# $^{14}$C CHRONOLOGY OF ARCHAEOLOGICAL SITES IN EUROPEAN RUSSIA AND CHANGES IN ENVIRONMENTAL PROCESSES: A DATABASE INVESTIGATION

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**ABSTRACT.** A large number of $^{14}$C dates for archaeological sites in European Russia have been entered into a new database. The database includes >1500 dates for *ca.* 500 archaeological sites. Because European Russia is a very large area, the database includes subdivisions of territories and regions. We analyzed our $^{14}$C dates according to archaeological periods (Paleolithic through Medieval period) and made a comparison with environmental (climatic) parameters. Our database for archaeological sites and monuments offers new possibilities for correlation between the development of ancient cultures and natural-climatic processes.

## INTRODUCTION

Radiocarbon dating of archaeological objects and monuments is the main focus of research of the Radiocarbon Laboratory at the Institute of the History of Material Culture of the Russian Academy of Sciences (IHMC). Since the late 1950s, the laboratory has held a virtual monopoly of the field of $^{14}$C dating archaeological objects discovered in the former USSR.

Over nearly 40 years, the laboratory has performed >4000 $^{14}$C measurements. The development of computer technology has made it possible to create database archives. Since the 1980s, many researchers have collaborated to design $^{14}$C databases (Kra 1989). In 1996, we created such a database for the storage and classification of $^{14}$C determinations made by IHMC. Our database was designed following those used in American and European laboratories (Maslovski 1995; Michczynski 1995).

Our database of $^{14}$C dates for archaeological objects provides information through the analysis of large collections of accumulated data. An attempt at a "regional chronological comparison" of archaeological epochs has been performed (Zaitseva 1996). This paper is based on data from European Russia (1546 $^{14}$C dates for 472 sites), ranging from the Paleolithic to the Medieval periods.

## METHODS

For the creation of the database of archaeological $^{14}$C dates, we used the general principles previously agreed upon (Kra 1989), together with some information specific to Russian archaeology. The database features specific to Russia include fields for entering precise location coordinates of archaeological sites. The coordinates are necessary because of the expanse of geographical area involved, including large parts of the European and Asian continents. It was necessary to include special fields for territories (*e.g.*, European Russia, Siberia) and large regions which have different environmental conditions. The samples are assigned to the following archaeological periods: Paleolithic, Mesolithic, Neolithic, Eneolithic, Bronze and Iron Ages, and the Medieval period. In some cases, these assignments are rather subjective and depend on the interpretations of individual archaeologists. The $^{14}$C database was created with the program Paradox (version 4) and has 22 fields. Some of the most important fields include: laboratory index, $^{14}$C date, error, intervals of the calibrated age, country (according to the new independent republics of the former Soviet Union), site/monument, location,

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geographical coordinates, archaeological period, archaeological culture, suggested archaeological chronology, excavator, commentaries, and list of publications. Since the Russian territory is so large, with very different environmental conditions, we included fields for European Russia, the Ural, West and East Siberia, and Far-East Russia. In addition, we differentiate between the northern, central and southern regions of these territories. The database includes 3700 $^{14}C$ dates. *Ca.* 80% of these were measured in the IHMC laboratory; the data from other laboratories comes from the literature. The database can be exported to Excel (version 6) for graphical display.

Figure 1 shows the distribution of sites and $^{14}C$ dates for the selected archaeological periods in European Russia. There are about three dates per site. The regional distribution of the dated samples from the Paleolithic to the Medieval periods, in order of archaeological periods, is shown in Figure 2. In the map of the dated sites from the Paleolithic to the Bronze Age (Fig. 3), the three regions North (I), Central (II) and South (III) are separated by dotted lines. We note that the southern region of European Russia includes the Northern Caucasus to the border of Russia. The map shows that in central Russia, the dated sites for all periods from the Paleolithic to Medieval are represented. In northern European Russia, the earliest dated sites are from the Mesolithic. In southern Russia (Steppe zone), the numerous dates consist mainly of Bronze-Age burials. It is very important to determine the maximum and minimum for the distribution of $^{14}C$ dates and dated sites. Figure 4 shows the distribution of $^{14}C$ dates for all of European Russia, from 1200–40,000 BP. For this plot, the Paleolithic starts at 40 ka BP, the Mesolithic at 12 ka BP and the Neolithic at 8 ka BP. The time resolution chosen is roughly twice the standard deviation for the $^{14}C$ measurement, ranging from 200 (Medieval) to 1000 yr (Paleolithic).

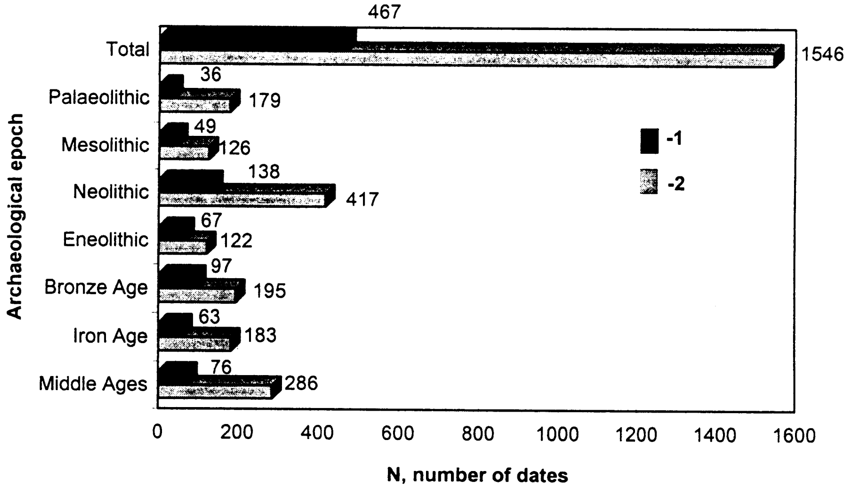


Fig. 1. Database content: the distribution of $^{14}C$ dates and sites for the archaeological epochs of European Russia. 1=number of sites; 2=number of $^{14}C$ dates.

## Results and Discussion

Figure 4 shows the quantitative distribution of $^{14}C$ dates and dated sites/monuments recorded in the database, according to the general archaeological period (from Paleolithic to Medieval), and geological era (Late Pleistocene and Holocene). For the Final Pleistocene, the smallest number of $^{14}C$ dates appear in the period 11,500–10,500 BP (*ca.* 13,000 BP). This interval corresponds to the Younger Dryas period. Chronological positioning for the Younger Dryas has been determined by many researchers (*e.g.*, Holmund and Fastook 1993; Goslar *et al.* 1995).

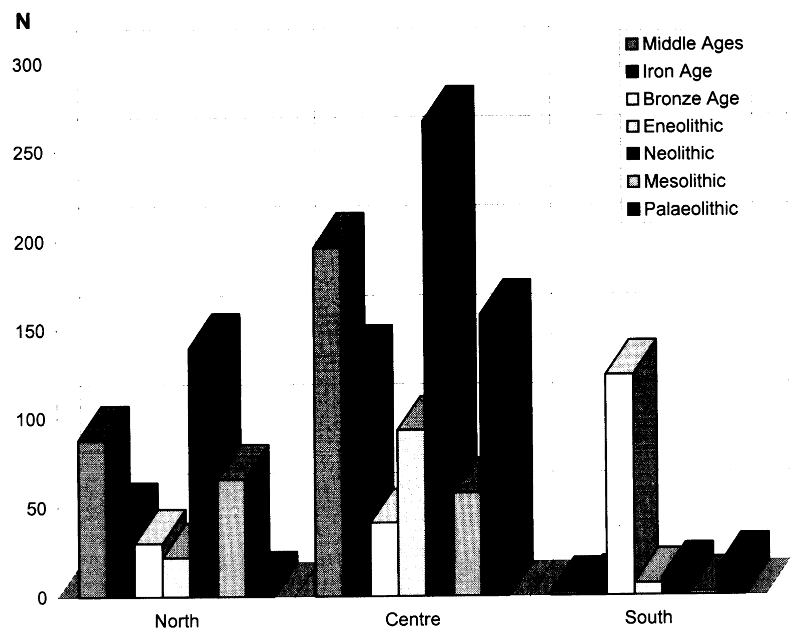


Fig. 2. Database content: regional distribution of $^{14}C$ dates of archaeological sites for different archaeological epochs

This small number of $^{14}C$ dates for archaeological sites during the Younger Dryas is seen in all areas of the former USSR covered by our database (Zaitseva *et al.* 1996). Because the dates of this distribution (Fig. 4) cover both the Pleistocene and Holocene with very different environmental conditions, we tried to determine the distribution of data for each period separately. The distribution of $^{14}C$ dates for the Paleolithic (Pleistocene) is shown in Figure 5A (curve 1, time resolution 1000 yr) together with the distribution of the shown dated sites (curve 2). Both curves show maxima at *ca.* 28–30 ka, 22–27 ka and 14–17 ka BP. The question arises of whether this distribution is accidental or if these peaks coincide with environmental changes. To answer this question, we used oxygen-isotope data from ice cores from Greenland (Johnsen *et al.* 1992). This core records high-resolution climatic parameters for the last 250 ka. The measurements of $\delta^{18}O$ from Summit Station for the period corresponding to the Upper Paleolithic in archaeological terms (Rogachev and Anikovich 1984) are shown in Figure 5B.

The most important episodes of temperature increases occur within the intervals 30–35 ka, 22–25 ka and 13–14 ka BP. These temperature fluctuations, indicated by $\delta^{18}O$, are probably related to significant environmental changes in the northern part of the Atlantic Ocean. These climatic temperature changes correspond roughly to the chronological distribution of the dated Paleolithic sites (Fig. 5A,B). It should be noted that the $^{14}C$ curve for the Paleolithic is based on samples originating from mostly key-sites or those most important for chronological reconstruction.

For the Holocene, the distribution of $^{14}C$ dates and dated sites/monuments in central Russia for the archaeological periods from the Mesolithic to the Early Iron Age are shown in Figure 6 (curves 1 and 2, time resolution 200 yr). Also, here we can see both curves' maxima and minima, and can investigate the correspondence to environmental changes. The Holocene climate, in general, did not have the rapid changes as did the preceding period. At the same time, understanding the natural processes during the Holocene is important for the reconstruction of the paleoclimate.

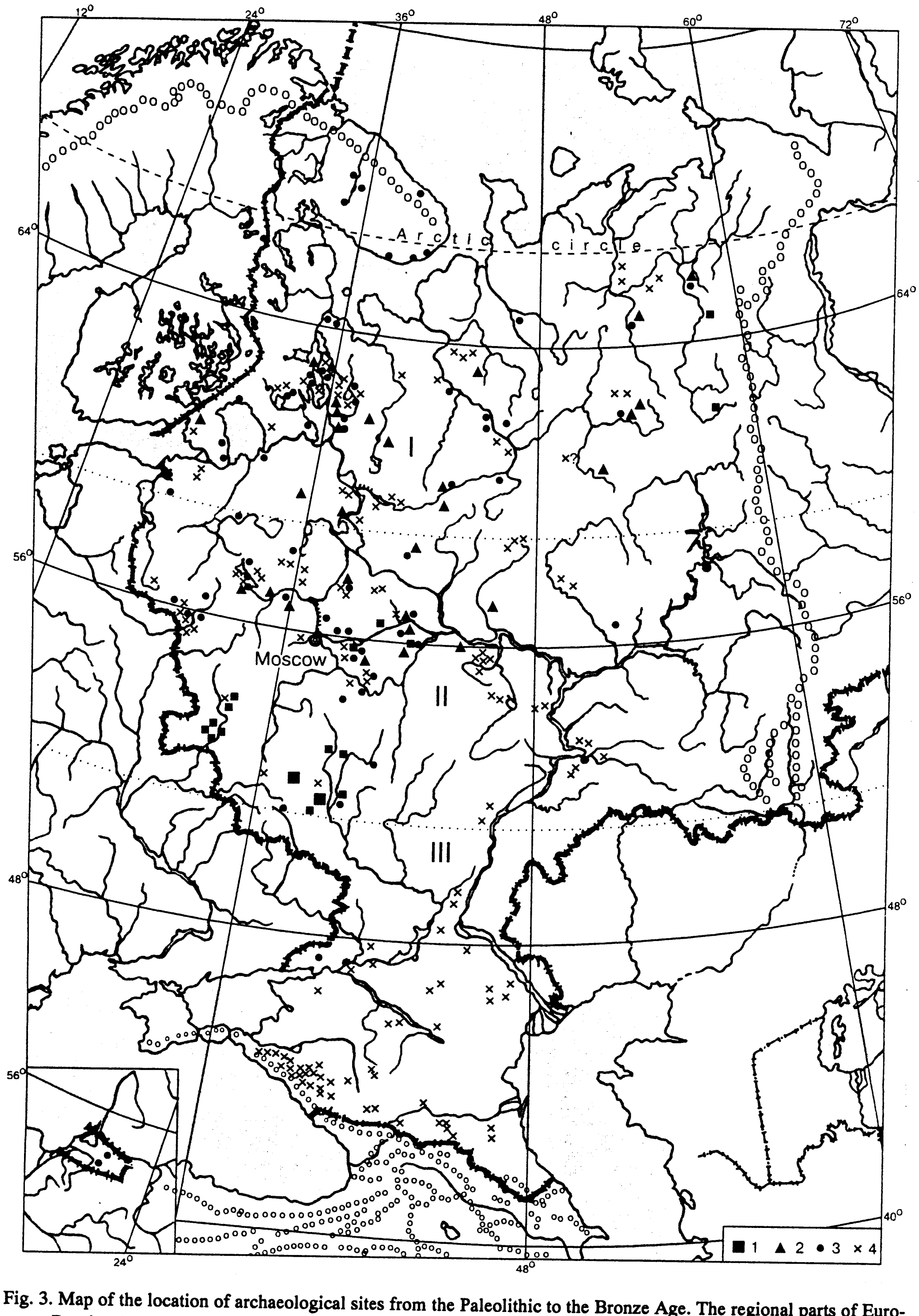


Fig. 3. Map of the location of archaeological sites from the Paleolithic to the Bronze Age. The regional parts of European Russia: I=Northern, II=Central, III=Southern. The symbols correspond to: 1=Paleolithic, 2=Mesolithic, 3=Neolithic, 4= Eneolithic and Bronze Age. The large symbols indicate that there are more than three dates for the site.

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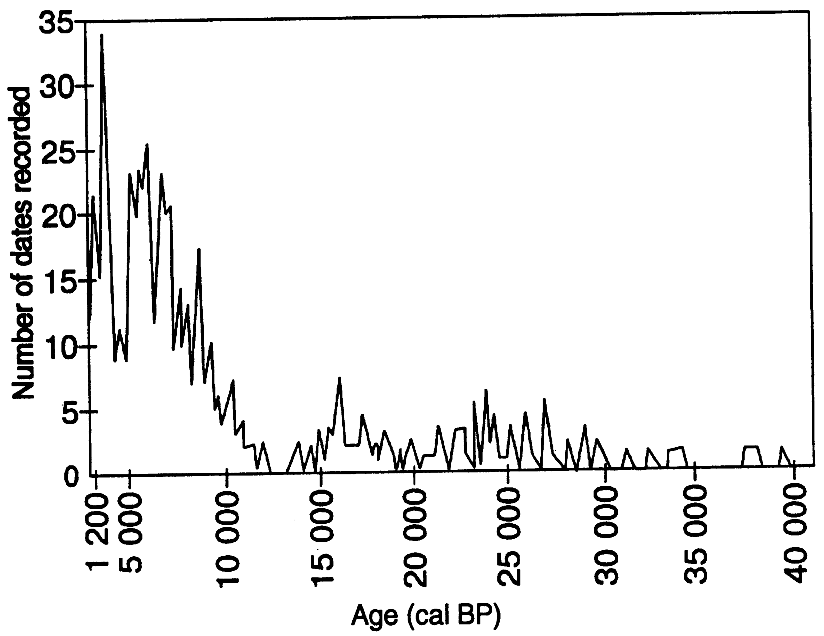


Fig. 4. Distribution of $^{14}C$ dates for the center of European Russia from 1200 to 40,000 BP

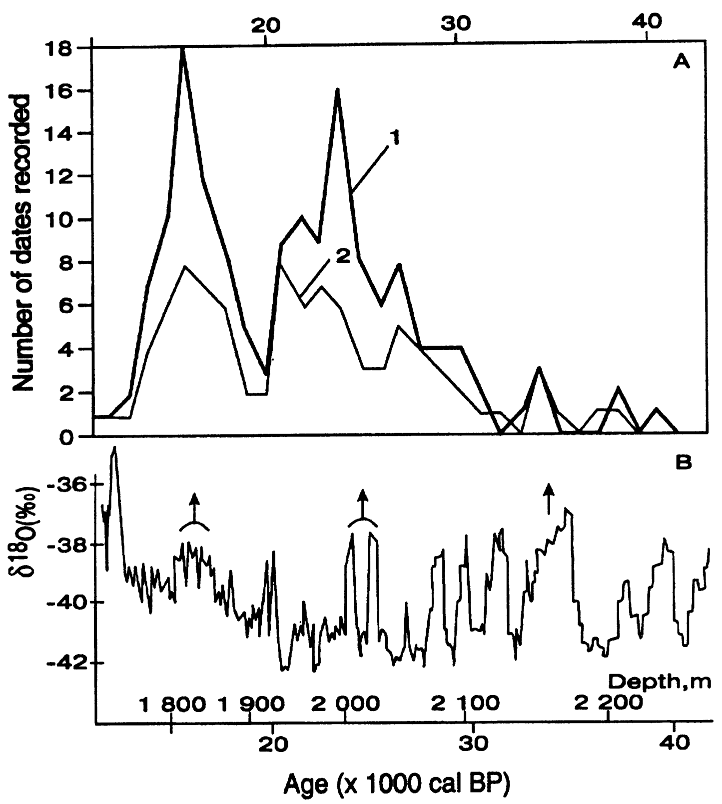


Fig. 5. Correlation of the distribution of $^{14}C$ dates and dated sites for the Paleolithic (Pleistocene) with ice-core data. Time resolution=1000 yr; the ages are given in cal BP. A. distribution of $^{14}C$ dates (1) and the number of dated sites (2). B. part of $\delta^{18}O$ profile from the Greenland ice core Summit Station (Johnsen *et al.* 1992).

Dergachev and Chistyakov (1992) demonstrated that climatic changes during the last 50–60 ka BP contain a 2400-yr cycle, possibly connected with changes in solar activity. Paleoclimatic curves for the mid-latitude areas of the Northern Hemisphere during the last 12 ka were constructed by Klimanov and Elina (1985). Klimanov and Klemenko (1995) reconstructed paleotemperatures and precipitation for the last 10 ka BP using data from Northern-Eurasian lake and peat-bog sediments. There are four mild periods recognized in the intervals: *ca.* 6700–5700, 4500–3200, 2300–1600 yr BP, including the small climatic optimum period of the Medieval era, 12th–13th century AD. All these mild periods are separated by cold periods. The results of temperature changes in central Russia after Velichko (1989), are shown in Figure 6B. The reconstructed temperatures have an error of ±1°C. Cyclic phenomena and synchronism between July and January temperatures are evident. The highest rise of temperature occurs *ca.* 5500 yr BP.

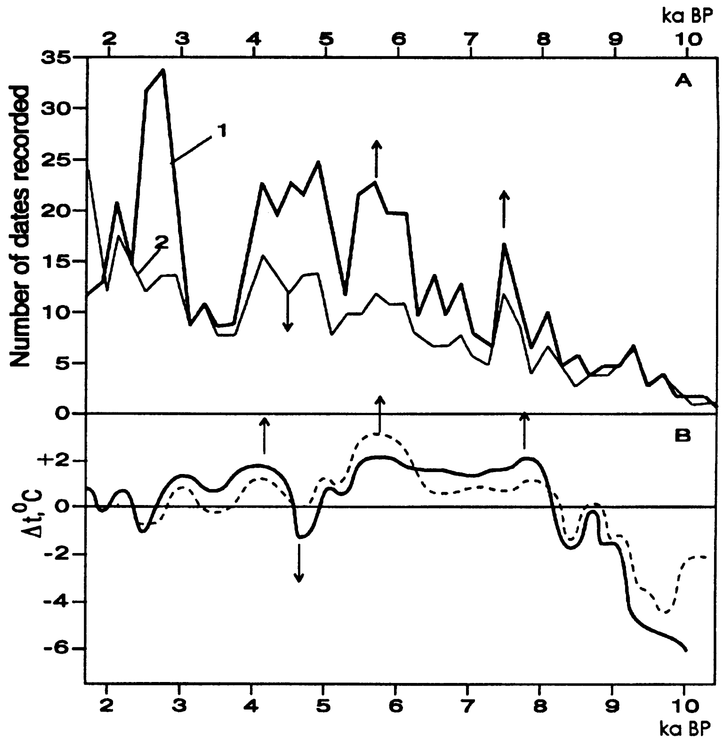


Fig. 6. Correlation of the distribution of $^{14}C$ dates and dated sites for the Mesolithic–Bronze Age with the climatic changes. The time resolution is 200 yr; the ages here are given in cal BP. A. distribution of $^{14}C$ dates (1) and dated sites (2). B. Generalized paleoclimatic curves for the Holocene showing temperature changes (deviation from present-day values) for the center of the Russian plain (Velichko 1989). (January temp. = straight line; July temp. = dotted line).

When comparing the chronological distribution of the $^{14}C$ dates for archaeological samples and the data of the climatic changes for the last 40 ka, we deduced a similarity in both. This could be caused by subjective factors. On the other hand, it might also be evidence of a true archaeology-environment relation. One possible explanation, especially valid for Stone Age archaeology, could be the direct link of climatic changes with the preservation of the organic matter (samples for $^{14}C$ dating) from the archaeological sites. This is especially true for the materials from the Final Pleistocene. For example, the climatic period of the Younger Dryas in the huge area of Eastern Europe and adjacent regions (Poland, Lithuania, Latvia, Byelorussia, Ukraine and some parts of European Russia) is characterized by several hundred sites of the Swider culture. This culture existed under the conditions of the cold Steppe zone that are characteristic for the Younger Dryas (Zaliznyak 1989). Until now, isolated $^{14}C$ dates were known for three sites of this culture. The poor preservation of organic material in the sandy cultural layers, which accumulated during conditions of the vegetation degradation and weak soil-formation, can be used as an explanation for the total absence of bone and antler tools at the Swider culture sites. Climatic conditions also influenced the economy and life of the nomadic reindeer-hunters.

The mild Early-Holocene period in the main part of European Russia is characterized by an intensive development of forest vegetation and soil formation. During this period, peat bogs accumulated in many lake-hollows of the forest zone of European Russia. The majority of the $^{14}C$ dates for the Mesolithic and Neolithic periods of this region are from peat-bog sites with their excellent conditions for the sample preservation. The permanent lake- and peat-bog dwelling-sites of the Neolithic Forest zone, along with an economy based largely on fishing (Gurina 1991), provided numerous samples for $^{14}C$ dating. The small number of $^{14}C$ dates for the Mesolithic and Neolithic in the Southern Russia (Steppe zone) also can also be explained by similar factors. Short-term sites, typical of ancient hunters and the earliest mobile stock-breeders, generate few samples or none for $^{14}C$ dating. The Early Neolithic agriculturists' permanent settlements of southeastern Europe (especially the large tumuli-hills of the Balkans and the adjacent regions) have much better conditions for providing a $^{14}C$ chronology. A large series of $^{14}C$ dates in the Steppe zone area is available for the Bronze Age. The samples, originating mainly from burials placed in mounds with rather good conditions for bone and charcoal preservation, are often discovered with wooden constructions.

Some observations of the chronological distribution of dates relate to ancient demographics (in particular, to the first stages of the settlement of the Russian plain), or with the unevenness of the archaeological research (for example, in a large part of the Forest zone, sites of the Early Iron Age are not well known (Fig. 6A)). This could explain some of the discrepancies between the curves in Figure 6A,B. Other explanations include a decrease in the societies' dependence on natural climatic factors, which followed the development of technical abilities and ancient economy.

## Conclusion

Our database for $^{14}C$ dates of archaeological sites and monuments yields, for the first time, new possibilities for a correlation between the development of ancient cultures and natural-climatic processes. We have shown that this research, based on a large amount of different factual data, allows us to recognize some global tendencies.

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