Acta zool. cracov., **39**(1): 311-319, Kraków, 15 Aug., 1995

Late Middle Pleistocene small mammal faunas from the Russian Plain and their analogs from western Europe

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Accepted for publication: 5 May, 1995

MARKOVA A. 1996. Late Middle Pleistocene small mammal faunas from the Russian Plain and their analogs from western Europe. Acta zool. cracov., **39**(1): 311-319.

Abstract. A more complex sequence of natural events and small mammal faunas is known from eastern Europe during the late Middle Pleistocene than from western Europe. The interval between the Likhvin (Holstein) Interglacial and the Dniepr (Saalian) Glaciation include a further two climatic cycles as compared to the western European sequence. Sediments of most of these cycles contain small mammal localities. The most secure correlation is between the Likhvinian and Holsteinian micromammalian faunas.

Key words: Late Middle Pleistocene, Likhvin Interglacial, Dniepr glacial, Russian Plain, small mammals.

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I. INTRODUCTION

According to the stratigraphic scheme of central eastern Europe, the Middle Pleistocene encompasses the period from the beginning of the Likhvin Interglacial to the end of the Dniepr (Moscow) Glacial (BRESLAV et al. 1992). On the Russian Plain a complex subaerial (loess and soil) sequence is synchronous with this interval. It includes four levels of soil formation (both of interglacial and interstadial time) and four loess horizons (VELICHKO et al. 1992) (Fig. 1).

Western European stratigraphic schemes show the beginning of the Middle Pleistocene to be much earlier, with the boundary drawn at the base of what is regarded as the Early Pleistocene complex of east European schemes, while the interval from the Likhvin (Holstein) Interglacial to the Dniepr (Saale) Glacial is correlated with the second half of the Middle Pleistocene (late Middle Pleistocene): the Toringian stage and *Arvicola cantiana* biozone (FEJFAR & HEINRICH 1981) and the zone *Arvicola* faunas, Type 2 (KOENIGSWALD 1973).

Material from eastern Europe suggests a far more complex history of environmental change during the Middle Pleistocene than that established for western Europe. Thus, data from western Europe record but one interglacial warming within this interval and one long and complex Saalian glacial epoch including two interstadials (ZAGWIJN 1985). Small mammal faunas from the early Middle Pleistocene (different intervals within the Cromer complex, including Cromer IV) are more comprehensively represented in western Europe (KOENIGSWALD 1973; SUTCLIFFE & KOWALSKI 1976; CHALINE 1977; STUART 1982; KOLFSCHOTEN & MEULEN 1986; CURRANT 1989; KOENIGSWALD & TOBIEN 1990; GIBBARD et al. 1992).

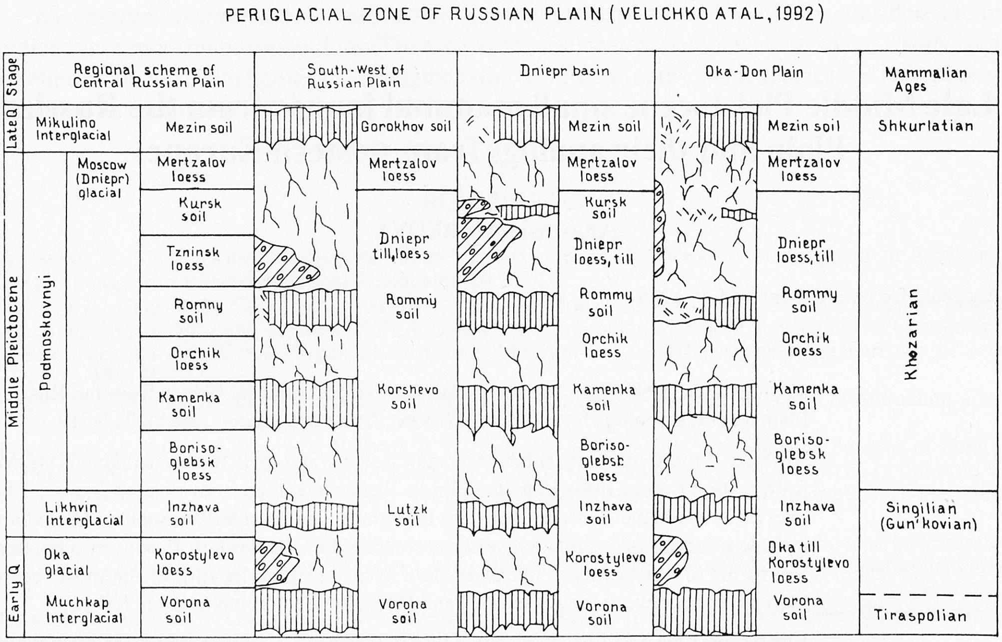

Fig. 1. Chronostratigraphy and mammalian ages of the late Middle Pleistocene in eastern Europe (after VELICHKO et al. 1992).

A c k n o w l e d g m e n t s. This project was supported by International Science Foundation Grants No MFH000 and No MFH300 and by Grant of Russian Foundation of Fundamental Studies No 95-04-11964a.

II. MATERIAL

Long term integrated studies of Quaternary deposits in the periglacial zone of the Russian Plain have led to the identification of repeated alternations of interglacial and glacial (periglacial) environments in the late Middle Pleistocene. In the course of tracing distinct stratigraphic horizons of loess from north to south (from the latitude of Roslavl to the northern coast of the Black Sea), three fossil soils (Inzhavino-Likhvin, Kamenka and Romny) and two loess horizons were found to occur between the Oka (=Elster) till (or loess) and Dniepr (=Saale) till (loess) (VELICHKO et al. 1992) (Fig. 2).

Another way of looking at this sequence is represented by KRASNENKOV & KAZANTZEVA (1993) who consider all of the Middle Pleistocene sequence above the Likhvin layers to belong to the Great Dniepr glaciation. This opinion is, however, inconsistent with a variety of palynological and paleopedological evidence from sections across the Russian Plain that strongly suggests that the Kamenka and Romny soils were formed in interglacial environments (VELICHKO et al. 1992; ZELIKSON personal communication). Small mammal remains recovered from the fossil soils and

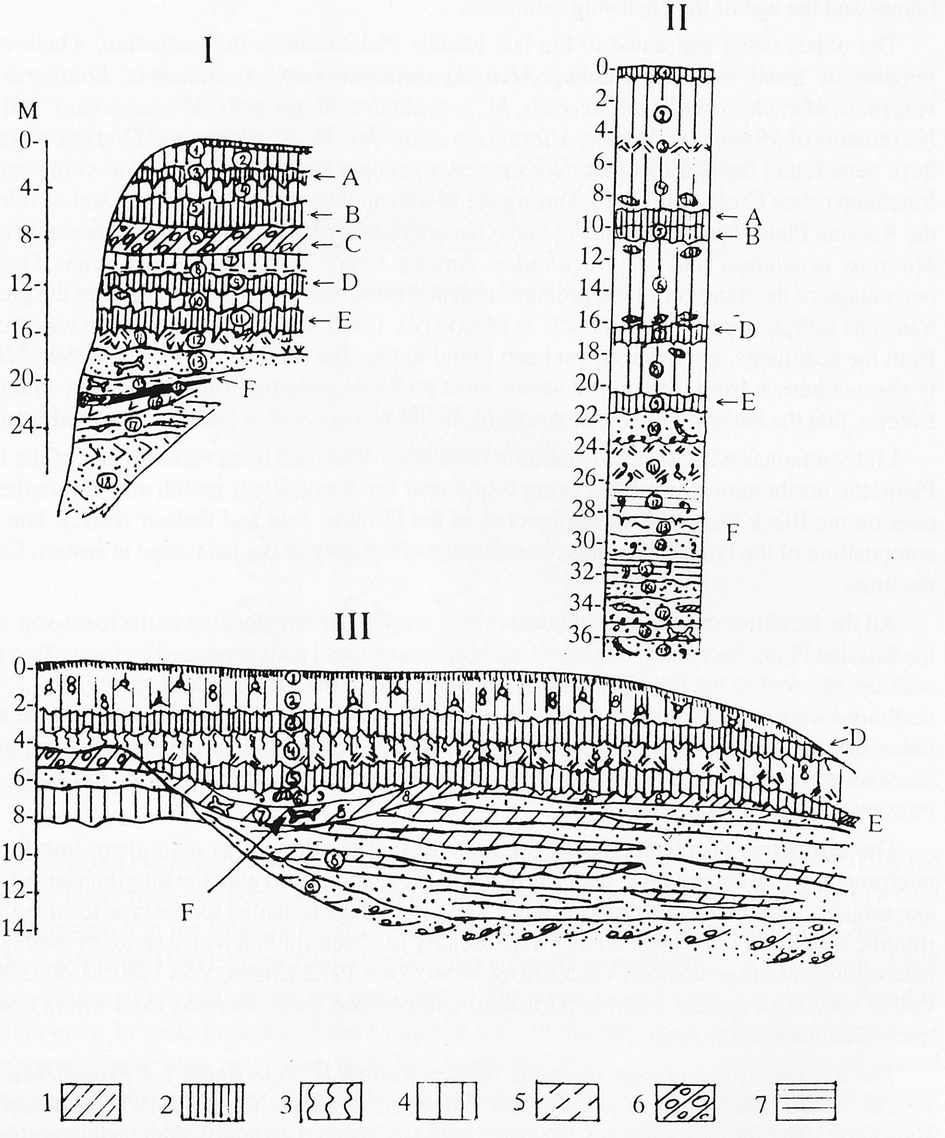

Fig. 2. Late Middle Pleistocene sections of the Russian Plain with small mammal localities: I – Gunki (Dniepr basin); II – Ozernoe (Danube basin); III – Verkhnaya Emancha (Don basin); 1 – loam; 2 – fossil soils (humus horizon); 3 – fossil soils (B horizon); 4 – loess; 5 – subaqueous loam; 6 – till; 7 – clay; 8 – sand; 9 – sapropel; 10 – ferruginous concretions; 11 – gleyization; 12 – carbonates (beloglazka); 13 – mole-courses; 14 – gravel; 15 – powder carbonates; 16 – marl; 17 – layer numbers; 18 – mollusks; 19 – large mammal remains; 20 – small mammal remains; A – Briansk fossil soil; B – Mezin fossil soil; C – Dniepr till; D – Romny fossil soil; E – Kamenka fossil soil; F – Likhvin deposits. (After UDARTZEV 1980; VELICHKO 1980; MARKOVA & MIKHAILESKU 1994).

synchronous alluvial and liman facies provide information on both the species composition of the faunas and the age of the enclosing sediments.

The oldest fossil soil dated to the late Middle Pleistocene is the Inzhavino, which contains remains of fossil rodents including *Arvicola cantiana*, *Lagurus transiens*, *Eolagurus luteus volgensis*, *Microtus arvalis*, *M. agrestis*, *M. gregaloides*, *M. gregalis*, *M. oeconomus*, and others. No remains of *Mimomys, Pliomys, Microtus gregaloides, M. arvalidens* and *Drepanosorex savini* have been found there, a fact that may suggest a younger age of these faunas as compared to the Muchkap (=late Cromerian) ones. During the Muchkap interglacial the Vorona soil developed on the Russian Plain. Faunas of this time are characterised by the continuous presence of *Mimomys, Microtus arvalidens* and *M. gregaloides*. Among steppe lemmings of the genus *Lagurus*, a percentage of the more primitive prolagurus dental morphotype was found, besides the prevailing transiens morphotype (MIKHAILESCU & MARKOVA 1992). No *Arvicola cantiana* was recovered from the sediments, nor has it as yet been found in the Oka (=Elster) layers. However, *Mimomys* is also not known from the latter. It seems most probable, judging from correlations with western Europe, that the earliest remains of *Arvicola* should be expected in late Muchkap sediments.

Likhvin faunas with *Arvicola cantiana* have been described from various parts of the Russian Plain, the northernmost localities being found near the Kama River mouth and the southernmost ones on the Black Sea coast (lower reaches of the Danube, Prut and Dniestr rivers). The species composition of the faunas indicates the existence of zonality of the landscape in eastern Europe at the time.

All the localities of the Likhvin faunas show a characteristic position in the loess-soil series of the Russian Plain: they are overlain by four horizons of fossil soils separated by loess. Two of these soils are referred to the Late Pleistocene the other two to the Middle Pleistocene (Figs. 1, 2). The northern locations also contain a horizon of the Dniepr (Saale) till. In the southernmost sections (near the Black Sea) the micromammalian remains occur in liman sediments together with brackish-water mollusks. This allows us to correlate these sediments with the early Euxine transgression of the Black Sea.

The distinctive characteristics of the Likhvin faunas allow us to unite them into the Gunki micromammalian assemblage, which is presumably synchronous with the Singilian large mammal assemblage described by GROMOV (1948). The assemblage is named for the type locality of Gunki (middle reaches of the Dniepr River). This locality has been studied with a series of methods, both paleontological and geological (VELICHKO & MOROZOVA 1972; CHEPALYGA 1980; MARKOVA 1982). Pollen spectra of typical Likhvin (Holstein) composition were obtained from layers containing micromammals (GUBONINA 1975).

The localities most closely resemble Neede, Karlich H, Petersbuch I, Bilzingsleben, Swanscombe, Kent, Clacton, Essex, and Orgnac 3 of western Europe (CHALINE 1977; CURRANT 1989; HEINRICH 1990; KOENIGSWALD & TOBIEN 1990; KOLFSCHOTEN 1990), which are correlated with the Holstein Interglacial on the basis of pollen data. The localities contain remains of *Arvicola cantiana* (*A. terrestris cantiana*, after KOLFSCHOTEN), *Sorex* cf. *araneus*, *Microtus agrestis*, and *M. arvalis*.

The species composition in the east European Gunki faunas is similar to that of the Holsteinian faunas of western Europe. The differences seen are mainly the result of the geographic positions of the respective sites, which accounts for the abundance of steppe species of small mammals, including steppe lemmings, in the east European faunas (Fig. 3).

In western Europe, Holsteinian sediments are immediately overlain by sediments of the Gross Saale. Therefore, a considerable interval is lacking in this region while it is well documented in the periglacial series of eastern Europe. Naturally, no faunas of this age are known in western Europe.

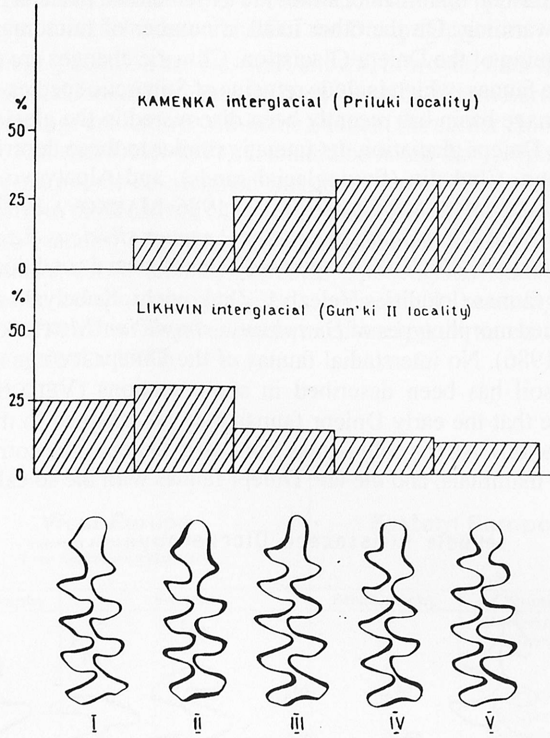

Fig. 3. The main molar morphotypes of late Middle Pleistocene *Lagurus* from the Likhvin and Kamenka interglacials.

On the Russian Plain, micromammalian faunas have been recovered from layers overlying the Likhvin: the fauna from the Topka locality in the Don drainage basin is likely to belong to a cold interval represented in the Russian Plain sequence by the Borisoglebsk loess horizon (KRASNENKOV & KAZANTZEVA 1993). In the Topka fauna water voles are represented by *A. chosarica*, while the *Pitymys* form of microtines has not been found. The fauna is undoubtedly younger than the Likhvinian ones. In mole burrows of the Kamenka soils in the Priluki and Rasskasovo sections small mammals have been recovered, including lagurids that are more evolutionarily advanced than those from the Likhvin layers (Fig. 3). Water voles from Rasskasovo also feature dental enamel more advanced than that of typical *A. cantiana* (MARKOVA 1981, 1990). This fauna is comparable to material recovered from Chermy Yar in the Volga basin. ALEKSANDROVA (1976) described these remains and assigned them to the Khozar faunal assemblage. A similar evolutionary level is shown by micromammalian faunas obtained from Plavni (the Danube basin) and Uzunlar (Crimea) (CHEPALYGA et al. 1986; MIKHAILESCU & MARKOVA 1992). Remains of *Arvicola* have also been found there. These show a uniform enamel cover on the anterior and posterior sides of the angles. Among steppe lemmings of the genus *Lagurus* the transiens morphotype is of secondary importance. The lagurus morphotype was dominant at this time.

It should be mentioned that systematic changes in the enamel with latitude as seen in modern *Arvicola* (ROTTGER 1987) are of no importance in the present situation as all the localities in question lie within the same temperature belt.

Unfortunately, no small mammal localities are as yet known that can be assigned to the Orchik cooling or Romny warming. On the other hand, a number of micromammal faunas have been referred to the beginning of the Dniepr Glaciation. Climatic changes are clearly manifested in the composition of these faunas, which include remains of Subarctic species. The Igorevka locality in the Seim River drainage basin has recently been discovered in the glacial deposits; it is dated to an early stage of the Dniepr glaciation. Its fauna is similar to those described from localities such as Strigovo, Volzhino, Chekalin (fluvioglacial sands), and Alpatyevo in the Dniepr and Oka drainage basins. (AGADZHANYAN & GLUSHAKOVA 1986; MARKOVA 1982). All these assemblages contain remains of typical *Dicrostonyx simplicior, Lemmus sibiricus, Lagurus* ex gr. *lagurus*, and *Microtus (Stenocranius) gregalis*. The strongest indicator of glacial conditions is *Dicrostonyx* (Fig. 4).

The later Dniepr faunas (localities Velezh 1, Zhukovichi, Kobelyaki and Pavlovka-na-Desne) include more advanced morphotypes of *Dicrostonyx simplicior* (MOTUZKO 1985; AGADZHANYAN & GLUSHANKOVA 1986). No interstadial faunas of the Dniepr ice age are known, although the interstadial Kursk soil has been described in some sections (VELICHKO et al. 1992). Some investigators believe that the early Dniepr faunas may be assigned to the Orchik cooling (SHIK personal communication). All the cold faunas from early Dniepr time correlate with the Khozarian assemblage of large mammals, and the late Dniepr faunas with the so called Mammoth complex.

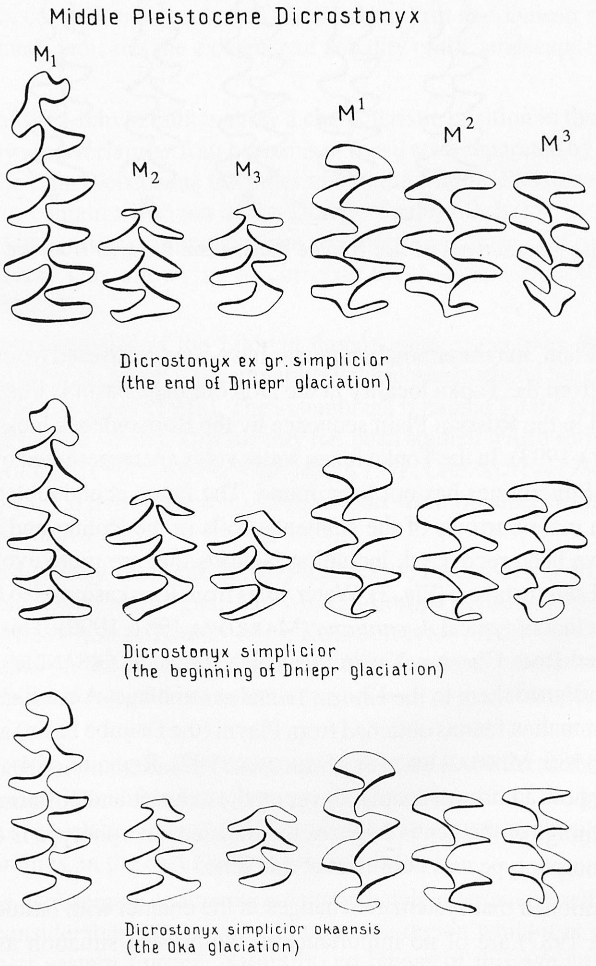

Fig. 4. The main tooth morphotypes of Middle Pleistocene *Dicrostonyx* from localities on the Russian Plain.

The earlier faunas are typified by *Mammuthus chosaricus*, while the appearance of *Mammuthus primigenius* of an early type marks the second half of the Dniepr glaciation.

The faunas of the Dniepr glaciation are less well known, however, than the Saalian faunas of western Europe. No interstadial faunas have thus far been found in eastern Europe, while in western Europe two important warmings are known within the Saalian: the earlier Hoogeveen and the later Bantega (ZAGWIJN 1985; KOLFSCHOTEN 1991). It should be noted that, judging from pollen data, the Hoogeveen warming may well be assigned interglacial rank (ZAGWIJN 1985). The small mammal fauna recovered from the localities Maastricht-Belvédère 4, 3A-C, 3, 2.2A, Wageningen – Fransche Kamp 1, 3, and Ariendorf 1 dated to this interstadial include mainly forest and interzonal species such as *Sorex araneus, Clethrionomus glareolus, Apodemys sylvaticus, Microtus agrestis* and *M. arvalis.* The species composition suggests a considerable warming and resembles an interglacial fauna. *Arvicola* from this fauna has uniform enamel on the anterior and posterior sides of the tooth angles (KOLFSCHOTEN 1991).

	West Europe (after W.H.Zagwijn, 1985; T.van Kolfshoten,1990,1991)		**Eastern Europe**	
	Stratigraphy	**Faunas**	**Stratigraphy**	**Faunas**
S A A L I A N			D N I E P E R	Pavlovka-na-Desne Strigovo, Volginovo Chekalin(all.) Igorevka
	Bantega Interstade	Rhenen	Romny Interglacial	
			Orchik Cooling (Glaciation)	
	Hoogeveen Interstade (Interglacial)	Wageningen-Fr.K.II Maastricht-Belvédère 4 Maastricht-Belvédère 3A_,3 Maastricht-Belvédère 2.2 Wageningen_Fr.K.I Ariendorf 1	Kamenka Interglacial	Priluki Plavni Chernyi Jar Rasskazovo Uzunlar
			Borisoglebsk Glaciation	Topka
H O L S T E I N		Neede Karlich H Petersbuch Bilzingsleben	L I K H V I N	Chekalin (sapropel), Gun'ki, Chigirin, Pivikha, Ozernoe, Rybnaya Sloboda, Uzmari, Tiraspol (Inzh.soil)

Fig. 5. Chronostratigraphy and principal small mammal faunas of the late Middle Pleistocene in eastern and western Europe.

In our opinion, it is not inconceivable that the Hoogeveen faunas may be correlated with east European localities assigned to the Kamenka interglacial, although to correlate them with confidence it will undoubtedly be necessary to compare in detail the micromammalian fossils from eastern and western European localities, together with relevant data obtained by other methods.

It seems possible that the subsequent interstadial warming within the Saalian, i. e., the Bantega, may correspond to the Romny interglacial, which is also assumed to be an interstadial by a number of geologists (UDARTSEV personal communication).

III. CONCLUSIONS

A complex sequence of natural events and small mammal faunas is known from the late Middle Pleistocene of eastern Europe. The interval between the Likhvin (Holstein) interglacial and Dniepr (Saalian) glaciation seems here to include two climatic cycles (glacial-interglacial) more than in western Europe. The majority of natural events is associated with small mammal faunas, though individual white spots still remain (Fig. 5).

Paleogeographical and paleontological data from western Europe record a more intricate history of the Saalian that do those from eastern Europe.

The Likhvinian and Holsteinian micromammalian faunas may be confidently correlated. This correlation is corroborated by palynological data.

The present view of the age of the post-Likhvin small mammal faunas is likely to be revised as a result of correlations between the events in eastern and western Europe. Micromammal material dated to the Kamenka Interglacial may be correlated with the Hoogeveen warm faunas. It is not improbable that the Romny warming could be correlated with the Bantega Interstadial. The latest data of KOLFSCHOTEN (personal communication) confirm these assumptions.

In the course of the late Middle Pleistocene, evolutionary changes in small mammals belonging to different phyletic lineages did not go beyond subspecies rank. The most conspicuous variation is recorded in the lineages of the steppe lemmings *Lagurus* and *Eolagurus* and the water voles *Arvicola* and *Dicrostonyx.*

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