, J. Meadows).

SampleID	Grave No	percentC	percentN	percentS	C/N	C/S	N/S	δ13C	δ15N	δ34S
KIA 54168	13	40.74	15.15	0.23	3.14	472	151	-19.03	9.1	6.27
KIA 54169	19	40.57	15.09	0.23	3.14	470	150	-17.43	9.8	5.32
KIA 54170	29	39.13	14.55	0.22	3.14	474	151	-18.7	8.36	6.32
KIA 54171	31	40.07	15.04	0.2	3.11	534	172	-17.64	7.93	5.68
KIA 54173	41	41.67	16.45	0.22	2.96	505	171	-16.63	9.8	5.21
KIA 54175	51	41.56	16.52	0.22	2.94	504	172	-19.22	9.19	6.16
KIA 54176	53	41.3	16.56	0.23	2.91	479	165	-18.99	9.31	5.82

Fig. 12. The distribution of the cemeteries with graves analysed for stable isotopes: 1. Ostriv, 2. Bikavėnai, 3. Žąsinas, 4. Pavirvytė, 5. Palanga, 6. Doles Vampinieši. Additions by R. Shiroukhov, map by A. Borisov.

Table 5. East Baltic cemeteries stable isotope indicators (C. Hamann, J. Meadows).

Sample ID	Cemetery	Grave No	d15N/ 14N	d13C/ 12C	C/N	d34S/ d32S	percentS	date received	Laboratory	Meas Received
54357	Doles Vampinieši	148	12,85	-19,36	3,03	11,54	0,23	04-Dec-19	isolab GmbH	04-Dec-19
54362	Bikavėnai	216	7,96	-20,11	3,02	10,51	0,21	04-Dec-19	isolab GmbH	04-Dec-19
54363	Žąsinas	136	7,82	-20,12	3,06	10,23	0,25	04-Dec-19	isolab GmbH	04-Dec-19
54364	Žąsinas	150	7,9	-20,66	3,09	8,92	0,27	04-Dec-19	isolab GmbH	04-Dec-19
54365	Palanga	2	10,53	-20,42	3,04	9,72	0,22	04-Dec-19	isolab GmbH	04-Dec-19
54366	Palanga	12	11,85	-20,08	3,03	9,88	0,22	04-Dec-19	isolab GmbH	04-Dec-19
54370	Pavirvytė Gudai	135	8,74	-21,08	3	8,82	0,21	04-Dec-19	isolab GmbH	04-Dec-19
54371	Pavirvytė Gudai	138	9,19	-21	3	8,24	0,23	04-Dec-19	isolab GmbH	04-Dec-19
54372	Pavirvytė Gudai	141	8,39	-21,37	3,01	6,89	0,22	04-Dec-19	isolab GmbH	04-Dec-19

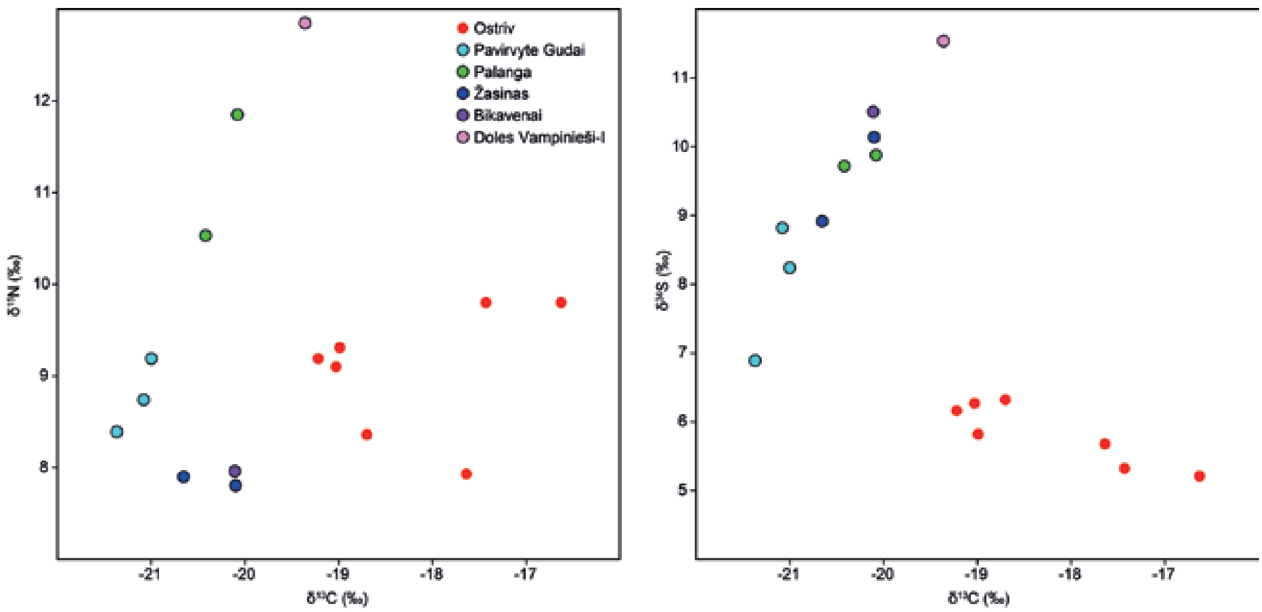

Fig. 13. Human bone collagen $\delta^{13}C$ values from Ostriv, plotted against $\delta^{15}N$ (left) and $\delta^{34}S$ (right) values in the same extracts (red dots). For comparison, values in individuals from several contemporaneous cemeteries in the East Baltic (mainly tooth samples) are also shown (see legend). Drawing by J. Meadows.

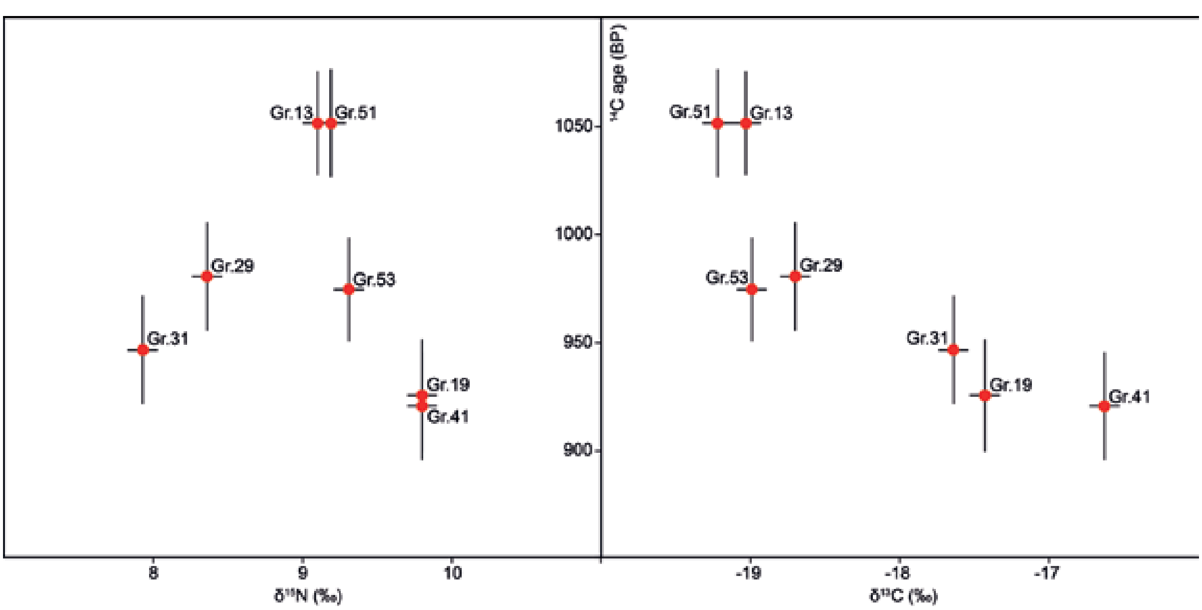

Fig. 14. Human $\delta^{15}N$ (left) and $\delta^{13}C$ (right) values plotted against ^{14}C ages of the same collagen extracts. Error bars correspond to 1-sigma measurement uncertainties. Drawing by J. Meadows.

differences in ^{14}C age between individuals are not due to differences in the amount of fish consumed (Fig. 14). On the other hand, the Ostriv $\delta^{13}C$ values are apparently correlated with $\delta^{34}S$ and perhaps with ^{14}C ages (Fig. 13, right), which may imply differential consumption of low-trophic-level aquatic species (which could affect ^{14}C ages without a clear effect on $\delta^{15}N$). We regard this explanation as unconvincing.

Instead, the spread of $\delta^{13}C$ and $\delta^{34}S$ values at Ostriv could reflect a mix of local and East Baltic region residents, with values closer to those found in east Baltic cemeteries occurring in more recent immigrants. The fact that these cases (Ostriv graves 29 and 53, and particularly 13 and 51) have higher ^{14}C ages would then imply that only the earlier burials were of individuals raised in the east Baltic, whereas later burials were of individuals who had spent their lives mainly or entirely on the territory of today's Ukraine. This interpretation is discussed further below. Although some isotopic enrichment due to nursing effects, particularly affecting $\delta^{15}N$,[20] may have influenced the isotope values of the teeth sampled from the east Baltic cemeteries (particularly the case from Doles Vampenieši, a young child), the wide range of $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ values (Fig. 14) may also reflect differential consumption of marine fish, which typically have higher $\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$ values than terrestrial animals and plants. This would imply that east Baltic ^{14}C ages may be subject to modest dietary reservoir effects. Even if some of the Ostriv individuals retain a residual isotopic signal of residence in the Baltic region, however, this signal appears to be at the terrestrial end of the spectrum of isotopic values in the selected Baltic cemeteries. There is a visible difference in diet between individuals from Ostriv 2 subgroups. Thus, the Ostriv population diet requires a separate detailed study.

Radiocarbon dating

Radiocarbon (^{14}C) dating was used to establish the absolute chronology of the Ostriv burials and to synchronise them with graves with similar/identical artefacts up to 1,000 kilometres away in Lithuania, Latvia, Poland and the Kaliningrad region of Russia. The Ostriv ^{14}C results also provide a site chronology that can be compared to historical events in Ukraine. Eight human bones and a wood sample from Ostriv were dated by Accelerator Mass Spectrometry (AMS) at the Leibniz Laboratory for Radiometric Dating and Stable Isotope Research of CAU, Kiel, following standard protocols for collagen extraction (bones) and acid-base-acid pretreatment (wood)[21] (Fig. 15). Collagen preservation was excellent (yields of mostly over 10%) in all bone samples. Extracts were combusted, graphitised and measured by AMS, following established procedures for ^{14}C age calculation.[22] The results are expressed as conventional ^{14}C ages,[23] with $^{14}C/^{12}C$ concentrations corrected for natural fractionation using the simultaneously measured AMS $^{13}C/^{12}C$ ratios (Table 6).

Simple calibration of the ^{14}C ages suggests that two individuals (graves 13 and 51) date from the end of the tenth century, or more probably the start of the 11th century; the pine wood sample from grave 46,

20 S. G. Jenkins, S. T. Partridge, T. R. Stephenson, S. D. Farley, C. T. Robbins, Nitrogen and carbon isotope fractionation between mothers, neonates, and nursing offspring, *Oecologia*, 129(3), 2001, pp. 336–341.
21 P. M. Grootes, M. J. Nadeau, A. Rieck, 14C-AMS at the Leibniz-Labor: radiometric dating and isotope research, *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms*, 223, 2004, pp. 55–61.
22 M. J. Nadeau, P. M. Grootes, M. Schleicher, P. Hasselberg, A. Rieck, M. Bitterling, Sample throughput and data quality at the Leibniz-Labor AMS facility, *Radiocarbon* 40(1), 1998, pp. 239–246.
23 M. Stuiver, H. Polach, Discussion reporting of 14C data, *Radiocarbon*, 19(3), 1977, pp. 355–363.

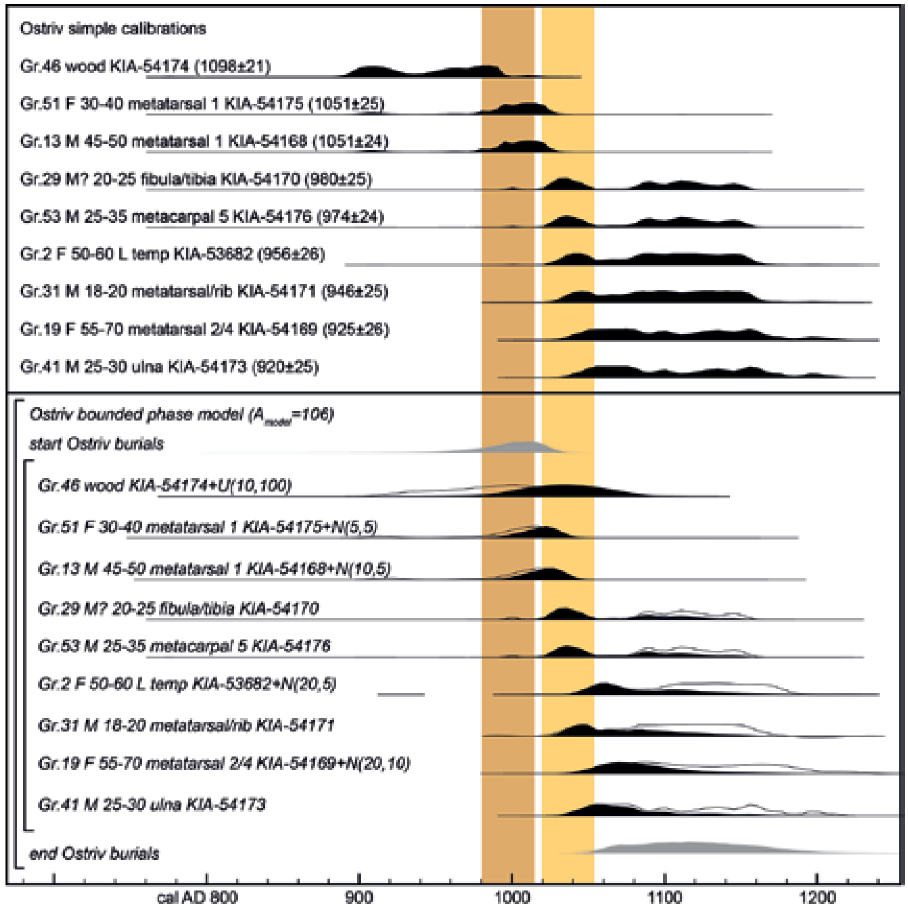

Fig. 15. Ostriv ^{14}C-dating results. Above: ^{14}C ages calibrated to calendar dates using IntCal20 (Reimer *et al.* 2020) and the program OxCal v.4 (Bronk Ramsey 2009), without any allowance for intrinsic age. Below: calibrated ^{14}C ages are shifted later by a normal (N, e.g. 5±5 calendar years) or uniform (U, e.g. 10–100 calendar years) distribution to account for intrinsic age at burial. These dates (outline distributions) are likelihoods for corresponding burial dates in a Bayesian chronological model, which assumes that they represent a single unordered phase of activity, with start and end dates determined by the scatter of burial dates (grey distributions). Drawing by J. Meadows.

with an unknown intrinsic age, probably dates from the tenth century.[24] All the other burials appear to date from a plateau in the calibration curve between circa 1040 and 1160 AD. Allowing for a modest wood-age offset in grave 46, one reading of the results would be that they represent a brief burial period in the early to mid-11th century (Fig. 15). This interpretation can be formally modelled, using the Bayesian chronological modelling software OxCal v.4.4,[25] as a simple bounded phase of activity. If the duration

24 The interpretation of the sample from a grave 46 is complicated. The ^{14}C date for the wood sample is older because the wood comes from the older part of the tree (the inner part of a trunk, etc).

25 Ch. B. Ramsey, Bayesian analysis of radiocarbon dates, *Radiocarbon*, 51(1), 2009, pp. 337–360.

Table 6. ^{14}C-dated Ostriv cemetery samples used in the study (J. Meadows).

No	Sample ID	Sample Customer Identification	Sampler bone	Gender (Phys. anthropology)	Age (Phys. Anthropology)	Extraction Fraction	Pre-treatment Yield	d13C/‰	error d13C/‰	Weight/ mg	Cweight/ mg	%C	pMC	pMC Error	Age BP	Age Error	Wheel ID
1	KIA-53682	Ostriv, Gr.2 - human bone	Temp li	F	50–60	Collagen	3,24	-18,47	0,18	6,55	2,9	44,50%	88,77	0,29	956	27	–
2	KIA-54168	Ostriv, Gr.13 - human bone	Metatarsal 1	M	45–50	Collagen	19,24%	-18,82	0,09	6,78	3,06	45,06%	87,74	0,26	1051	25	1755
3	KIA-54169	Ostriv, Gr.19 - human bone	Metatarsal bone 2/4	F	55–70	Collagen	18,91%	-16,83	0,18	6,26	2,82	45,05%	89,12	0,28	925	26	1755
4	KIA-54170	Ostriv, Gr.29 - human bone	Fragm. of long bones (fibula, tibia)	M?	20–25	Collagen	6,15%	-18,73	0,08	6,52	2,80	42,87%	88,51	0,27	980	25	1755
5	KIA-54171	Ostriv, Gr.31 - human bone	Metatarsal bone, rib	M	18–20	Collagen	8,31%	-16,86	0,07	6,12	2,68	43,79%	88,89	0,28	946	26	1755
6	KIA-54172	Ostriv, Gr.31 - horse rib		–	–	Collagen	9,06%	-20,56	0,09	6,5	2,84	43,62%	61,66	0,21	3884	28	1755
7	KIA-54173	Ostriv, Gr.41 - human bone	Ulna	M?	25–30	Collagen	18,78%	-15,83	0,08	6,56	3,02	45,96%	89,18	0,28	920	25	1755
8	KIA-54174	Ostriv, Gr.46 - wood		v	–	Laugen-rück-stand	46,50%	-25,23	0,27	6,58	3,89	59,04%	87,22	0,22	1098	21	1752
9	KIA-54175	Ostriv, Gr.51 - human bone	Metatarsal 1	F	30–40	Collagen	20,74%	-18,08	0,11	6,62	3,04	45,92%	87,73	0,27	1051	26	1755
10	KIA-54176	Ostriv, Gr.53 - human bone	Metacarpal 5, fragment of Mc 3	F?	25–35	Collagen	18,83%	-18,58	0,09	6,3	2,82	44,68%	88,58	0,26	974	24	1755

of burial activity is not artificially constrained, the model output also includes early 12th-century solutions permitted by the calibration plateau between circa 1040 and 1160, but the ^{14}C results are all compatible with all burials having occurred in the early to mid-11th century (Fig. 15, lower). Our model incorporates small calendar-age offsets to better account for the intrinsic age of the wood dates in grave 46, and for collagen turnover time for the bone samples from mature adults. All these samples were from bones that are continuously remodelled throughout life, but the rate of remodelling will have varied according to factors including the skeletal element sampled and the age at death of the individual concerned. Slow remodelling can produce collagen ^{14}C ages corresponding to dates decades before death.[26]

If we model the Ostriv ^{14}C dating-results as ^{14}C ages converted to probability distributions for the calendar date of each sample using the IntCal20 calibration data, these dates (distributions in outline) are treated as likelihoods for the corresponding burial dates in a Bayesian chronological model, which assumes that they are representative of a single, unordered phase of activity (there is no relative dating of burials), with a start and end date determined by the scatter of individual burial dates (grey distributions). The model, created in OxCal v.4,[27] produces posterior density estimates (black distributions) for the dates of individual burials. The coloured bars represent the reigns of Volodymir the Great (980–1015 AD) and Yaroslav the Wise (1019–1054 AD). According to the chronological model output, all the dated burials could have occurred during the reign of Yaroslav.

By comparing the ^{14}C dating of individual skeletal remains and their isotopic signatures, it is possible to understand the relationship between diet and migration. Two readings of the Ostriv ^{14}C results appear to be permitted by the data. Our preferred model, in which dietary reservoir effects are assumed negligible, locates the burials in the early to mid-11th century cal AD, and interprets patterns in the ^{14}C, $\delta^{13}C$ and $\delta^{34}S$ values as the effect of dietary changes over individual lifetimes, probably due to migration from the Baltics to Ukraine. An alternative reading is that the apparent correlation between higher ^{14}C ages, lower $\delta^{13}C$ and higher $\delta^{34}S$ values in the Ostriv burials (Fig. 13, right) primarily reflects differences in the consumption of local freshwater fish, which may account for most or all of the differences in ^{14}C ages. It is more difficult to construct a formal chronological model for this interpretation without isotopic data for local fish and terrestrial food sources and direct measurements of ^{14}C depletion in local fish. Allowing for moderate reservoir effects (up to circa 100 ^{14}C years) in bones with more negative $\delta^{13}C$ and higher $\delta^{34}S$ values, all the dated burials might belong to the third quarter of the 11th century, when terrestrial samples have ^{14}C ages of circa 920 BP, the lowest ^{14}C age obtained at Ostriv. This would imply a larger wood-age offset in grave 46 (>100 years) than in our preferred model.

The patterns in the ^{14}C, $\delta^{13}C$ and $\delta^{34}S$ values can probably be better explained by changes over time in individual diets. In this case, samples from graves 13 and 51, which isotopically are closest to East Baltic burials from the period, may represent individuals who began life in the east Baltic and did not live long enough in what is now Ukraine for their bones to completely remodel, leaving an isotopic record of their Baltic origins in their collagen. Under our preferred model (Fig. 15, lower), graves 51 and 13, and perhaps also 29 and 53, correspond to

26 L. Calcagnile, G. Quarta, C. Cattaneo, M. D'Elia, Determining 14C content in different human tissues: Implications for application of 14C bomb-spike dating in forensic medicine, *Radiocarbon*, 55(3), 2013, pp. 1845–1849.

27 Ch. B. Ramsey, Bayesian analysis of radiocarbon dates.

the first wave of migrants, perhaps starting towards the end of the reign of Volodymir the Great (980 to 1015 AD), but clearly continuing under Yaroslav the Wise (1019–1054 AD). Those Ostriv individuals with 'local' stable isotope signatures (graves 2, 19, 31 and 41) died either towards the end of Yaroslav's reign, or in subsequent decades. These individuals were either born locally, or had lived in Ukraine for a significant period of time.

Conclusions

A comparative analysis of Ostriv and east Baltic cemetery data established long-distance connections between the two regions. The results of the laboratory research of several Ostriv individuals represent the Ostriv population as East Baltic migrants who served as mercenaries (?) on the River Ros' in the first half of the 11th century AD. Typological features indicate the east Baltic origin of most of the ornaments found in the cemetery. The similarity of the ^{14}C results, together with the typo-chronological background of Ostriv and east Baltic individuals, may indicate the synchronicity of both populations. Stable isotopic values of Ostriv could reflect a mix of local and east Baltic residents, with earlier burials of individuals raised in the east Baltic region, and later burials of individuals who had spent their lives mainly/entirely in the territory of today's Ukraine. The first results of the genetic analyses link the Ostriv individuals to east Baltic and Scandinavian populations. The discovery of Ostriv emphasises the role of the Balts archaeological cultures and their representatives in the Eastern Europe region, as well as prompting a reconsideration of the predominantly Scandinavian origin of the Varangians or Rus', who participated in the creation and development of the Kyivan Rus' state.

Acknowledgements

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Bibliography

Baranov, Vyacheslav; Vsevolod, Ivakin. "Burials with weaponry in the Ostriv Baltic graveyard in the Middle Dnieper area (excavated in 2017–2018). Medieval warriors in the Slavic and Baltic area". *Acta Historica Universitatis Klaipedensis* XXXVII (2019), pp. 99–127.

Borysov, Artem Vadimovitch. "Old Rus" Porossya. Settlement system. Qualifying scientific work on the rights of manuscripts". Dissertation for the degree of candidate of historical sciences (PhD) in speciality 07.00.04 "Archaeology". Institute of Archaeology of National Academy of Sciences of Ukraine, (Kyiv, 2019).

Bronk Ramsey, Christopher. "Bayesian analysis of radiocarbon dates". *Radiocarbon* 51(1) (2009), pp. 337–60.

Buko, Andrzei (ed.). *Bodzia. A Late Viking-Age Elite Cemetery in Central Poland. (East Central and Eastern Europe in the Middle Ages, 450–1450)*, Bd. 27. (Leiden, Boston: Brill, 2014).

Calcagnile, Luigi; Quarta, Giuseppe; Cattaneo, Claudia; D'Elia, Maurizio. "Determining 14C content in different human tissues: Implications for application of 14C bomb-spike dating in forensic medicine". *Radiocarbon*, 55(3) (2013), pp. 1845–1849.

Cooper, Alan; Poina, N. Hendrik. "Ancient DNA: Do It Right or Not at All". *Science* 289/5482 (2000), pp. 1139–1141.

Deeb, Chris; Walter, P. Ryan; Castaing, Jean; Penhoud, Pierre; Veyssière, Paul. "Transmission Electron Microscopy (TEM) investigations of ancient Egyptian cosmetic powders". *Applied Physics*, 79 (2004), pp. 393–396.

Diachenko, Dmytro. "Baltska zoomorfna bronzova plastyka v pokhovalnii obriadovosti mohylnyka Ostriv". Bibikov, Dmytro (ed.), Materialy naukovoi konferentsii "*Vid yazychnytstva do khrystyianstva: relihiini viruvannia rannoserednovichnoho naselennia Serednoho Podniprov'ia*". Kyiv, 2021, pp. 60–67.

Grootes, Peter M.; Nadeau, Marie-Josée; Rieck, Andreas. "14C-AMS at the Leibniz-Labor: radiometric dating and isotope research". *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms*, 223, (2004), pp. 55–61.

Ivakin, Vsevolod; Baranov, Vyacheslav; Bibikov, Dmitro; Gniera, Volodymir. "Novoviaevlenni balts'kii mogil'nik XI st na Porossi". Tezi dopovidiei uchasnykiv mizhnarodnoi naukovoi konferentsii "*Mihratsii ta inovatsii: u poshukakh pervynnosti idei, rechei i liudei*", 8–11 lystopada 2017 r. Lviv-Vynnyky (2017), pp. 5–7.

Jenkins, Stephen G.; Partridge, Steven T.; Stephenson, Tricia R.; Farley, Scott D.; Robbins, Charles T. "Nitrogen and carbon isotope fractionation between mothers, neonates, and nursing offspring". *Oecologia*, 129(3) (2001), pp. 336–341.

Kuchera, Mikhail Petrovitch; Ivanchenko, Liudmila Ivanovna. "Davn'orus'ska oboronna liniiia v Porossi". *Arkheolohiia*, 59 (1987), pp. 67–79.

Likhachev, Dmitrij S.; Romanov, Boris A. (eds.) *"Povest' vremennykh let, Ch. 1. Tekst i perevod".* Moskva-Leningrad: Izdatel'stvo Akademii nauk SSSR, 1950.

Lillie, Mark; Henderson, Robyn; Budd, Colin; Potekhina, Inna. "Factors influencing the radiocarbon dating of human skeletal remains from the Dnieper river system: archaeological and stable isotope evidence of diet from the Epipaleolithic to Eneolithic periods". *Radiocarbon* 58(4), (2016), pp. 741–753.

Margaryan, Ashot; Lawson, Daniel J.; Sikora, Martin. "Population genomics of the Viking world". *Nature*, 585, (2020), pp. 390–396.

Morgunov, Yurij Yurievitch. "K problematike izucheniia pivdenno-russkikh zmievykh valov". Makarov, Nikolai Andreevtich; Chernetsov, Aleksej Vladimirovitch, eds. *Rus' v IX–XIV vekakh. Vzaimodeistvie Severa i Yuga*. Moskva: Nauka, 2005, pp. 253–268.

Motsia, Oleksandr Petrovitch. *Naselennia pivdenno-ruskikh zemel' IX–XIII st. (za materialamy nekropoliv).* Kyiv: Instytut arkheolohii NANU, 1993.

Nadeau, Marie-Josée; Grootes, Pieter M.; Schleicher, Michael; Hasselberg, Per; Rieck, Andreas; Bitterling, Mark. "Sample throughput and data quality at the Leibniz-Labor AMS facility". *Radiocarbon* 40(1) (1998), pp. 239–246.

Niderle, Lubor. *Slavianskie drevnosti*. Moskva: Institut russkoi tsivilizatsii, 2015.

Osypenko, Maksim; Hrytsik, Yurii. "Shiini hryvni typu ,Totenkhrone' u zibranni Natsional'noho muzeiu istorii Ukrainy". *Arkheolohiia i davnia istoriia Ukrainy*, 2 (35) (2020), pp. 340–34.

Rohland, Nadin, Harney, Éadaoin, Mallick, Swapan, Nordenfelt, Susanne, Reich, David. 'Partial uracil - DNA - glycosylase treatment for screening of ancient DNA', Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 370 (1660), (2015).

Shiroukhov, Roman; Carnap-Bornheim, Claus v.; Meadows, John; Baranov, Vyacheslav; Ivakin, Vsevolod. "The Baltic cemetery at Ostriv on the Ros' (Ukraine).The main conclusions from the first five years of interdisciplinary research". *ZBSA Jahresbericht* 2021, (2022), pp. 58–61.

Stuiver, Minze; Polach, Henry. "Discussion reporting of 14C data". *Radiocarbon*, 19(3) (1977), pp. 355–363.

Širouchovas (Shiroukhov), Romanas. "Nauji prūsų X–XIII a. kapinynų tyrimai vakarų baltų kultūros kontekste". *Lituanistica* 57, 3(85) (2011), pp. 276–304.

Tolochko, Petr Petrovitch. "Kyievska zemlia". *Drevnerusskie kniazhestva in the 10th-13th centuries*. Moskva: Nauka, 1975), pp. 5–56.

Baltų migrantai Ukrainoje? Lyginamasis laboratorinis vėlyvojo vikingų laikotarpio Ostrivo kapinyno tyrimas

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2017 m. spalį Ukrainos nacionalinės mokslų akademijos Archeologijos instituto komanda aptiko Viduramžių Ostrivo kapinyną prie Rosės upės Kyjivo srityje. Iki 2022 m. pradžios buvo aptikta 100 griautinių kapų. 53 iš jų analizuoti tipologiškai, o 66 – antropologiškai. Ostrivo kapinyno dirbiniai siejami su buvusios Rytų Prūsijos vakarų baltais.

Šiame straipsnyje pateikiami integruoti Ostrivo bandomųjų laboratorinių tyrimų rezultatai, kuriais, taikant įvairius metodus, siekta įvertinti hipotezę, teigiančią, kad Ostrivo gyventojai buvo migrantų grupė. Siekiant nustatyti labiausiai tikėtiną Ostrivo paleopopuliacijos kultūrinę ir geografinę kilmę, taikyti šie metodai: antropologiniai tyrimai, senovinės DNR analizė, stabiliųjų izotopų tyrimai ir radiokarboninis datavimas (AMS ^{14}C) bei elektroninė mikroskopinė metalo dirbinių analizė.

Lyginamoji Ostrivo ir rytų baltų kapinynų duomenų analizė leido nustatyti ryšį tarp šių dviejų regionų. Dauguma Ostrivo kapų datuoti radiokarboniniu metodu, gauta data – XI–XII a., akcentuojant pirmąją XI a. pusę. Tiek Ostrivo kapai, kuriuose rasta rytų baltų dirbinių, tiek baltų kapinynai su vienodo tipo įkapėmis yra datuojami tuo pačiu laikotarpiu. Antropologinių tyrimų duomenimis, Ostrivo senovės gyventojai buvo jauni, neseniai atsikraustę ir prastai prisitaikę prie naujųjų gyvenimo sąlygų. Pirmieji genetinių tyrimų rezultatai Ostrivo žmones sieja su rytinio Baltijos regiono ir Skandinavijos populiacijomis. Iš Ostrivo radinių išgautos stabiliosios izotopų vertės rodo, kad šioje vietovėje galbūt maišėsi vietos ir rytinio Baltijos regiono gyventojai: ankstyvesniuose kapuose laidoti asmenys, užaugę rytiniame Baltijos regione, o vėlesniuose – didžiąją gyvenimo dalį praleidę dabartinės Ukrainos teritorijoje. Ostrivo archeologinės vietovės atradimas pabrėžia rytų baltų archeologinių kultūrų ir jų atstovų svarbą kuriant ir plėtojant Kyjivo Rusios valstybę.