DYNAMICS OF SIBERIAN PALEOLITHIC COMPLEXES (BASED ON ANALYSIS OF RADIOCARBON RECORDS): THE 2012 STATE-OF-THE-ART

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ABSTRACT. Our updated database of Siberian Paleolithic radiocarbon records (the 2011 date list of ~800 values) was used to analyze the patterns of population changes, following the methodology developed previously (Kuzmin and Keates 2005). Although the main conclusions remain similar to our 2005 results, some new features were also detected. The intensity of occupation after ~35,000–34,000 BP was higher than previously thought, and the rise in population began at ~20,000–19,000 BP. It is once again confirmed that no significant decline can be observed for the Last Glacial Maximum (~22,000–16,000 BP). The relationship between climate and Paleolithic humans in Siberia was complex and without a clear trend toward the intensification of occupation during the warm phases.

INTRODUCTION

Large ^{14}C data sets are extensively used for the reconstruction of the population history of prehistoric humans (e.g. Collard et al. 2010; Peros et al. 2010; Steele 2010; Lemmen et al. 2011; Bocquet-Appel et al. 2012) and animals (e.g. Ugan and Byers 2008; Nikolskiy et al. 2011; MacDonald et al. 2012). A recent overview of this approach can be found in Williams (2012). Due to rapid data accumulation, the need for updating the databases and their interpretation is constant. In this paper, we present the 2012 situation of the ^{14}C records for the Siberian Paleolithic with an analysis of their frequency. Previously, our studies were based on about 440 ^{14}C values obtained before 2005 (see Kuzmin and Keates 2005; Fiedel and Kuzmin 2007; Fiedel et al. 2007).

MATERIAL AND METHODS

For the updated analysis, the latest published database (see Kuzmin et al. 2011) was used. It consists of ~800 ^{14}C values for the late Middle Paleolithic and the Upper Paleolithic complexes in Siberia, totaling 168 sites and site components (see Figure 1). For the geographic subdivision of Siberia, we use primary sources (Suslov 1961; Shahgedanova 2002). The spatial distribution of the ^{14}C-dated localities is very uneven: the majority of sites are situated in southern Siberia (south of 55°N), while in the Arctic regions (north of 65°N) there are few Paleolithic ^{14}C-dated sites. As for the longitudinal distribution, sites are concentrated in the western and eastern parts of Siberia, between 80° and 120°E. As a result, both western Siberia (including the Urals, Figure 1) and eastern Siberia are the best-studied regions (Figure 2); especially noteworthy is eastern Siberia where 39% of sites by latitude and 70% of sites by longitude are located.

Before entering the ^{14}C data into the analysis, a critical evaluation of their reliability should be conducted. On the one hand, the criteria used for “chronometric hygiene” (*sensu* Spriggs 1989:590–8) should be rigorous; examples are research by Kuzmin and Tankersley (1996) and Pettitt et al. (2003). On the other hand, the artificially high requirements can lead to confusing results when most of the ^{14}C dates appear to be of dubious quality as in the case of Graf (2009a); see details in Kuzmin (2009). Therefore, common sense should be employed when examining the quality of the data.

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Figure 1 Position of ^{14}C-dated Siberian Paleolithic sites (with major geographic regions). N.K. = North Korea.

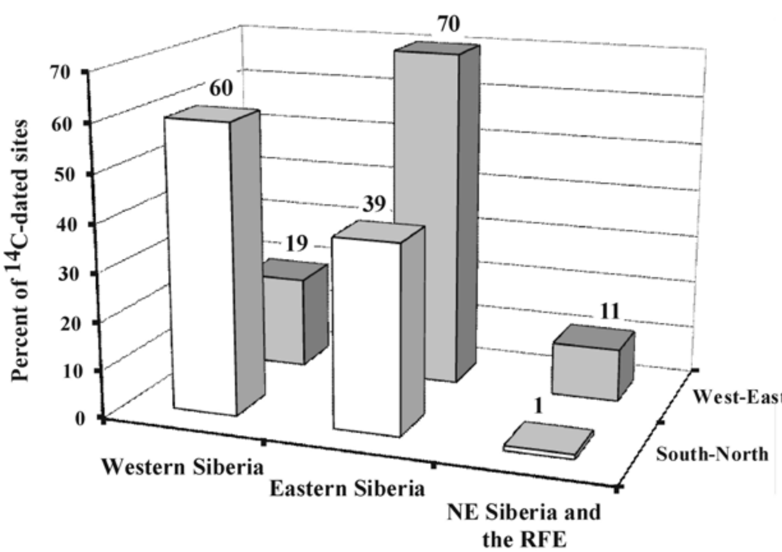

Figure 2 Geographic distribution of ^{14}C-dated Siberian Paleolithic sites, in percent values

In this study, there are 4 main criteria for rejecting raw ^{14}C dates: 1) inversions in age-depth profiles; 2) uncertainties of association with cultural components and lack of documentation; 3) association with megafaunal remains from mass accumulations ("mammoth cemeteries"), which are often only very loosely related to human presence; and 4) infinite ages (i.e. greater than). Of the 801 original ^{14}C values from Kuzmin et al. (2011), 56 (7.0% of the total) are rejected due to stratigraphic inversions; 50 (6.2%) due to unclear association, including the values derived from the "mammoth cemeteries"; and 43 (5.4%) as infinite dates. In total, we discarded 149 ^{14}C dates (18.6%). As a result, 652 ^{14}C values (81.4%) are accepted as reliable and used here for the reconstruction of Paleolithic population dynamics in Siberia. The approach follows Kuzmin and Keates (2005), and *occupation episodes* were counted for the time span of ~49,000–10,000 BP (Table 1). We accept the age of ~10,000 BP as the general upper limit for the Paleolithic cultural complexes in Siberia (e.g. Vasil'ev 2003:522).

Concerning the possible distortion of our data set by "taphonomic bias," put forward by Surovell et al. (2009) and caused by decreasing preservation of archaeological sites and paleontological materials as their ages increase, it was shown that it does not affect the reliability of large ^{14}C date series significantly (Peros et al. 2010; Williams 2012). Thus, we consider our data as a reliable and representative source for understanding the changes in Siberian Paleolithic populations at the first degree of approximation.

RESULTS AND DISCUSSION: THE 2012 STATUS

The updated distribution of occupation episodes for the Siberian Paleolithic is presented in Figure 3. Compared to our previous study (Kuzmin and Keates 2005), several new features can be detected: 1) at ~32,000–21,000 BP, the intensity of occupation is higher (average 12.3 episodes per 1000 yr) than in the 2005 analysis (average value 7.9 per 1000 yr); 2) the increase in occupation began at ~20,000 BP compared to ~16,000 BP detected previously; and 3) no clear decrease in occupation is confirmed for the Last Glacial Maximum (LGM), neither in the narrow (~20,000–18,000 BP; e.g. CLIMAP 1976) nor broader (~22,000–16,000 BP; e.g. Clark et al. 2009) sense of the LGM duration (see Figure 3).

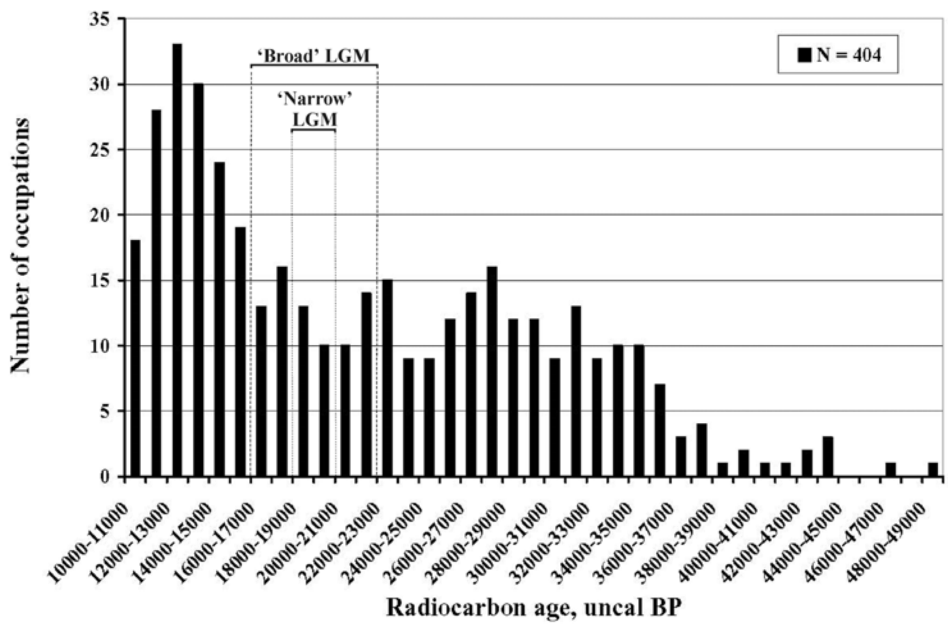

Figure 3 Frequency distribution of occupation episodes for Siberian Paleolithic complexes

Generally, the intensity of human occupation in southern Siberia after ~36,000 BP seems to be higher than previously thought. This is especially true at 32,000–31,000 BP (13 in this study vs. 7 in Kuzmin and Keates 2005) and 28,000–27,000 BP (16 vs. 6). The beginning of the rise of Paleolithic populations in Siberia at the end of the LGM can now be assigned to ~20,000 BP, with a minor drop at ~17,000–16,000 BP (Figure 3). These conclusions became possible after incorporating the new ^{14}C values in the database. Compared to our earlier study (Kuzmin and Keates 2005), the amount of material used for this paper has increased by >50%.

The distribution of raw ^{14}C dates mainly follows frequencies of occupation episodes (Table 1, Figure 4). However, for some 1000-yr slices, definite *artifacts* are observed: there is a very high number of ^{14}C dates for ~28,000–27,000 BP (36 values) and ~22,000–21,000 BP (28 values). To a large extent, this is due to numerous ^{14}C dates generated for the Yana RHS (the former) and Malta (the latter) sites, compared to far less ^{14}C dates for the adjacent 1000-yr timespans. Occupation frequencies for these time periods are 16 and 14, respectively (Table 1, Figures 3–4). It is clear that in order to avoid an artificial increase in the frequencies of ^{14}C dates, normalization of the initial ^{14}C records is necessary, and an occupation episode approach with its advantage over the simple counting of the frequency of ^{14}C dates seems to be feasible (see details in Fiedel and Kuzmin 2007:743–4).

Table 1 Frequencies of ^{14}C dates and occupation episodes for the Siberian Paleolithic (original data after Kuzmin et al. 2011, revised).

Time intervals (yr BP)	Number of ^{14}C dates	Number of occupations
10,000–11,000	40	18
11,000–12,000	59	28
12,000–13,000	76	33
13,000–14,000	58	30
14,000–15,000	42	24
15,000–16,000	22	19
16,000–17,000	19	13
17,000–18,000	27	16
18,000–19,000	13	13
19,000–20,000	14	10
20,000–21,000	19	10
21,000–22,000[a]	28	14
22,000–23,000	18	15
23,000–24,000	13	9
24,000–25,000	14	9
25,000–26,000	14	12
26,000–27,000	20	14
27,000–28,000[a]	36	16
28,000–29,000	19	12
29,000–30,000	13	12
30,000–31,000	11	9
31,000–32,000	15	13
32,000–33,000	9	9
33,000–34,000	14	10
34,000–35,000	11	10
35,000–36,000	7	7
36,000–37,000	4	3
37,000–38,000	4	4
38,000–39,000	1	1
39,000–40,000	2	2

Table 1 Frequencies of ^{14}C dates and occupation episodes for the Siberian Paleolithic (original data after Kuzmin et al. 2011, revised). *(Continued)*

Time intervals (yr BP)	Number of ^{14}C dates	Number of occupations
40,000–41,000	1	1
41,000–42,000	1	1
42,000–43,000	2	2
43,000–44,000	4	3
44,000–45,000	0	0
45,000–46,000	0	0
46,000–47,000	1	1
47,000–48,000	0	0
48,000–49,000	1	1
Total	**652**	**404**

[a]For these intervals, multiple ^{14}C dates at some sites distort the occupation picture (see text).

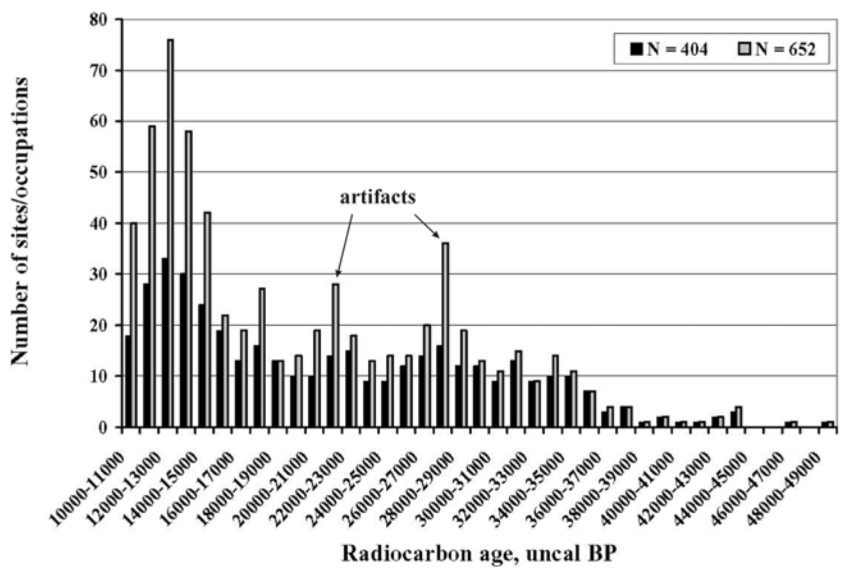

Figure 4 Comparison of frequencies of ^{14}C dates (gray bars) and occupation episodes (black bars) for the Siberian Paleolithic.

An example of what we perceive to be a clear misunderstanding of the occupation episode approach (*sensu* Kuzmin and Keates 2005) is given in a paper by Goebel et al. (2010). They assumed that the younger ^{14}C values of ~9750 BP (MAG-637) and ~9960 BP (LE-3024) for Layer 7 of the Ushki 1 site on the Kamchatka Peninsula along with the older dates of ~14,300–13,600 BP and ~11,360–10,810 BP should be accepted by those who count the occupation episodes using our approach: "...their [Kuzmin and Keates (2005)] prescribed analytical method of counting 'occupation episodes' requires the use of the full suite of dates" (Goebel et al. 2010:2644). Further, they write: "Following this method, if we consider all of the uncalibrated ^{14}C dates from Ushki-1, layer 7 … we would conclude that the cultural layer represents five occupation episodes: 9,000–10,000, 10,000–11,000, 11,000–12,000, 13,000–14,000, and 14,000–15,000 ^{14}C BP. The implication of these results would be that layer 7 represents a series of occupations spanning as much as 5000 years" (Goebel et al. 2010:2645).

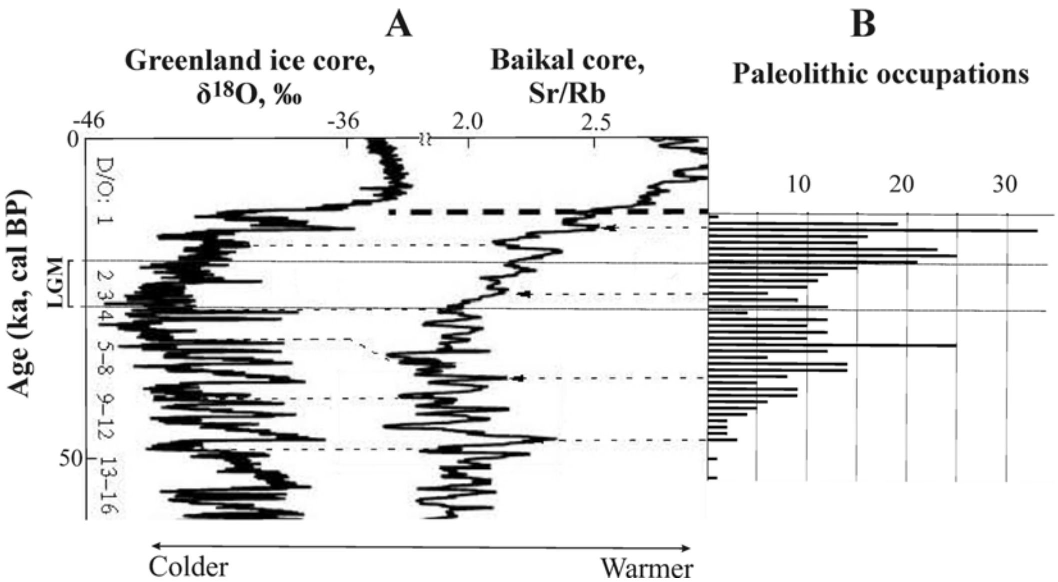

Figure 5 Comparison of climatic fluctuations in the Greenland and Lake Baikal records (A; Goldberg et al. 2008, modified) and intensity of human occupation in Siberia (B; see Figure 3). The numbers on the vertical axis are the Dansgaard-Oeschger (D/O) events for the last 50,000 cal yr.

However, the younger dates of ~9960–9750 BP for Layer 7 clearly are outliers because of the older age of the overlying Layer 6, ~10,800–8790 BP (e.g. Goebel et al. 2010; Kuzmin et al. 2010), and should therefore be rejected (see above). We never stated (e.g. Kuzmin and Keates 2005:777–80) that the "full suite of dates" should be used without prior critical examination.

As for the relationship between Paleolithic humans and Pleistocene megafauna in Siberia, it was recently concluded that the hunting pressure on woolly mammoths and rhinoceroses was relatively weak and did not contribute considerably to their extinction (MacDonald et al. 2012; Stuart and Lister 2012; see also Kuzmin 2010, 2011). Ugan and Byers (2007, 2008), and Nikolskiy et al. (2011) independently arrived at the same conclusion. It is apparent that the sparse human communities of the final Upper Paleolithic (~15,000–10,000 BP) in northern Siberia were unable to significantly affect the already decreasing mammoth and rhinoceros populations, and that environmental changes were the major factors that led to the final extinction of the megafauna.

In order to compare the frequencies of human occupation for the Siberian Paleolithic with high-resolution paleoclimatic records, it is necessary to calibrate the ^{14}C age for each occupation episode (Table 1). This was done with the help of CALIB 6.1.0 software (Reimer et al. 2009), following the approach by Fiedel and Kuzmin (2007). For comparison of occupation frequencies with climatic oscillations in Siberia at ~53,000–11,000 cal BP, the geochemical record of the Sr/Rb ratio in the Lake Baikal cores as reflecting both global and regional warmings and coolings, was chosen (Figure 5, "Sr/Rb" column). As one can see, no direct correspondence between climatic changes and intensity of human presence can be observed. For example, a steady rise in occupation is typical for ~40,000–30,000 cal BP, despite several large climatic fluctuations (D/O events 4–8, Figure 5). The peak at ~32,000–31,000 cal BP does not correspond to either a warm (Dansgaard-Oeschger event) or cold (Greenland stadial) interval (see also Fiedel and Kuzmin 2007:747). At the LGM, ~26,000–19,000 cal BP, the population size fluctuated but did not decrease (average occupation frequency is

10.7 per 1000 yr), with a minimum at ~24,000–23,000 cal BP (6 occupations). The attempt by Graf (2005, 2009b) to "revive" the idea of LGM abandonment of Siberia (e.g. Goebel 2002, 2004) contradicts the primary evidence, and cannot be accepted (see discussion in Kuzmin 2008; Kuzmin and Keates 2005).

CONCLUSION

The newly acquired data generally confirm our previous conclusions (Kuzmin and Keates 2005). However, some new features can also be observed. The intensity of Paleolithic occupation in Siberia since ~35,000–34,000 BP seems to be higher than was previously detected. The increase of population size began at ~20,000–19,000 BP, several millennia earlier than it was suggested before. Once again, no significant decline is observed for the LGM timespan in Siberia. Therefore, the relationship between climate and Paleolithic humans in Siberia was nonlinear as suggested previously (e.g. Fiedel and Kuzmin 2007).

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