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# The European small mammal faunas related to the first half of the Middle Pleistocene

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## ABSTRACT

By now the abundant European small mammal data have been collected from the deposits of the first part of the Middle Pleistocene (MIS 18 – MIS 11). The significant number of global climatic events (glaciations and interglacials) corresponds to this period. We analyzed the evolutionary changes of small mammals of the Middle Pleistocene, revealed the reactions of small mammals on the different climatic events (glaciations, interglacials) and correlated the Western and the Eastern European faunas. The collected data also help us to divide the geological deposits age and permit to reconstruct the palaeogeographic picture of the past. The obtained results may serve as an important component for compiling biostratigraphic schemes of the Middle Pleistocene and the Pleistocene in general.

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## 1. Introduction

Problems of evolution of the Middle Pleistocene small mammals and the synchronization of the principal stages of their evolution with geological and climatic events are widely discussed in the scientific literature. In a previous publication (Markova, 2014a,b) we analyzed the main stages of European small mammal faunas changes referring to the period from the Jaramillo paleomagnetic event (the second part of the Early Pleistocene 1.07–0.99 Ma, ~MIS 26–30) to the beginning of the Middle Pleistocene (the first part of the Ilyinian interglacial, interglacial Cromer II of Western Europe), until the beginning of MIS 18. In this paper, we would like to focus on the evolutionary changes of small mammals of the Middle Pleistocene during the period from 0.761 Ma to 0.424 (Lisiecki and Raymo, 2005), from the middle part of the Ilyinian interglacial (MIS 18) to the beginning of the Likhvinian (Holsteinian) interglacial (MIS 11). A significant number of global climatic events, glaciations and interglacials, corresponds to this period. Revealing the reactions of small mammal faunas to the different climatic situations is one of the tasks of this paper. Synchronization of the faunas of Eastern and Western Europe, widely discussed by specialists in palaeontology and geology, is a serious problem. Opinions on some items still differ. Thus, the reasons for the appearance of some taxa at different times in Western and Eastern Europe are not clear;

synchronization of the number of stratigraphic horizons is not specified. These items will be also considered in this publication.

## 2. Time intervals

The present paper gives the analysis of the faunas referring to five major climatic events. The oldest complex, in homogenous in climatic conditions is Ilyinian interglacial (MIS 18 and 17), that apparently includes the glacial A of the Cromerian complex and interglacial Cromer II. The second complex is the Donian glaciation (MIS16) = glaciation B of the Cromerian complex. The next one is the Muchkapien interglacial complex = Cromer III. The Muchkapien interglacial stage (by the data from Eastern Europe) includes Glazov and Konakhov warm phases and the cool interval (Podrudnyansky) separating them (MIS 15). The Navlinian cooling (MIS 14) and the later Ikoretskian warming (MIS13) follow it. The Navlinian cooling probably corresponds to the cooling (glaciation) C of the Cromerian complex, the Ikoretskian interglacial corresponds to Cromer IV (MIS 13) and the Okian glaciation to Anglian glaciation = Elsterian glaciation (MIS 12) (Shik, 2014). The durations of these intervals are given according to Lisiecki and Raymo (2005). In this paper for the materials from Eastern Europe, the authors follow the last stratigraphic scheme, proposed by Shik (2014). This scheme differs from the previously published stratigraphic scheme of the Quaternary in the European Russia (Borisov, 2010), which does not contain the interval of the Ikoretskian interglacial and the preceding cooling. The West European stratigraphic subdivisions are given according to Gibbard et al. (2004).

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Faunas, referring to most of these intervals, beginning from the oldest, will be considered in this publication.

### 3. Fauna of small mammals

#### 3.1. Faunas of the Ilyinian interglacial of Eastern Europe – the glaciation A of the Cromerian complex and Cromer II of Western Europe (~0.780 Ma – 0.676 Ma, MIS 18, 17)

##### 3.1.1. Eastern Europe

Faunas of the complicated Ilyinian interglacial, during which the Ilyinian paleosol complex was formed, are attributed to the beginning of the considered period (Velichko et al., 1992; Shik, 2014).

**3.1.1.1. First part of Cromer II.** In deposits of the Ilyinka locality (Kalach district of Voronezh region, 51° 15' 17.87"N, 40° 50' 49.37"E) a number of faunas of small mammals was found. These faunas slightly differ in the evolutionary level, but can be correlated with different phases of the Tiraspolian mammal age (Agadjanian, 2009). The deposits of the Donian till and the underlying thick sequence of alluvial deposits with four sites of small mammals (Ilyinka 6, Ilyinka 5, Ilyinka 4, and Ilyinka 2) are exposed in this section. This alluvial sequence was called Ilyinian (Krasnenkov et al., 1984) (Figs. 1 and 2).

The fauna of the lower fossil-bearing layer (Ilyinka 6) was described (Markova, 2014a,b) and includes according to the data of A.K. Agadjanian such species as *Mimomys pusillus* (89), *M. ex gr. reidi* (3), *Mimomys intermedius* (=savini) (18), *Prolagurus pannonicus* (15), *P. posterius* (12), *Eolagurus argyropuloi* (1), *E. simplicidens* (1), *Microtus (Stenocranius) hintoni* (12), *M. (Terricola) arvalidens* (1), and *M. cf. hyperboreus* (4) (Agadjanian, 2009). The presence of such species as *P. posterius* and *Microtus cf. hyperboreus* along with rhizodont voles of *Mimomys* genera (prevalence of *M. pusillus* fossils was noted in the locality) and steppe lemmings *P. pannonicus*, indicates the Early Tiraspolian age of the fauna. The fauna is correlated with the lower layer of the Ilyinian paleosol complex and the first phase of the Ilyinian interglacial (Shik, 2014) (Figs. 1–3).

The appearance of “transiens” morphotypes of steppe lemmings and the remains of *M. (Stenocranius) gregaloides* and *M. oeconomus* are noted in overlying layers of the Ilyinka section, evidence of their advanced character. However, all these sites (Ilyinka 5, 4 and 2) also undoubtedly contain the remains of species redeposited from more ancient deposits (*Allophaiomys pliocaenicus*, *Prolagurus praepannonicus* = *ternopolitanus*) (Agadjanian, 2009). Probably, faunas of Ilyinka 5, 4 and 2 should be correlated with faunas of the first part of Cromer II of Western Europe.

The Veret'e locality (Ostrogozh district of Voronezh region, the basin of the Olshanka river, 50° 46' 48.26"N, 38° 53' 05.69"E) has alluvial deposits, underlying the strata of the Donian till and Donian fluvio-glacial deposits, and also fossil soils under them (Krasnenkov et al., 1984). This fauna by its evolutionary level is similar to the fauna from the upper layers of the Ilyinka (Agadjanian, 2009). It also contains the remains of such typical species as *Microtus (Stenocranius) ex gr. hintoni-gregaloides*, *M. oeconomus*, *M. cf. hyperboreus* and *Lagurus cf. transiens*. Rhizodont voles *Mimomys pusillus* dominate the fauna. By its species composition, the Veret'e fauna may be attributed to Cromer II.

The Zaplatino locality (right bank of the Oka river, 2 km from the Pavlovsk town and 1.5 km from the Zaplatino village at Pavlov district of Nizhny Novgorod region, 55° 56' 31"N, 43° 00' 34" E) fauna includes *Mimomys pusillus* (57), *Prolagurus cf. pannonicus* (3), *Dicrostonyx simplicior okaensis* (4), *Lemmus cf. sibiricus* (7), *Microtus (Stenocranius) hintoni-gregaloides* (36), *Microtus oeconomus* (31), *M. hyperboreus* (32) and others (Agadjanian, 2009). A. Agadjanian with

caution attributes this fauna to one of the cold epochs of the Early Neopleistocene (=Middle Pleistocene).

This fauna by its evolutionary level is similar to Ilyinka 6 and, to all appearances, is older than the faunas of Veret'e and Ilyinka 5, 4, 2. Probably, it corresponds to the Pokrovian horizon (Shik, 2014), that is expressed in Eastern Europe by a loess layer and is attributed to the very beginning of the Brunhes epoch.

#### 3.2. Younger faunas of the Ilyinian interglacial (=second part of Cromer II) (MIS 17) (~0.712–0.676 Ma)

##### 3.2.1. Eastern Europe

The Klepki locality (Voronezh region, ~50° 30'N, 40 04'E) was discovered by V.P. Udartsev on the right bank of the Osered' river, 30 km upstream from Pavlovsk (Udartsev et al., 1979). The locality was found in alluvium overlapped by fluvio-glacial deposits and the Donian till. The loess-soil sequence lies above the till.

The fauna includes *Mimomys savini* (10), *Lagurus posterius* (7), *Lagurus transiens* (2), *Eolagurus cf. simplicidens* (1), *Microtus (Stenocranius) hintoni* (7), *M. (S) ex gr. gregaloides-gregalis* (2), *Microtus (Terricola) arvalidens* (1), *M.(M.) arvalinus* (6), *Microtus oeconomus* (2) and others (Markova, 1982, 1992). This fauna is younger than faunas of Ilyinka and Veret'e, because remains of *Mimomys pusillus* were not found in it, and a number of remains of *Stenocranius* subgenus have advanced character, resembling *M. gregalis* (Markova, 1982). The loess-soil sequence located under the till in the Veret'e section, is absent in the Klepki.

The unique section of Kolkotova Balka (Moldova, Tiraspol, Transdnestrria, 46° 51'N, 29° 38'E) includes 5 mammal localities. The three lowest are confined to alluvial deposits of the Kolkotova terrace of the Dniester. The rich fauna of large and small mammal fauna from the alluvial deposits of this Dniester terrace was attributed to the Tiraspolian mammal age (Tchepalyga, 1967; Nikiforova et al., 1971; Aleksandrova, 1976; Mikhailetsku and Markova, 1992; Markova, 1998).

Faunas of small mammals from different alluvial facies of the Kolkotova terrace are similar in evolutionary level and include *Mimomys savini*, *Prolagurus posterius* – *Lagurus transiens*, *Microtus (Stenocranius) hintoni-gregaloides*, *Microtus (Terricola) arvalidens*, *Microtus arvalinus*, *Microtus ratticepoides* (= *M. oeconomus*) (Aleksandrova, 1976). These faunas are related to the second part of Ilyinian interglacial, confirmed by the thick and full loess-soil strata with well-presented Voronian (the Muchkapian interglacial), Inzhavinian (the Likhvinian interglacial), Kamenkian (the Kamenkian interglacial), Romnian (the Romnian warming), Mezinian (the Mikulinian interglacial) paleosols lying above the alluvial sequence (Dodonov et al., 2006). Fauna of small mammals has been recovered from the Voronian and the Inzhavinian soils (Markova, 2007). Freshwater molluscs *Viviparus tiraspolitanus*, *Crassiana crassa* and others have been found in the alluvial deposits (Tchepalyga, 1967; Mikhailetsku and Markova, 1992). Molluscs of the Chaudian complex: *Tschaudia tschaudae*, *Didacna cf. pseudocrassa*, *Monodacna subcolorata* have been found also in the liman deposits of the 6th terrace of the Danube and the Prut, synchronous to the Kolkotova terrace (Mikhailetsku, 1989).

The Kolkotova Balka section is in the zone of the direct polarity Brunhes. The fauna from the alluvium deposits of this section is not the oldest of the faunas of Eastern Europe, corresponding to the Tiraspolian mammal age. It may be correlated with the faunas from the upper half of the Ilyinian interglacial and the second part of the Cromer II interglacial.

The Levada locality is located on the Dniester Kolkotova terrace, 30 km to the east from Tiraspol, Transdnestrria, Moldova. The thick loess-soil sequence with the Voronian, Inzhavian, Kamenkian and Romnian fossil soils has been observed in this locality (Tchepalyga

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