ЭКОЛОГИЯ

PALAEOECOLOGY OF THE MOSKVA-RIVER FLOODPLAIN: SOIL, POLLEN AND ARCHAEOLOGICAL RECORDS

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Floodplain deposits in the valley of the Moskva-river contain a series of buried soils of the Holocene age, which can be an important source of palaeoecological information. These soils are aged: Soil 1 — last 4 centuries, Soil 2 — cal 1200 AD-500 BC, Soil 3 — 900—2700 BC, Soil 4 — 3500—5000 BC. Archaeological monuments attributed to these soils are dated: Neolithic (Soil 4), Early Bronze Age (Soil 3), the Iron Age and the Middle Ages (Soil 2). Buried soils have well developed profiles and diagnostic features. Buried soils of the Sub-Atlantic period (Soil 2) are usually referred to Luvisols and Albeluvisols. Dark-colored soils of the Atlantic period (Soil 4) in most cases refer to Phaeozems; pollen analysis shows that these soils were formed under forest-steppe communities. Buried soils of Subboreal period (Soil 3) are traced in rare cases and have no clear diagnostic features; pollen analysis shows that this soil could be developed under mixed forests dominated by spruce. Radiocarbon dating suggests that the landscapes of the lower levels of the valley have changed dramatically between 5000 and 4500 cal BP. The forest-steppe communities, typical for the Atlantic period, were replaced by dense spruce forests due to early Subboreal climate change. Some traces of human impact on the floodplain vegetation from the Neolithic and Bronze Age were revealed. The maximum anthropological transformation was noted in the beginning of Middle Ages.

Key words: Holocene, Neolith, Bronze Age, buried soils, floodplain deposits, pollen analysis, landscape reconstruction.

Floodplains are of great interest for studying the history of nature and people in the Holocene because the sections located in it are with complex stratigraphy, which include a series of buried soils, and also peat and other sediment, rich with pollen [16; 21; 23; 29; 31; 48; 56; 57]. Many important conclusions about the relationship of pedogenesis and sedimentation processes, such as phenomenon of avulsion, were made [8]. The question of synchronicity of soil formation in different river systems is discussed [48]. Also the floodplain contains clearly stratified culture layer of different age [9; 2; 4; 2010]. Complex floodplain geoarcheological research in the basins of the Upper Volga and Oka rivers began in our country in the 1970—1980's. However, the observed data is not yet sufficient to give reliable detailed reconstruction of paleolandscapes and their rhythm changes, caused by climate waves and anthropogenic impacts. Recently, studies in the basin of the Moskva-river were mainly concentrated in the area within the city of Moscow [4; 6—8]. As a result of studying the stratigraphy of floodplain deposits a series of buried soils was revealed, for which age have been defined. Soil humus, and, in some cases, coal and archeological objects were used for radiocarbon dating. The genetic type of these soils was identified using morphological analysis [1]. This data complies well with data of the sequence of buried soils in the floodplains of neighboring river systems, especially Oka-river [28; 34]. For some archeological objects, associated with buried soils, palaebotanical data was obtained [39; 40]. However, this data was limited to the culture layer of Iron and Middle Age. Complex archeology-palaeoecological research of monuments of older ages in the floodplain of the Moskva-river was not conducted until recently.

The goal of studies in the floodplain of Moscow-river near the town Zvenigorod (50 km upstream from Moscow-city) was to complete the already available data of the rivers flood regime, the formation of soils and vegetation, settlement and development of the floodplain by people in the last 5—6 thousand years. Studies conducted in 2007—2013 years showed that this area is exceptionally promising as an object of complex research [3; 5; 24—26; 52; 58]. The floodplain here was not heavily affected by the economic activities of 19—20 century and development. Because of this the typical soils and vegetation of the Moscow-river floodplain have been preserved. Numerous sites with a series of buried soils and archaeological monuments of different eras (from the Mezolithic Age to the late Middle Ages) were found specifically in the floodplain [42—47]. The advantage of this study is comparing archaeological, palaeobotanical and soil data with each other to confirm our conclusions.

Regional setting. The study area is located on the Moskva-river (55°42'N, 36°43'E), 10 km upstream from the town of Zvenigorod, and 60 km west of Moscow (fig.1).

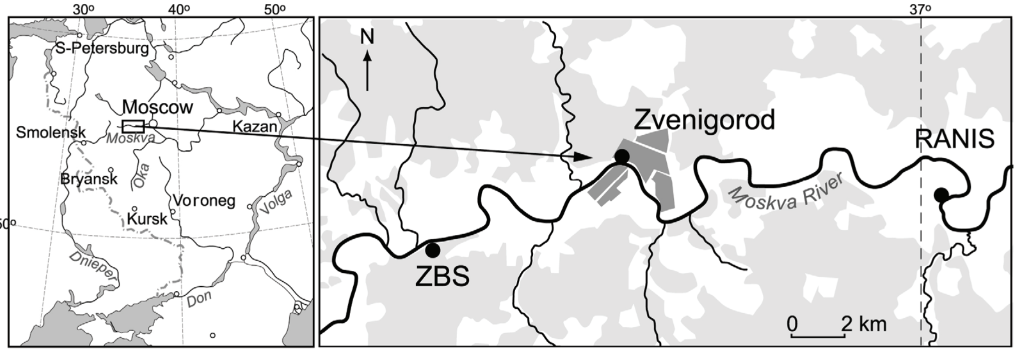

Fig. 1. Map of the studied area in the valley of the Moskva-river near the town Zvenigorod. Archaeological sites are marked with black circles

The area is located outside the last Late Pleistocene glaciation zone (Valday). Watersheds and high terraces are formed by glacial and fluvioglacial sedimentation in the end of the Middle Pleistocene (Moscow glaciation, MIS 6). The modern floodplain (300—600 m wide) partially includes lower portions of the terrace created in the Late Glacial, while the Holocene floodplain terrace is rather narrow (< 100 m) due to relative stability of the river channel in the Holocene [51; 52; 5] (fig. 2). In the last centuries the floodplain had been seasonally inundated by snowmelt floods in spring. In the middle of the 20th century the river had been regulated by reservoirs in the upper course. Modern floodplain soils are Fluvisols [37], and they are classified as Albeluvisols by the WRB [61].

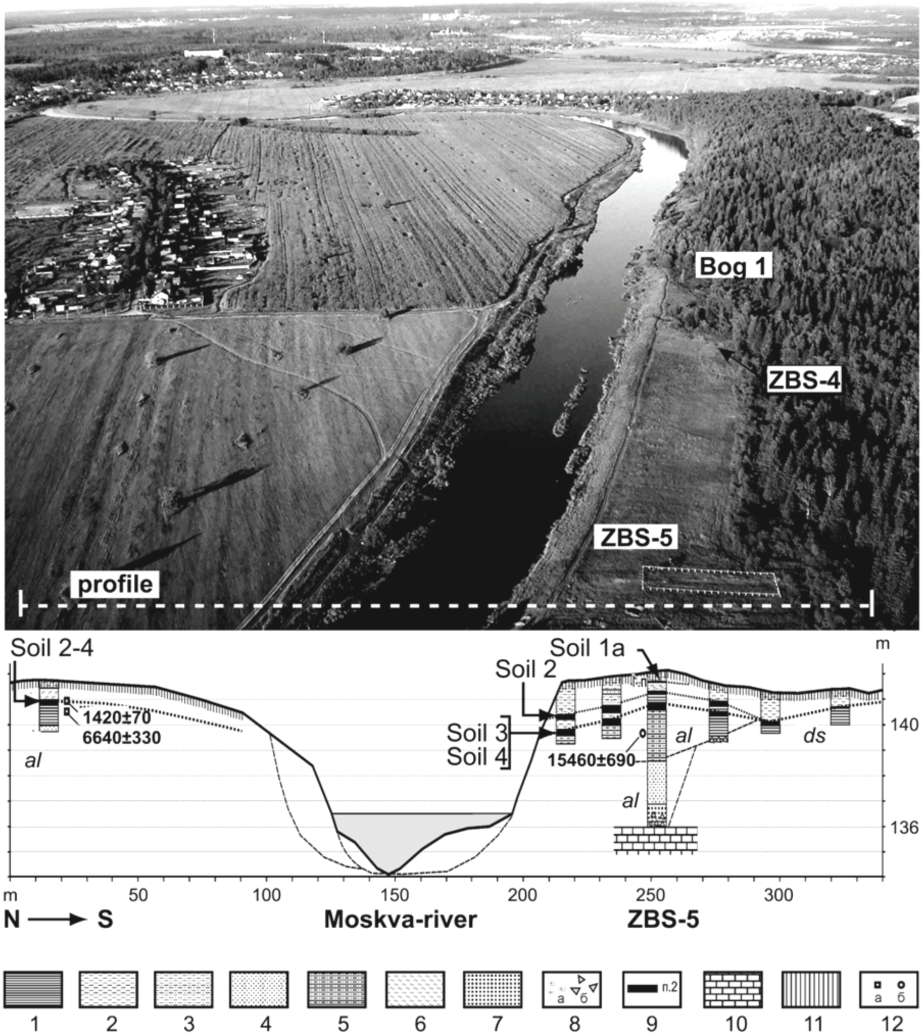

Fig. 2. The prospect of the floodplain of the Moskva-river (view from the west) near the Zvenigorod Biological Station (ZBS) with identification of archaeological sites and the geomorphological profile of the floodplain (Panin, 2013).

1 — heavy clay, loam; 2 — light loam, silt; 3 — sandy loam; 4 — sand; 5 — horizontal alternation of loam and sandy loam; 6 — horizontal alternation of sand and sandy loam; 7 — gravel; 8 — patches of sand and clastic inclusion; 9 — humus horizons of buried soils and their numbers; 10 — limestones; 11 — arable horison; 12 — dates (uncalibrated).

The Zvenigorod district is located within the spruce-broadleaf deciduous forest zone. Currently, a major portion of the forest has been cleared for development of fields and buildings. Most of the contemporary forests are secondary and are formed in place of logging and arable lands. The dominant species are spruce, pine and birch. On flat watersheds small bogs can be found. Forests on the slopes of the Moskva-river terrace differ from those on the watershed and are characterized by a large part of broad-leaved trees — lime, oak, maple. In the floodplain some areas of floodplain meadows, fens and forests of alder remain [10].

Material and methods. *Archaeology.* The search of archaeological sites in the valley was made considering the existing and hidden (buried) waterways, slight elevations formed on the place of ancient riverside shafts and alluvial fans of the ravines (fig. 3). The nature and dates of archaeological sites was determined by the composition of the finds and the features of their bedding. In particular, a conclusion was made about the character of the settlement: short-term, seasonal or permanent, depending on the set of the finds, the presence of hearths and traces of buildings.

Fig. 3. Archaeological excavations in the floodplain of the Moscva-river near Zvenigorod Biological Station

Radiocarbon dating was done in the University of Helsinki, Geological Institute RAS, University of Georgia, USA, Kiev laboratory. Calibration of dates was carried out with the OxCal calibration program v. 4.1.7 [17], updated with the recommended IntCal09 dataset [55] with a probability range of 95,4%.

Soils. By studying their morphology, soils were classified in to specific types, according to the existing classification. The landscape conditions of soil formation (forest, grassland or arable) were identified when it was possible [1]. The degree of soil development was also determined and, therefore, the duration of their formation and of pauses in the alluvium accumulation was also defined. A standard methodology for studying the surface and buried soil chronosequences was used [35]. In the field, morphological descriptions and the soil sampling were performed from archaeological pits. Soil analyses were performed by routine methods; the Corg content was determined by the Tyurin method (wet combustion, similar to the Walkley-Black method), the soil pH was measured with a potentiometer in the water soil suspension; the $CaCO_3$ content was determined by the acidimetric method (according to Kozlovskii), and the clay (< 0.001 mm) content was determined by the method in modification by Kachinskiy [32]. The ^{14}C age of humic acids was obtained using liquid scintillation counting. The names are given according to the WRB classification of soils [61].

Pollen. Palaeobotanical data was obtained from a series of profiles, placed in the floodplain alluvium, and in small peat bogs (до 50 m in diameter) on the slopes of the valley. The soil samples were treated with HCL, then KOH and were centrifuged in heavy liquid (CdJ+KJ); the peat samples were treated using the standard acetolise procedure [27; 53], pollen count was counted to 300—500 pollen grains per sample. Diagrams were constructed with TILIA and TILIA-GRAPH programs [30]. When interpreting the pollen data openness of the landscape was estimated by the ratio of trees and herbs pollen in the spectra. Signs of human activity were diagnosed by the presence of anthropogenic indicators in the spectra [12; 13; 19]. *Cerealia-type* pollen was defined by criterion proposed by Andersen [11] and Beug [14; 15].

Results. The sequence of buried soils in the alluvium near Zvenigorod is generally similar to the structure of floodplain deposits previously identified in the vicinity of the City of Moscow [8].

Soil 1. Modern floodplain surface (Soil 1), usually, is plowed up or passed the stage of cultivation in the recent past. Archaeological finds on the surface are usually not older than the end of the 18th century. At a depth of 0.5 m to 1.5 m (in the young areas of floodplain) underdeveloped Soil 1a were traced, which can not be clearly attributed. At this level archaeological finds were documented, including the settlement, dated 15th — first half of the 16th century by the ceramics. The pollen spectra of Soil 1 reflect the current state of the floodplain vegetation (fig. 4, LPZ4).

Soil 2. Buried Soil 2 is most widely represented in the floodplain; it lies usually at a depth of about 1 m from the current surface. The profile of this soil is always well identified as a forest profile in the areas of the floodplain made by loam. The eluvial (podzolic) horizon and the Bt horizon are up to 1—2 m in depth from the surface of the soil and are well traced there.

The youngest findings from the surface of the Soil 2 refer to the 14—15th centuries. Traces of plowing and dispersed ceramic shards typical for the fields and remote periphery of settlements have been found there. The remains of ancient settlements of the pre-Mongol age (12—13th centuries) are attributed to this soil. Finds of Iron Age, including its early phase, which have a radiocarbon dating about 2500 BP (cal 700 BC) were discovered at the bottom of the soil.

Pollen analysis of Soil 2 from most of the soil pits in the floodplain did not give reliable results due to the very low pollen concentration; with the exception of the excavation site RANIS. Pollen analysis of Soil 2 from this site shows the dominance of tree pollen (*Pinus, Picea*), but it shows also considerable percentage of meadow herbs, weeds and cultivated cereals, including rye (fig. 4, LPZ3).

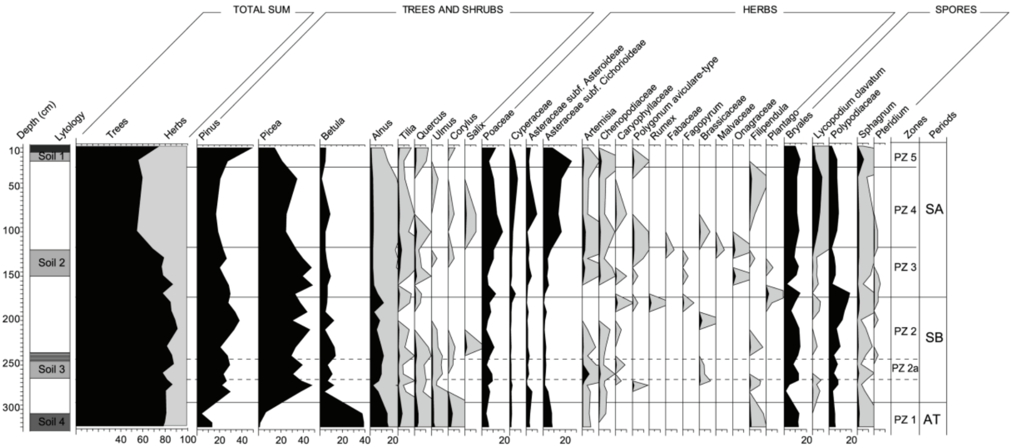

Fig. 4. Pollen diagram of the RANIS excavation pit (2005), modified after Spiridonova et al (2008).
Percentages of pollen are calculated from the total amount of pollen. Percentages of spores are calculated from the total amount of pollen and spores. Local pollen zones: LPZ1 — meadows and broadleaved trees (AT); LPZ2 — spruce forests (SB); LPZ3 — spruce forests, meadows and arable (SA); LPZ4 — meadows (16—19 centuries); LPZ5 — meadows (modern time)

The same results were obtained from floodplain pit bog near site ZBS. This indicates the deforestation of the floodplain, as well as the presence of arable land and meadows from at least the beginning of the 2nd millennium (early Middle Age) (fig. 5, 2).

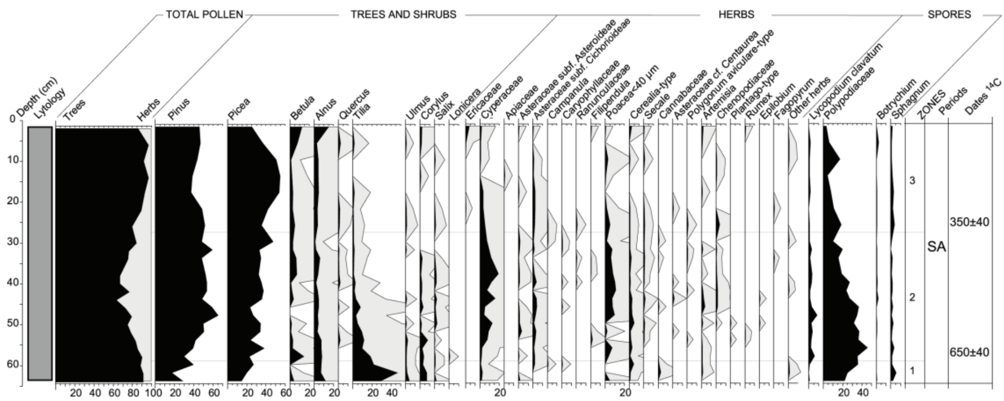

Fig. 5. Pollen diagram of peat bog (Bog-1).
Percentages of arboreal pollen are calculated from total arboreal pollen; percentages of herbs and spores are calculated from the total amount of pollen. Pollen zones: 1 — spruce forest in the floodplain and lime forest on the slope of the valley; 2 — forests, meadows, arable fields (11—14 centuries); III — restoration of spruce forest on the slope

Soil 3. Buried Soil 3, which lies at 0.5—1.0 m below the Soil 2, is traced in rare cases. The profile of this soil indicates its nondurable development. In some cases, the soil was defined as forest soil, in others — as meadow soil. The radiocarbon dates for soil humus cover the interval about 4400—4700 BP (cal 3000—3400 BC). These dates are much earlier than the dates of the soil 3 from Oka-river floodplain [4; 7].

Traces of seasonal settlements of local Cord ware culture (Fatyanovskaya) were found on the surface of the Soil 3 (RANIS-site) [46]. Their cultural layer was very thin (a few centimeters) and contained a small amount of flint debris and quite a large number of flint tools and pottery. Coal from these archaeological sites have been dated about 4000 BP (cal 2500 BC) in the three laboratories (University of Helsinki, Geological Institute RAS, University of Georgia, USA) and about 3600—3700 BP (cal 2000—2100 BC) in the Kiev laboratory [46; 47]. In one case, a fragment of pottery Abashevo culture succeeded Fatyanovo culture of the Bronze Age has been found at the site of the cone of the ravine in the rear part of the floodplain (object ZBS-4). It was found in a layer overlapping the soil 3. Radiocarbon dates of 3630—3650 years (cal 2000 BC) were obtained for coals accompanying this find [42]. For Abashevo culture there are only a few radiocarbon dates, including a series of dates around 3600 BP, obtained in the laboratory of the University of Helsinki [20]. Some signs of the arable horizon were also detected in the soil 3 during this excavation.

Pollen spectra of Soil 3 near ZBS contained mostly arboreal pollen (up to 95% of the total), with *Picea* absolutely dominated (up to 75%) (fig. 4, LPZ2). This data indicate that during the formation of this soil at least part of the floodplain of the Moskva-river was occupied with mixed coniferous-deciduous forests dominated by spruce. The pollen data from Soil 3 from the site ZBS–4 also shows some human disturbance of vegetation, such as partial deforestation of the floodplain. This is indicated by fluctuations in the trees/herbs ratio in the pollen spectra and by a significant amount of apophytes pollen (Asteraceae subf. Cichorioideae, *Chenopodium*) in the layers containing archaeological remains (Fatyanovo and Abashevo cultures) (fig. 4, LPZ2a). Single pollen grains of *Cerealia-type* and Cannabiaceae (*Cannabis-type*?) were also found in these layers, but insufficient quantity and poor preservation does not allow more accurate determination.

Soil 4. Buried Soil 4 lies at a depth 1.7—2 m from the current surface and is clearly distinguished from all overlying soils. This soil had a thick dark-colored humus horizon. It can be defined as Phaeozem, meadow. On the higher parts of floodplain (ancient levees) Soil 3 lies directly on soil 4. In other cases, they were divided up to 0,7 m fast accumulating alluvium. Radiocarbon dates 4900—6000 BP (cal 3700—4900 BC) were obtained for the buried Soil 4 (humus and carbonaceous residues of natural origin). The dates for this soil are also older than for the Oka-river floodplain [4; 7].

Finding of the long-term and short-term Neolithic sites (Lyalovskaya culture) are attributed to the surface of the Soil 4, which in some cases corresponds to the current level of the river. Dating 5370 BP was obtained from burned meal on the shard of the pot from the cultural layer (Krenke et al., 2012; Ershova et al., 2014). This dating corresponds well with dates from similar archaeological material for other sites [22; 62]. In areas where the Soil 4 was combined with Soil 3 (object ZBS–5) Neolithic finds and more recent Bronze Age objects were found on the same surface. These findings of the Corded Ware culture, probably, reflect the initial phase of colonization of the region by a new population, which already knew the productive forms of economy [44]. According to the Baltic analogies, the radiocarbon age of these monuments should be in the interval 4200—4000 BP (cal 2800—2500 BC).

Pollen data from the Soil 4 (1 Zvenigorod Neolithic site) showed that the vegetation of the Moskva-river valley was significantly different compared to later periods [25]. Arboreal pollen made only 30—40% of the total sum, with less then 3% of *Picea* pollen. This data indicate that during the period 6000—4900 BP (cal 4900—3700 BC) there were no conifers in the floodplain and on the watershed. Slopes and watersheds were covered with deciduous forests (*Quercus, Tilia, Ulmus*), while the low levels of the floodplain was dominated by open or semi-open landscapes: sparse riparian oak forests, thickets of shrubs (*Salix, Alnus*), wet meadows (Cyperaceae, *Filipendula*, *Urtica, Typha latypholia*) and, possibly, steppe grasslands (Poaceae, *Artemisia,* Asteraceae subf. Asteroideae, Asteraceae subf. Cichorioideae, Apiaceae, Fabaceae, Caryophyillaceae, Brassicaceae Ranunculaceae). The abundance of nutshells and pollen grains of hazel, as well as pollen of some apophytes (Plantago, Polygonum aviculare, Chenopodiaceae, Cichoriaceae, Onagraceae, *Lycopodium* and Hepaticae spores) in the Neolithic cultural layer could be an indication of partial deforestation and disturbance of vegetation near the settlement. Pollen grains, which by size and shape can be attributed to the group *Cerealia-type* were also found there. However, accurate determination of the pollen grains within the group *Cerealia-type*, as well as macrofossil analysis of the cultural layer, was not held. A significant presence of *Artemisia* pollen (up to 15%) was recorded in all pollen spectra of buried Chernozems and Phaeozems of the Atlantic age, including ZBS and RANIS (fig. 4, LPZ1) [58]. Therefore, we interpret *Artemisia* in this case to be not an indicator of the Neolithic settlements, but rather an indicator of open steppe communities.

Discussion. The results suggest contrasting changes in the landscape and vegetation at lower levels of the Moskva-river valley range from the Atlantic to the sub-Atlantic periods (fig. 6). The results obtained by different methods are somewhat controversial, as well as our data and the previously existing views.

Atlantic period (8000—4500 BP). According to soil diagnosis, flood activity of the Moskva-river in the Atlantic period was low, and Chernozem and Phaeozem soils was formed on the surface of the floodplain [2; 8]. Pollen analysis of Soil 4 also indicates the openness of the landscape and the spread of meadow-steppe communities in the floodplain but, nevertheless, shows the presence of deciduous forests in the floodplain and adjacent slopes of the valley. This data provides evidence that the boundary between the forest and steppe zones may have lain much farther north in the Atlantic period than had been previously believed. Palaebotanical data suggests also noticeable human impact on the vegetation in the area of permanent settlements, such as the 1st Zvenigorod Neolithic site. The finding of Poaceae pollen grains, which, according to their size, can be attributed to *Cerealia-type*, makes it important to conduct detailed studies using all available methods for determining when the agricultural development of the valley began. Previously, the idea of early farming in the area of the Volga-Oka interfluve in the Neolith was rejected by archaeologists. At the same time, a number of palynological studies in the forest zone of Central Russia show some signs of early farming [33; 38; 49; 50]. This data exhibits many similarities with the analogous data for a number of Neolithic settlements in Europe, for which the presence of the agriculture is either shown or actively discussed [18; 54; 60].

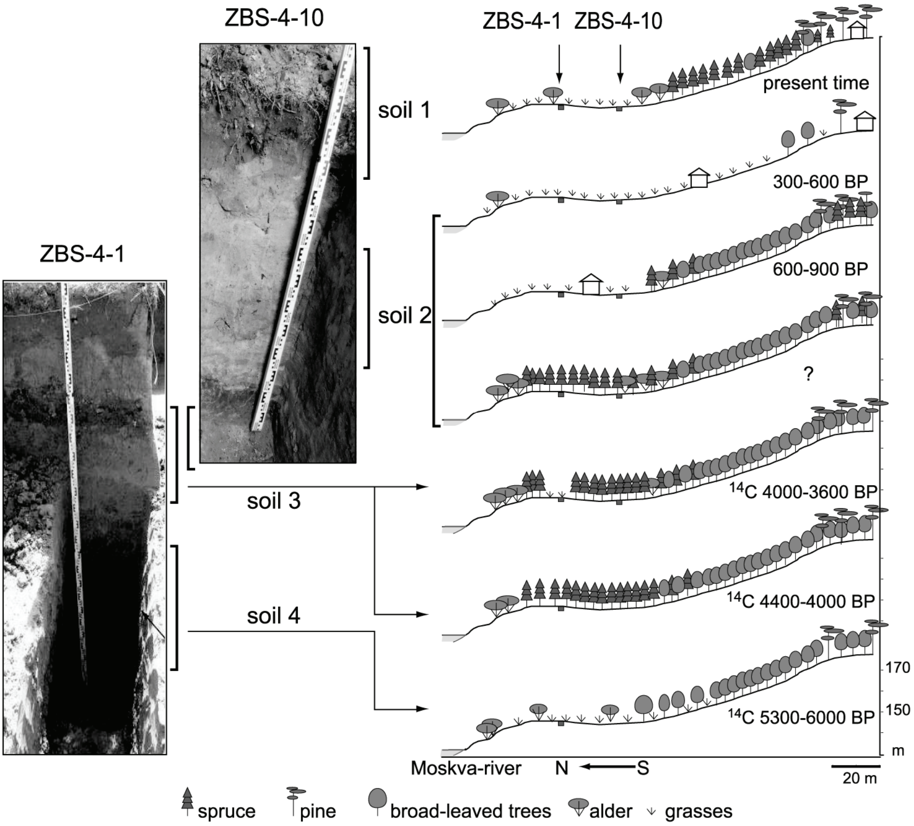

Fig. 6. Photographs of excavation pits in the floodplain of the Moskva-river near site ZBS–4 with buried soils (left) and a schematical reconstruction of the landscape evolution in the valley. Radiocarbon dates are uncalibrated

Subboreal period (4500—2500 BP). The obtained data on Bronze Age monuments indicate that the process of colonization of the territory by the Corded Ware tribes was somewhat earlier and more complex than previously thought. By the beginning of this colonization the vegetation of the lower levels of the valley has changed dramatically compared to the previous stage as a result of transformations caused by climate. The pollen data shows that from 4500 cal BP the floodplain of the Moskva-river was occupied, at least partially, with mixed coniferous-deciduous forests dominated by spruce. The same results were obtained for RANIS [58]. Pollen and radiocarbon data from both sites indicate the wide distribution of spruce in the low levels of the Moskva-river valley between 5000 and 4500 cal BP. We assume that this abrupt landscape transformation was a result of the early Subboreal climate cooling [8]. During this period, rapid expansion of spruce is also observed in the northern regions [49]. However, spruce pollen is virtually absent in the peat deposits of the same age on the higher levels of the Moskva-river valley [26]. It is possible that spruce forests colonized only the lower level of the floodplain in this period. The pollen data from Soils 3 in the sites ZBS–4 and RANIS [58] also shows some human disturbance of vegetation, such as partial deforestation of the floodplain. Single and corrupted *Cerealia-type* and *Cannabis-type* pollen grains were also found in the Fatyanovo cultural layers from both archaeological sites [43; 58]. Given the signs of plowing discovered in the Soil 3 (ZBS–4), we can not exclude the possibility of the presence of primitive agriculture. At the same time, the available data does not allow us to consider the Moskva-river valley as a major area of concentration of economic and settlement activities of the Bronze Age people. The pollen data and the nature of settlement sites show that the settlements were obviously short-term and economically specialized.

Sub-Atlantic period (2500—0 BP). Some contradictions between archaeological and palynological data, on one hand, and the soil on the other hand are observed for the Iron Age — early medieval period, which corresponds to the horizon of buried Soil 2 in the floodplain. The buried Soil 2 is confidently defined as forest according to soil diagnosis. Thick and well structured illuvial (argillic) Bt horizon indicates that the forest stage of soil development was durable. However, the eluvial horizon (E) of this soil is missing or poorly expressed, it dyed gray with humus from well-developed horizon A. This probably reflects the replacement of floodplain forests by meadows. At the same time, archaeological evidence suggests a very dense population in the river valley. Numerous stationary settlements of people engaged in agriculture and animal husbandry were formed in the valley of the Moskva-river from the early Iron Age. The intervals between these settlements are often less than five kilometers [39—41]. Pollen diagrams of the cultural layers of the Iron Age sites in Moscow [40] and floodplain pit bogs also show significant deforestation and anthropogenic transformation of landscapes. We assume that pollen spectra obtained from the Soil 2 may reflect only the late stages of the soil formation. Evidently the floodplain vegetation was already significantly transformed by man at that time. The important task for future research is to clarify the time of formation of a permanent anthropogenic landscape in the Moskva-river valley during the Sub-Atlantic period.

Current time (the last 4 centuries). The processes of the alluvium accumulation significantly increased during the last millennium. The underdeveloped soils with humus horizons of up to 10 cm are often found in this young alluvium. They were formed during the short breaks in the sedimentation. The changes in the hydrological regime of the river associated with climatic variations and human activities could be responsible for their formation. The deforestation and plowing of large areas, especially in the 18—19th centuries, caused high and intensive floods of the Moskva-river and its tributaries, and the increased erosion of slopes. In Siberia, where development and distribution of plowing became significant only in the end of 19—20th centuries, the erosion and alluvium accumulation began only in the 20th century, which is much later than in the European part of Russia. Therefore, there are reasons to believe that the formation of the Soil 1a in the floodplain of the Moskva-river was caused by the abandonment of the territory in the Time of Troubles (16—17th centuries). It can be especially noticed in the floodplain of Istra River, the left tributary of the Moskva-river. The population remained low there for a long time and recovered only at the end the 17th century. Then, in the 18—19th centuries plowing up of the territory reached a maximum. This was the cause of the rapid accumulation of the alluvium layers, which is often more than 2 m above the surface of the 17th century [23].

At the same time, some authors (A.V. Panin, S.A. Sycheva, personal communication) believe that the main factors of formation of soils in the last centuries are natural — climate-driven changes in the hydrology. During the last centuries Little Ice Age continued. A lot of snow is accumulated during the long winter, the soil freezes deeply, and the runoff is mostly superficial. All this reinforced the removal of the solid material from the slopes, which intensified the accumulation of the alluvium in the flood plain.

It should also be noted that some researchers do not support the idea of the synchronous (climate-caused) formation of buried soils in the floodplains of different river valleys [48].

Conclusions. Floodplain deposits in the valley of the Moskva-river contain a series of buried soils of Holocene age, which can be an important source of palaeoecological information and promising for archaeological research.

The revitalization of the flood regime of the river, which led to the formation of alluvium, which covered the buried soils, refers to the time range with the radiocarbon age 4900—4400, 4000—2500, 700—0 (cal 3700—3000 BC, 2500—700 BC, 1300—2000 AD).

It was found that meadow-steppe Chernozem soils (buried Soil 4) were common in the floodplain of the Moscow-river in the Atlantic period. Forest-steppe communities dominated the valley vegetation, human disturbance can be traced near the archaeological sites (Lyalovskaya Culture Neolithic sites).

Meadow and forest weakly podzolic soils relating to the Subboreal period (Soil 3) were found in the floodplain; pollen data indicate that the floodplain was colonized by spruce in this period. Some antropogenic changes of the vegetation associated with the activity of different groups of the Corded Ware culture were noted.

At the turn of the Subboreal and Subatlantic periods the floodplain surface was permanently stabilized. Podzolic soils with well-developed profile (Soil 2) were formed under spruce forests. The human impact on the landscape significantly enhanced, the formation of agricultural landscapes began. In the Middle ages there was a system of settlements and agricultural areas that occupied the floodplain and the first terrace.

Due to historical and climatic causes the number of settlements in the lower levels of the valley decreased during 16—19th centuries, forests were partially recovered. But most of the floodplain remained open and economically used.

Some issues remain unresolved. The duration of the formation of soils and layers of alluvium is not clear. Presumably, the periods of soil formation were longer than the periods of alluvium accumulation. Despite the large number of radiocarbon dates, it is not clear how synchronously the formation of soils was in different river systems (e.g. Oka and Moscow River). The cause of flood regime change and the formation of the buried soils 1a in the last centuries also remain unclear.

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ПАЛЕОЭКОЛОГИЯ ПОЙМЫ МОСКВЫ-РЕКИ В ГОЛОЦЕНЕ: ПОЧВЕННЫЕ, ПЫЛЬЦЕВЫЕ И АРХЕОЛОГИЧЕСКИЕ ДАННЫЕ

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Пойменные отложения в долине Москвы-реки содержат серию погребенных почв голоценового возраста, которые являются важным источником палеоэкологической информации. Согласно радиоуглеродным датировкам, почва 1 имеет возраст 100—400 лет, почва 2 — кал. 1200 AD-500 BC, почва 3 — 900—2700 BC, почва 4 — 3500—5000 BC. К погребенным почвам приурочены археологические памятники: неолитические (почва 4), бронзового века (почва 3), РЖВ и Средних веков (почва 2). Погребенные почвы часто имеют хорошо развитый профиль и диагностические признаки. Почвы субатлантического возраста (почва 2) обычно относятся к серым лесным и подзолистым. Темноцветные почвы атлантического возраста (почва 4) в большинстве случаев относятся к черноземам; спорово-пыльцевой анализ показал, что они формировались под лесостепными сообществами. В отличие от них, погребенные почвы суббореального периода (почва 3) встречаются не везде и не имеют хорошо выраженных диагностических признаков; пыльцевые данные показали, что они могли формироваться под смешанными лесами с доминированием ели. Резкое изменение ландшафтов поймы, смена лесостепных сообществ еловыми лесами, произошло, согласно радиоуглеродному датированию, в период 5000—4500 лет назад, в результате раннесуббореального похолодания. Почвенные и пыльцевые данные свидетельствуют о некоторых антропогенных изменениях растительности поймы в эпохи неолита, бронзового и железного веков. Однако максимальная антропогенная трансформация ландшафтов отмечается с начала Средневековья.

Ключевые слова: голоцен, неолит, бронзовый век, погребенные почвы, пойменные отложения, спорово-пыльцевой анализ, реконструкция ландшафтов.