Chapter 4

SMALL MAMMAL FAUNA FROM KABAZI II, KABAZI V, AND STAROSELE: PALEOENVIRONMENTS AND EVOLUTION

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INTRODUCTION

Excavations of Starosele, Kabazi II, and Kabazi V included the recovery of small mammal remains. The principal tasks of the paleontological investigation of small mammal remains were: to establish the species composition of rodents, insectivores, and lagomorphs present during the Paleolithic occupation of these sites; to reveal changes in species composition; to elucidate the characteristics of the paleoenvironments surrounding the sites as related to climatic fluctuations; and to establish the principal morphological features of small mammal remains and their difference from modern and more ancient remnants.

Dr. Constantine Mikhailesku and Gavril Gylku (Institute of Geography, Moldova) carried out the bulk of the selection of fossil remains of small mammals. Samples of small mammal remains were also selected by the archeologists studying these sites: Dr. Victor Chabai (Kabazi II), Dr. Alexander Yevtushenko (Kabazi V), Dr. Anthony Marks and Dr. Yuri Demidenko (Starosele).

PRINCIPAL METHODS OF SAMPLING

During excavation of the sites, normal methods for the selection of mammal bones were used. At the first stage of work, test samples from most archeological levels were screened through 5 mm screens, followed by screening through 1-1.5 mm screens. In the event that small mammal bones were found in these test samples, the sample was increased three-fold. After this procedure, the remaining sediments were washed through 1.5 mm screens. More detailed information about the principal stages of collecting the mammalian remains will be described below and can be found in Chapter 5. In most cultural layers, the density of small mammal remains was rather low.

Kabazi II

During fieldwork between 1994-1996, small mammal remains were sought for in six strata of Kabazi II (Strata 6, 7, 9, 10, 11, 13). This site is situated on third ridge of the Crimean Mountains, on the right bank of the Alma River. This Middle Paleolithic-age multi-layered site is currently being studied by archeologist Dr. Victor Chabai (Chabai 1996, 1998).

At Kabazi II, only a few remains of small mammals were found in a sterile layer in the lower part of Stratum 11, between Units III and IV, and included only one species, northern mole-vole *Ellobius (Ellobius) talpinus* Pallas.

Kabazi V

Kabazi V is situated on the third ridge of the Crimean Mountains, on the right bank of the Alma River, 100 m above the river and 350 m in altitude. The site is a buried rock shelter located beneath the limestone cliff at the top of Kabazi Mountain, on the south-south-west facing slope (Kolosov et al. 1993, Yevtushenko 1998a). Archeologist Dr. Alexander Yevtushenko is currently studying the site and has recognized 8 archeological complexes (A - G) and 9 geological strata with numerous archeological levels containing artifacts of the Middle Paleolithic "Staroselian" industry (Yevtushenko 1998b).

Four complexes—B, C, D, and E—of Kabazi V were sampled. About 140 Kg of sediment were sampled from each complex. An additional 105 Kg of sediment (which was set aside by A. I. Yevtushenko in the beginning of the field season) were washed from these complexes. Small mammalian materials found in previous years of excavation (1990 and 1994) at Kabazi V were also included in the sample. The species composition of small mammals from Kabazi V is shown in Table 4-1.

Starosele

Starosele is situated in Kanly-Dere Gorge, which is a part of the Bakchisarai Valley system, a drainage basin of the Kacha River. The site is located on a narrow platform at the base of a cliff on the right bank of the Kanly-Dere Valley, 11 m above the valley floor (Marks et al. 1998). This site was excavated by A. A. Formozov between 1952-1956 (Formozov 1958) and again between 1993-1995 as part of the Joint Ukrainian-American Middle Paleolithic project (Marks and Chabai 1998).

The recent excavations at Starosele revealed the presence of four archeological levels, separated by extensive rockfall and sterile sediments (see Marks et al. 1998). As the levels differ in thickness and in extent, the sample sizes and their results are quite variable. More than one ton of sediment was washed from Level 1, providing the largest number of small mammal remains. In Level 2, about 50 Kg of sediment were screened and washed, producing rodent remains only. In Level 3, 1.5 tons of sediments were screened, of which 230 Kg were further washed, and which produced small mammals and snails. Over one ton of material from cultural Level 4, consisting of a reddish-brown loam (pedosediment), was screened, and 140 Kg further washed. This level produced poorly preserved rodent remains. Sediments from sterile layers were also processed; in the layer between archeological Levels 3 and 4, 0.5 tons of sediment were screened, and 105 Kg further washed, which produced rodent remains. Table 4-2 presents the species composition and number of small mammal remains from the site.

ECOLOGY OF SMALL MAMMALS

Small mammals are good indicators of landscape types, as most small mammals are closely connected with specific environmental conditions. The *Rodentia* and *Lagomorpha* are herbivorous and thus, are trophically closely associated with certain vegetation types. Fluctuations in temperature and precipitation indirectly influence changes in zoogeographical provinces, chiefly through changes in the food base. Some small mammals are ecologically specialized and occur only in certain habitats. This group includes most tundra species and many forest animals. Steppe and desert mammals are adapted to defined biotic conditions, primary vegetation, and substrate types. At the same time, a certain number of eurytopic species of small mammals exist which are distributed from tundra zones to semi-desert. These are species often connected with intrazonal areas near water basins.

TABLE 4-1
Kabazi V, Species Composition of Small Mammals

		Complex B			*Complex C*		*Complex D*			*Complex E*
		II/3	*II/3-4*	*II/4*	*II/4a*	*II/7*	*III/1*	*III/1a*	*III/2*	*III/3*
Insectivora:										
Talpa sp.	Eurasian mole	1	–	–	–	–	–	–	–	–
Sorex araneus Linnaeus	Eurasian common shrew	1	–	–	–	–	–	–	–	–
Rodentia:										
Spermophillus pygmaeus Pallas	little suslik	2	1	–	13	–	4	6	7	–
Allactaga major Kerr	great jerboa	1	–	–	–	–	–	–	–	–
Apodemus (Sylvaemus) flavicollis Melchior	yellow-necked mouse		2	1	–	–	–	–	–	–
Cricetulus migratorius Pallas	grey hamster	2	–	–	–	–	–	–	–	–
Ellobius (Ellobius) talpinus Pallas	northern mole-vole	–	–	–	1	–	–	–	–	–
Lagurus lagurus Pallas	steppe lemming	1	1	–	2	–	–	20	–	–
Eolagurus luteus Eversmann	yellow steppe lemming	–	–	–	3	–	2	–	1	2
Arvicola ex gr. terrestris Linnaeus	water vole	1	–	–	1	–	–	–	–	–
Microtus (Microtus) arvalis obscurus Eversmann	common vole	65	56	2	25	–	5	–	6	–
Microtus (Pallasiinus) oeconomus Pallas	root vole	–	3	–	–	–	–	–	–	–
Microtus (Stenocranius) gregalis Pallas	narrow-skull vole	–	–	–	–	–	2	–	–	–
Microtus sp.	vole	–	–	–	–	–	–	–	2	–

TABLE 4-2
Starosele, Species Composition of Small Mammals

		Level 1	*Level 2*	*Level 3*	*Sterile*[1]	*Level 4*
Insectivora:						
Talpa sp.	Eurasian mole	1	–	–	–	–
Rodentia:						
Spermophillus pygmaeus Pallas	little suslik	2	–	–	–	–
Sicista subtilis Pallas	steppe sicista	2	–	–	–	–
Allactaga major Kerr	great jerboa	1	–	–	–	–
Apodemus (Sylvaemus) flavicollis Melchior	yellow-necked mouse	4	–	–	–	–
Cricetulus migratorius Pallas	grey hamster	5	5	–	1	–
Ellobius (Ellobius) talpinus Pallas	northern mole-vole	30	–	5	7	–
Lagurus lagurus Pallas	steppe lemming	–	4	2	–	–
Arvicola ex gr. terrestris Linnaeus	water vole	26	1	8	3	–
Microtus (Microtus) arvalis obscurus Eversmann	common vole	170	14	26	24	24
Microtus sp.	vole	–	–	1	3	–

[1] archeologically sterile horizon between Levels 3 and 4.

The modern species diversity in Eastern Europe changes significantly from the north to the south: 25 species now live in the tundra zone, 47 in the taiga, 60 in mixed forests, 59 in broad-leaved forests, 53 in steppes, and 35 in semi-deserts and deserts (Tishkov 1993). These changes are closely connected with values of the hydrothermic gradient. During the time of last glaciation, the values of species richness on the Russian Plain were noticeably lower (Markova et al. 1996). Only in mountain systems (Carpathians, Caucasus, and partly in the Crimean Mountains) were the number of mammal species rather high during this time. Numerous *Mammalia* species founded refugia in a variety of local biotopes in the mountain systems.

Small mammals also evolved very intensively during the Pleistocene and these changes are reflected in their morphology. Even during the Late Pleistocene, numerous pronounced evolutionary stages in several lineages of *Rodentia* (especially in *Arvicolinae*) have been recognized. These morphological changes help to establish the age of localities and fossiliferous layers.

Studies of Paleolithic sites containing small mammals indicate that the accumulation of these remains is due to the activities of predators—both birds and mammals (Gromov 1961; Andrews 1990; Smirnov et al. 1990). Generally, these accumulations at such localities correspond closely to the time when ancient people lived at a site, as the intervals of bone accumulation were relatively short. This has been confirmed by AMS (Accelerator Mass Spectrometer) dating of small bone samples (for example, separate rodent teeth) from cultural layers of archeological sites in North America (Graham and Grimm 1990). These data, therefore, can carry very important information about the age of cultural layers, as well as the environmental conditions near the sites.

KABAZI V

Thirteen species of *Rodentia* and *Insectivora* were identified in nine levels, corresponding to 4 archeological complexes, at Kabazi V. Only one species, the yellow steppe lemming *Eolagurus luteus*, was present in the lower Level III/3 (Table 4-1). This species is typical of desert, semi-desert, and dry steppic landscapes (fig. 4-1). Presently, *Eolagurus luteus* inhabits the Zaisan Depression in Middle Asia, in N-W China and Interior Mongolia, where it is found on the plain and low mountain desert and semi-desert areas (Gromov and Erbaeva 1995). In the Late Pleistocene, during the Valdai Glaciation, the range of yellow lemming was very wide and covered the vast territories of Northern Eurasia (Markova et al. 1996). It still remained rather widespread during the Holocene, and even in the 19th century existed in the Lower Volga River drainage basin and in Kazakhstan deserts. The remains of the *Eolagurus* genus were found in different localities of the southern and central Russian Plain from the Lower Pleistocene through Late Pleistocene, during both interglacials and glacials, in steppe mammal communities of different types. Gromov (1961) described this species from several Paleolithic and Mesolithic sites of the Crimean Mountains. The presence of this species in the lower layer of Kabazi V indicates an open semi-desert or dry steppic environment near the site.

Kabazi V, Level III/2 is characterized by three species of *Rodentia* (Table 4-1): little suslik *Spermophillus pygmaeus*, yellow steppe lemming *Eolagurus luteus,* and common vole *Microtus arvalis obscurus*. *Eolagurus* and *Spermophillus pygmaeus* prefer open landscapes, and now inhabit the south-east Russian Plain and northern regions from the Caspian Sea and Kazakhstan. They prefer semi-desert and southern steppic landscapes, and live on plains as well as in low mountains. *Microtus arvalis obscurus* presently inhabits meadow-steppe biotopes, and is currently distributed throughout the Crimean and Caucasus Mountains, the Volga-River basin, and the Urals (fig. 4-2) (Malygin 1983; Zagaradniuk 1991). The presence

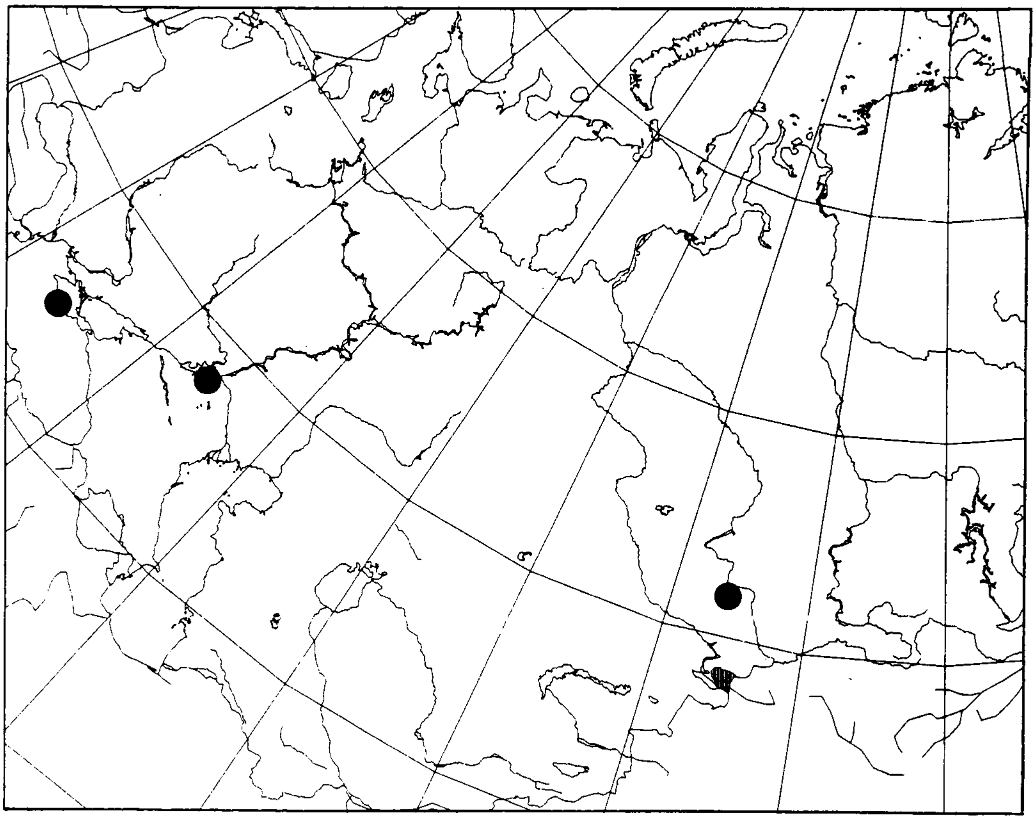

Fig. 4-1—Early Valdai localities (black circles) and modern range (crosshatched areas) of *Eolagurus luteus*.

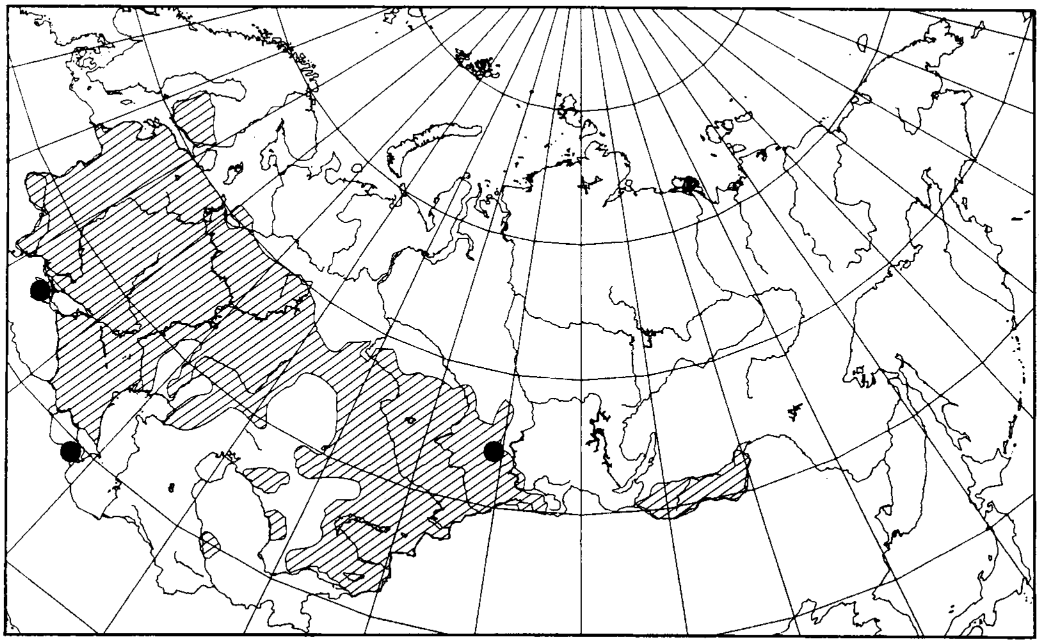

Fig. 4-2—Early Valdai localities (black circles) and modern range (crosshatched areas) of voles of *Microtus arvalis* group.

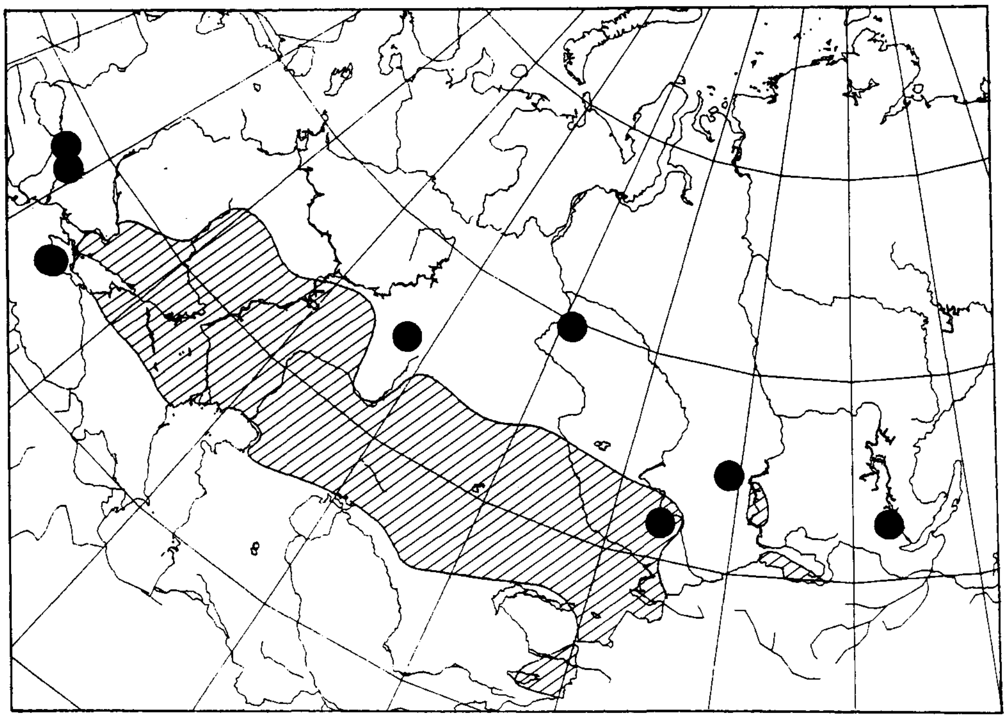

Fig. 4-3—Early Valdai localities (black circles) and modern range (crosshatched areas) of *Lagurus lagurus*.

of these three species definitely points to the presence of open environments near the site during the formation of Level III/2.

During the formation of the upper Level III/1a and Level III/1, the same type of landscapes continued to exist. In Level III/1a, the remains of two typical steppe species were distinguished: little suslik and steppe lemming *Lagurus lagurus*. The latter species (and its ancestral forms) was very characteristic of open landscapes of different types, periglacial as well as warm steppes of interglacials (Markova 1982a; Recovets 1994). During the Valdai Glacial (Early Valdai and Late Valdai), steppe lemmings were widely distributed in the Northern Hemisphere (fig. 4-3). In Level III/1, the remains of little suslik, yellow steppe lemming, common vole, and narrow-skulled vole *Microtus (Stenocranius) gregalis* were found (Table 4-1). *M. gregalis* now lives in different types of open landscapes (tundra and steppe). Narrow-skulled voles are indifferent to low temperatures. During the Valdai Glacial, their range was very wide, and *M. gregalis* was one of the characteristic members of the mammoth faunal complex (Markova 1982b; Baryshnikov and Markova 1994). At the present time, its range is in tundra and steppe zones.

During the time of following unit's (Level II/4a) deposition, the environmental conditions became more moderate. The presence of substantial *Microtus arvalis obscurus* remains and the bones of water vole *Arvicola terrestris* demonstrate changing environmental conditions. The remains of a single northern mole-vole *Ellobius talpinus* in Level II/4a is interesting; this mammal prefers open steppe and forest steppe landscapes (figs. 4-4, 4-5). In Level II/3, the tooth of great jerboa *Allactaga major* was found. This animal is typical of steppe, forest-steppe, and semi-deserts; it is distributed on the southern Russian Plain, in Crimea, and in western Siberia (figs. 4-6, 4-7a). In the same level, remains of grey hamster *Cricetulus migratorius* were also identified (fig. 4-7a-c). This species now inhabits open landscapes of different types; its modern range includes the central and southern Russian Plain, Crimea, and Middle Asia.

As a whole, moderate conditions were maintained during the deposition of Levels II/4, II/

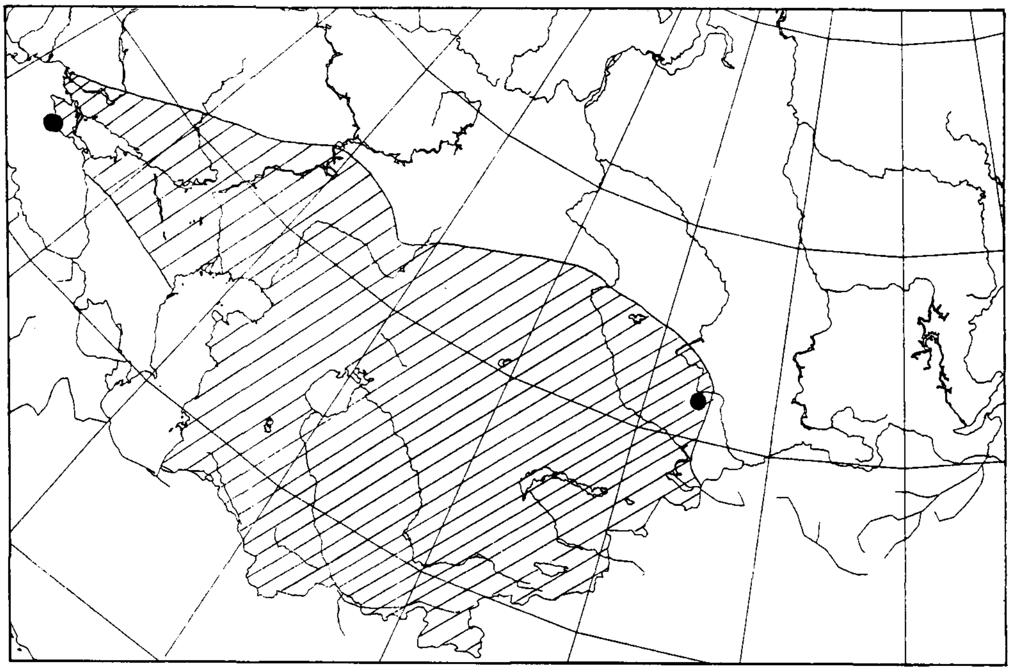

Fig. 4-4—Early Valdai localities (black circles) and modern range (crosshatched areas) of *Ellobius talpinus*.

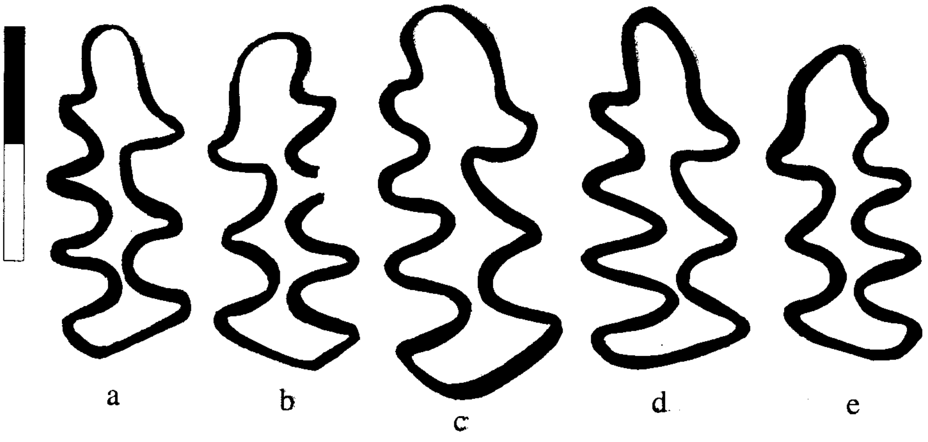

Fig. 4-5—Occlusal surface of M_1 of *Ellobius talpinus* from Starosele: *a-d*–Level 1; *e*–Level 3.

3-4, and possibly, Level II/3. This is indicated by the presence of forest species such as yellow-necked mouse *Apodemus flavicollis*, Eurasian mole *Talpa* sp., and a substantial quantity of *Microtus arvalis obscurus*. *Apodemus flavicollis* is a typical dweller of broad-leaved forests, distributed on plains as well as in mountains (figs. 4-8, 4-9). Its preferred foods are the nuts of beeches, acorns of oaks, hazels-nuts, and the seeds of lime-trees and maples. The near-absence of *Eolagurus luteus* remains and low numbers of *Lagurus lagurus* and *Spermophillus* bones confirm this conclusion of a moderation of climate at this time. However, the presence of such typical steppe species as the great jerboa, little suslik, grey hamster, and steppe lemming is prolonged, and make up a significant portion of the species composition even at this time.

In sum, during Levels III/3-III/1, practically only steppe species of small mammals existed

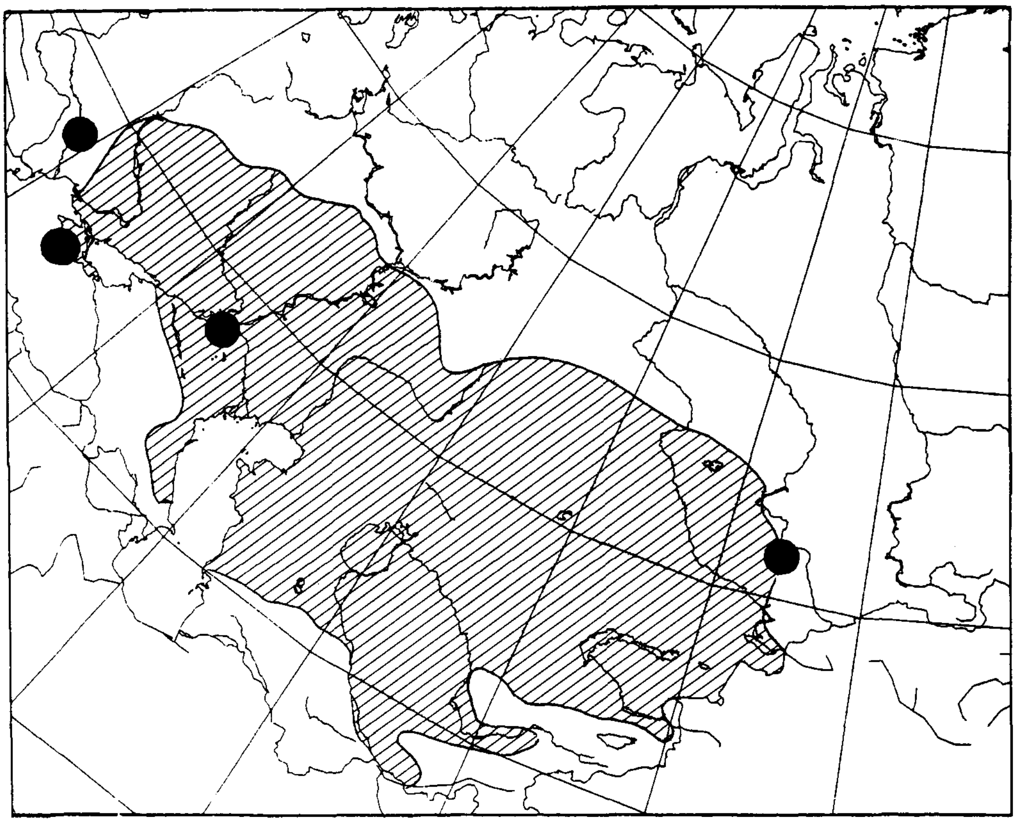

Fig. 4-6—Early Valdai localities (black circles) and modern range (crosshatched areas) of *Allactaga major.*

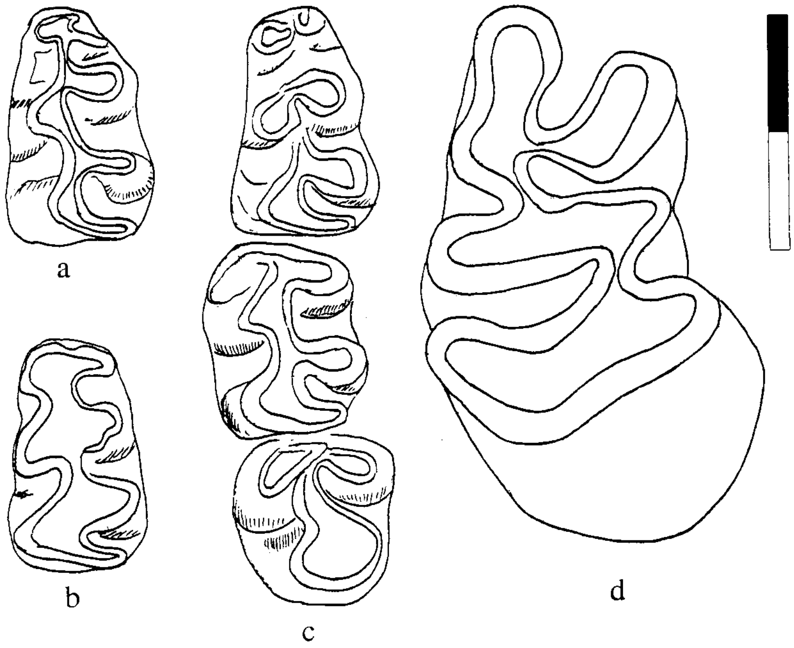

Fig. 4-7—Occlusal surface of teeth of *Cricetulus migratorius* and *Allactaga major* from Starosele: *a-b*–M^1; *c*–M_1-M_3 of *C. migratorius*; *d*–M_1 of *A. major.*

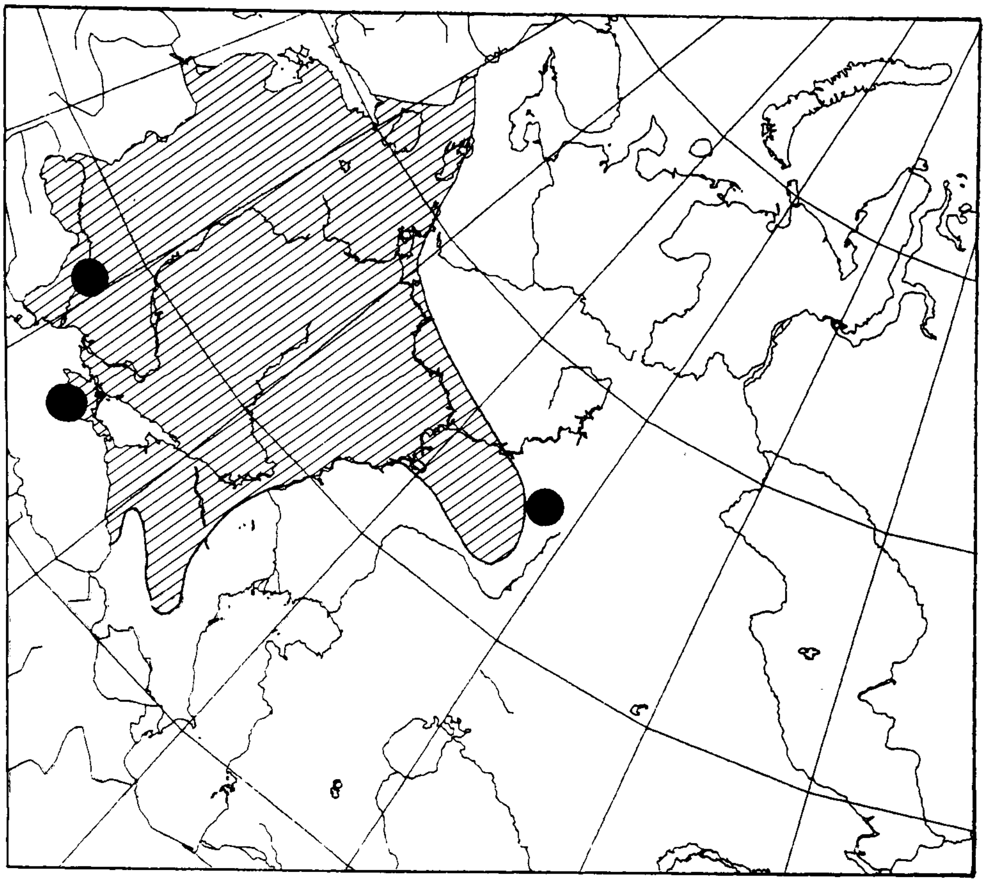

Fig. 4-8—Early Valdai localities (black circles) and modern range (crosshatched areas) of *Apodemus flavicollis*.

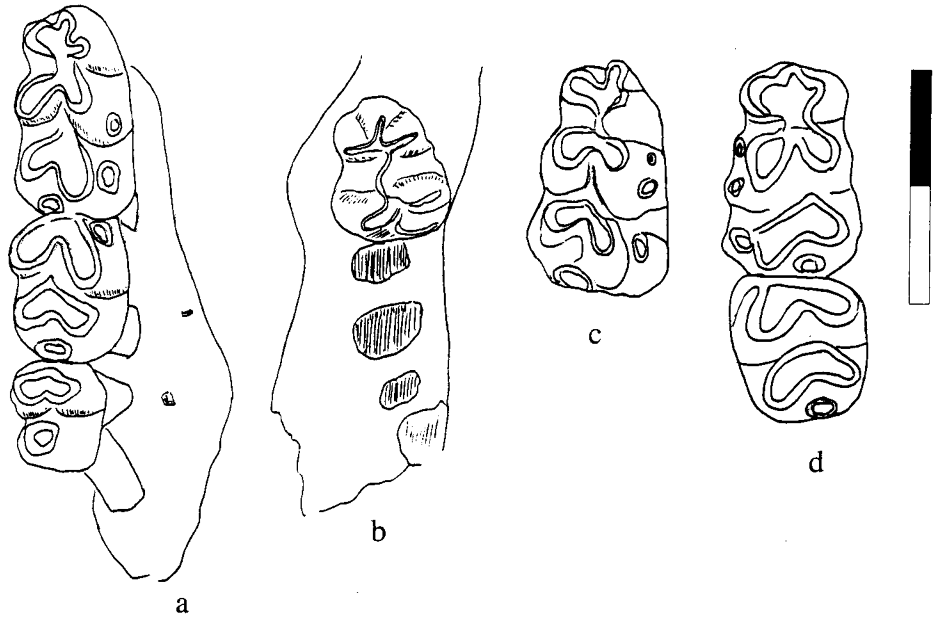

Fig. 4-9—Occlusal surface of teeth of *Apodemus flavicollis* and *Sicista subtilis* from Starosele: *a*–M_1-M_3 of *A. flavicollis*, Level 2; *b*–M_1 of *Sicista subtilis*, Level 2; *c*–M_1; *d*–M_1-M_2 of *A. flavicollis*, Level 1.

near Kabazi V, and it is possible to reconstruct the steppe landscapes surrounding the site. The environment noticeably changed—becoming more moderate—during the deposition of Levels II/4a-II/3. In this time, according to the small mammal data, a mosaic of forest and steppe biotopes existed near the site, in spite of the location of this site on the sunny slope of Kabazi Mountain and 100 m above the Alma River.

STAROSELE

The remains of small mammals were found in 5 layers (in all 4 archeological levels and 1 sterile layer) of Starosele.

The bones of only one species, *Microtus arvalis obscurus,* were present in the lowermost level, Level 4 (Table 4-2). As discussed above, this species presently prefers meadow-steppe conditions.

Four species were found in the culturally sterile layer between Levels 4 and 3. Two of these are typical steppe animals: grey hamster *Cricetulus migratorius* and northern mole-vole *Ellobius talpinus.* The presence of water vole *Arvicola terrestris* points to the nearness of a water basin. This species has intrazonal range and inhabits periaquatic biotopes of wide areas of Eastern Europe, from steppe to forest-tundra zones. The location of the site on the right bank of Kanly-Dere Valley, only 11 m above the bottom of the canyon, is reflected in the species composition of the small mammals. The ecological characteristics of other species from Level 3 definitely indicate the wide distribution of steppe environments near the site.

It is possible that in Level 2, deposition occurred under somewhat more moderate climatic conditions. The remains of northern mole-vole were not found in this level. Two of the species present in Level 2 prefer open landscapes: grey hamster *Cricetulus migratorius* and steppe lemming *Lagurus lagurus. Microtus arvalis obscurus* inhabits meadow and steppe biotopes, *Arvicola terrestris* inhabits hydromorphic biotopes. The number of small mammal remains in this level is rather low, and this reconstruction, therefore, is rather tentative.

A richer small mammalian fauna was found in Level 1. Here, eight species were distinguished. The faunal list includes two forest species: yellow-necked mouse *Apodemus flavicollis* and Eurasian mole *Talpa sp.* Other species besides *Arvicola terrestris* and *Microtus arvalis obscurus* prefer open habitats. They include the little suslik, steppe sicista, grey hamster, and northern mole-vole. It is significant that there are no remains of steppe lemming found here, which were present in Levels 2 and 3. Forested, as well as open steppe-like biotopes, were distributed near Starosele during the formation of Level 1. The ranges of bush and forest vegetation are possibly connected with the better watered depression of the valley. Steppe animals were distributed on higher and drier slopes. These environmental changes are probably connected with climatic warming (possibly with the Bryansk Interstadial).

CONCLUSIONS

During the present day in the mountainous part of Crimea, 14 species of rodents (including *Rattus* and *Ondatra* which appear only in Holocene and historical times) and 6 species of insectivores exist (Flint et al. 1970; Panteleev et al. 1990; Gromov and Erbaeva 1995). The remains of ten species of *Rodentia* and two species of *Insectivora* were identified from Kabazi V and Starosele. Kabazi II, unfortunately, produced small mammal remains only in one archeologically sterile horizon. No lagomorphs were found in the sites (one species is present today). Several of the *Rodentia* species have now disappeared from the Crimean Mountains, including *Eolagurus luteus* and *Microtus gregalis.* These species were very well adapted to various periglacial open landscapes widely distributed during the Valdai glaciation in the Northern Hemisphere.

Modern species currently inhabiting the Crimean Mountains, such as *Sciurus vulgaris* and *Mus musculus*, were not found in the cultural layers at Kabazi V or Starosele. Their absence may be connected with the generally infrequent recovery of the remains of fossil small mammals, as well as with changing mammal ranges during the Late Pleistocene and Holocene due to climatic fluctuations. *Sciurus vulgaris* is a typical forest mammal. In sub-arctic and forest zones, *Mus musculus* prefers to inhabit human buildings. It is also abundant in steppe and semi-desert "wild" biotopes.

Most of the species present in the cultural layers of Kabazi V and Starosele prefer to inhabit open landscapes. However, definite differences are noticeable between the small mammal fauna of Kabazi V and Starosele, as well as the fauna of different layers of each site. As a whole, the local small mammal fauna from all the levels of Starosele reflect the proximity of a wet biotope connected with the valley depression. The position of Kabazi V at a significant height above the river basin and on the sunny slope of Kabazi Mountain is expressed by another species composition lacking periaquatic species.

Definite changes in species composition of different levels of every site can also be seen. This allows elucidation of the main environmental fluctuations most likely caused by climatic changes.

The changes in natural conditions expressed in the moderation of steppe environments are

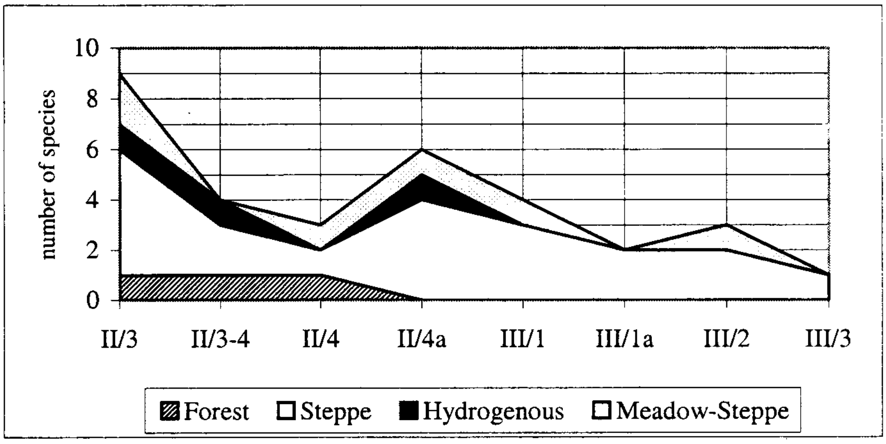

Fig. 4-10—Kabazi V, ecological groups of small mammals.

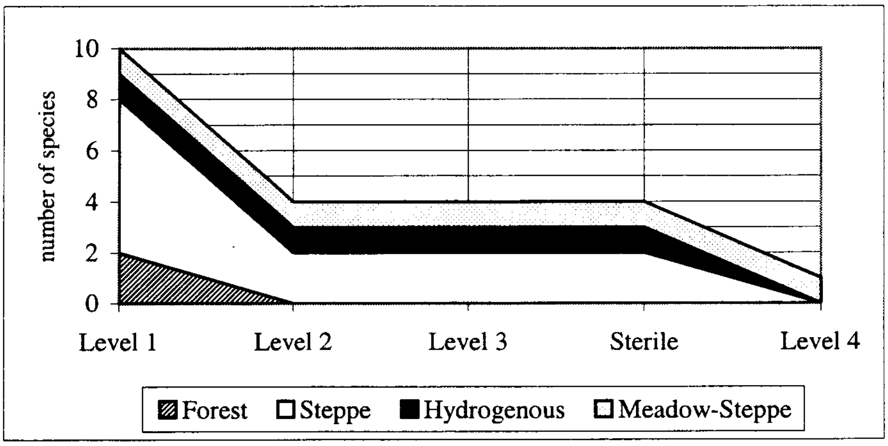

Fig. 4-11—Starosele, ecological groups of small mammals.

seen in the time after the formation of Kabazi V, Levels III/3-III/I and the deposition of Levels II/4a-II/3, when forest-steppe landscapes were distributed around the site (fig. 4-10). These environmental changes probably were connected with the interglacial warming of Middle Valdai time, possibly with the Grazhdansky Interstadial of the Russian Plain, dated to 40-50,000 BP (Faustova and Velichko 1992). Serebryanny (1978), however, identified this warming period as an interglacial.

Analysis of small mammal fauna from Starosele shows that the noticeable changes in species composition correspond to Levels 2 and 1. Earlier (during the formation of Levels 3 and 4), the principal types of biotopes near the site were open steppe-like landscapes. Later, when Levels 2 and 1 were deposited, more temperate conditions prevailed. The presence of small forest mammals signals this change (fig. 4-11). This moderation of the climate possibly can be correlated with the beginning of Bryansk Interstadial warming (Velichko 1973; Serebryanny 1978).

SYSTEMATIC DESCRIPTION

Rodentia - rodents
Cricetidae Fischer, 1817
Arvicolinae Gray, 1821

***Microtus (Microtus) arvalis obscurus* (Eversmann, 1941) – common vole**

Material

Kabazi V—58 M_1,14 M_2, 4 M_3, 26 M^1, 19 M^2, 8 M^3.
Starosele—61 M_1, 9 M_2, 6 M_3, 38 M^1,16 M^2, 8 M^3.

Description

The teeth are relatively large in size, without roots, with cement. The enamel is differentiated in a "microtus" way.

M_1 has 7 well-distinguished dentine fields. The angles in the base of the anteroconid complex are usually separated (fig. 4-12c, d, f, h, j-k, o-r), sometimes broadly confluent (fig. 4-12a, b, e, g, n). M_1 has an "arvalis" morphotype with anterior cap that varies from a simple "arvalis" form (fig. 4-12a-c, f) to a "mushroom" form (fig. 4-12d, e, k). The neck of the anterior cap is usually narrow. The teeth are rather big (Table 4-3).

M^3 has separate dentine surfaces on the occlusal surface. The form of the posterior loop varies from a trefoil to "mushroom" form (fig. 4-13). The measurements of the upper third molars are presented in Table 4-4.

Comparison

The *Microtus* teeth from Kabazi V and Starosele were compared to five modern species: (1) *Microtus* from Crimea national park (Crimean Mountains); (2) *Microtus arvalis arvalis* from the Tver' district; (3) *Microtus rossiaemeridionalis* from the Tver' district; (4) *Microtus agrestis*; and (5) *Microtus socialis* from the southern Russian Plain.

The sizes of *Microtus* teeth from Kabazi V and Starosele are most similar to modern Crimean *Microtus*. They differ from *M. rossiaemeridionalis* by their larger size (Tables 4-3,

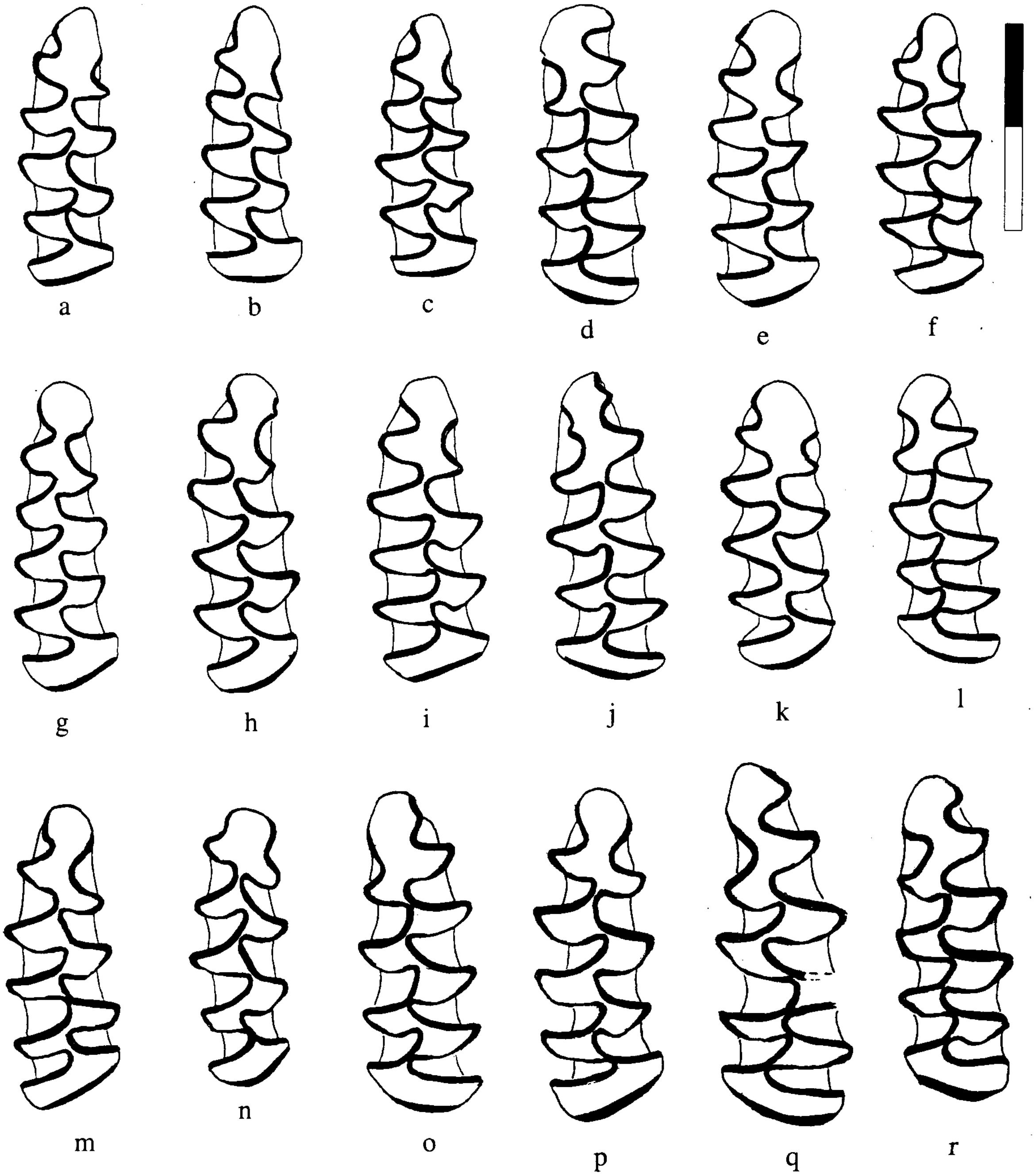

Fig. 4-12—Occlusal surface of M_1 *Microtus arvalis obscurus*: *a-l*–Starosele, Level 1; *m-r*–Kabazi V, Level II/3.

4-4) and the more asymmetrical anteroconid complex (most of the M_1 of *M. rossiaemeridionalis* has the anteroconid complex with trefoil anterior cap). In addition, the M^1 and M^2 of *M. rossiaemeridionalis* are always without additional angles in the posterior part of the teeth. Crimean voles sometimes have the tendency of complication of the posterior part of these teeth.

The teeth of Crimean voles are distinguished from the teeth of modern *Microtus socialis* (collections of the Zoological Museum of Moscow University) by: (1) larger sizes; and (2) by the absence of the additional angle on the posterior part of M^2, which is always present on the *Microtus socialis* second upper molar.

The Crimean remains are distinguished from the teeth of *Microtus agrestis* (collections of

TABLE 4-3

Measurements of M_1 of Recent *Microtus* from the Russian Plain and Crimea, and *Microtus arvalis obscurus* from Kabazi V and Starosele (in mm)

	Length						*Width*					
	N	$\bar{X}$	*Min*	*Max*	*S.E.*	*S.D.*	*N*	$\bar{X}$	*Min*	*Max*	*S.E.*	*S.D.*
Microtus arvalis obscurus (Kabazi V, Level II/3-4, Sq.10A)	10	2.85	2.50	3.05	0.057	0.171	10	1.03	1.00	1.10	0.010	0.035
Microtus arvalis obscurus (Kabazi V, Level II/3, Sq. 12B)	17	2.87	2.50	3.30	0.480	0.205	17	1.04	0.95	1.10	0.010	0.044
Microtus arvalis obscurus (Starosele, level1)	30	2.86	2.50	3.25	0.041	0.227	30	1.07	0.90	1.20	0.014	0.077
Microtus arvalis obscurus (Crimean Mts., modern)	15	2.61	2.45	2.80	0.029	0.113	15	0.99	0.90	1.00	0.007	0.028
Microtus arvalis arvalis (Tver' district, modern)	12	2.52	2.45	2.60	0.013	0.044	12	0.93	0.80	1.00	0.015	0.065
Microtus rossiaemeridionalis (Ndth' district, modern)	35	2.51	2.25	2.80	0.018	0.105	35	0.92	0.85	1.00	0.007	0.044
Microtus agrestis (Carpathian Mts.)	5	2.69	2.50	2.80	0.053	0.019	5	1.04	1.00	1.05	0.010	0.022
Microtus socialis (Southern Russian Plain)	15	2.54	2.30	2.75	0.028	0.105	15	0.93	0.85	1.00	0.013	0.050

TABLE 4-4

Measurements of M^3 of Recent *Microtus* from the Russian Plain and Crimea, and *Microtus arvalis obscurus* from Kabazi V and Starosele (in mm)

	Length						*Width*					
	N	$\bar{X}$	*Min*	*Max*	*S.E.*	*S.D.*	*N*	$\bar{X}$	*Min*	*Max*	*S.E.*	*S.D.*
Microtus arvalis obscurus (Starosele, Level 1)	5	2.14	2.10	2.30	0.055	0.111	5	0.98	0.95	1.00	0.012	0.027
Microtus arvalis obscurus (Crimean Mts., modern)	15	1.79	1 60	2.10	0.034	0.130	15	0.89	0.80	0.95	0.011	0.042
Microtus arvalis arvalis (Tver' district, modern)	12	1.64	1.55	1.80	0.024	0.085	12	0.82	0.70	0.90	0.017	0.058
Microtus rossiaemeridionalis (Tver' district, modern)	35	1.69	1.45	1.95	0.190	0.112	33	0.87	0.70	0.95	0.009	0.055
Microtus agrestis (Carpathian Mts.)	5	1.87	1.60	2.00	0.077	0.177	5	0.94	0.90	1.00	0.024	0.055
Microtus socialis (Southern Russian Plain)	14	1.71	1.60	1.85	0.021	0.079	14	0.85	0.75	0.90	0.013	0.048

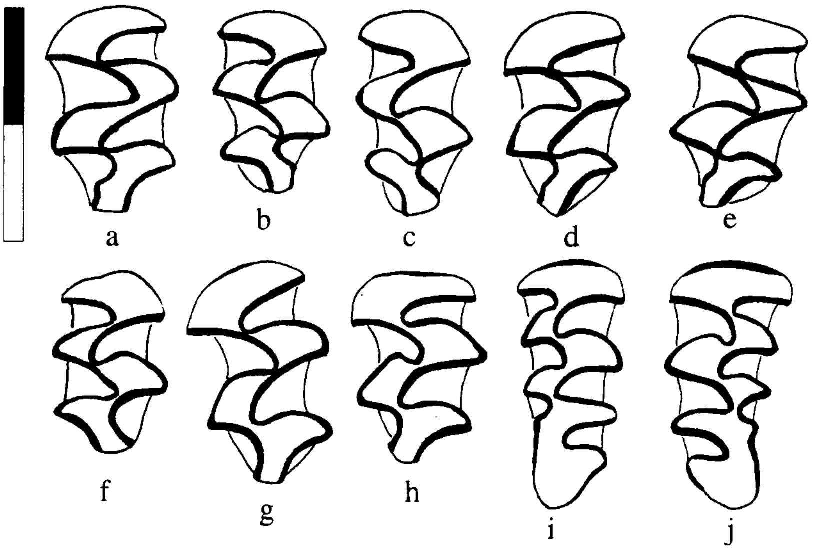

Fig. 4-13—Occlusal surface of M^2 and M^3 *Microtus arvalis obscurus*: *a-f*–M^2, Kabazi V, Level II/3; *g-h*–M^2; *i-j*–M^3, Starosele, Level 1.

the Zoological Museum of Moscow University) by the absence of an additional prism on second upper molars. The sizes of teeth of *Microtus agrestis* and Crimean *Microtus* are close (Tables 4-3, 4-4). The anteroconid complex of M_1 of *M. agrestis* has a more complicated form, with additional internal angles on the anterior cap and a well-pronounced asymmetrical structure of the tooth.

Comparison with the teeth of modern *Microtus arvalis arvalis* (karyotyped) from the Tver' district shows that the latter have a more simple structure of the first lower and upper third teeth, and tooth size is also smaller than Crimean voles (Tables 4-3, 4-4).

According to recent data, the polytypic species *Microtus arvalis* (common vole) includes not less than 45 subspecies and not less than 5 species distinguished by karyotype (Malygin 1983; Gromov and Erbaeva 1995; Pavlinov et al. 1995). Genetic analysis has allowed the revision of Eurasian forms of *Microtus arvalis* (with 2n=46; NF=56) (Malygin 1983; Zagaradniuk 1991), distinguishing several species: *M. kirgisorum* (2n=54; NF=80); *M. rossiaemeridionalis* (2n=54; NF=56); *M. transcaspicus* (2n=52; NF=54); and *M. kermalinsis*. The rank of the Crimean subspecies *Microtus arvalis obscurus* (2n=46; NF=72), which also now inhabits the Caucasus, the Ural Mountains, and Siberia, is debated. Dr. Zagaradniuk (1991) attributed this form to a separate species; but according to Malygin (1983) and Pavlinov et al. (1995), this form is a subspecies of *Microtus arvalis*, since it easily mates with *M. arvalis arvalis* and produces fecund progeny.

From the present study, it is possible to distinguish significant morphological differences between Crimean *Microtus* and the subspecies of *Microtus arvalis*, as well as between *Microtus agrestis* and *M. socialis*. This indicates the significant antiquity of the Crimean form (*M. a. obscurus*) which was common during the first part of the Late Pleistocene.

Lagurus lagurus (Pallas, 1773) – steppe lemming

Material

Kabazi V—1 M_3, 1 M^2 (Level II/4a); 1 M_2 (Level II/3-4); 1 M_2 (Level II/3); 6 M_1, 5 M_2, 2 M_3, 4 M^1, 2 M^2, 1 M^3 (Level III/1A).

Starosele—2 M_1, 2 M_2 (Level 2); 2 M_3 (Level 3).

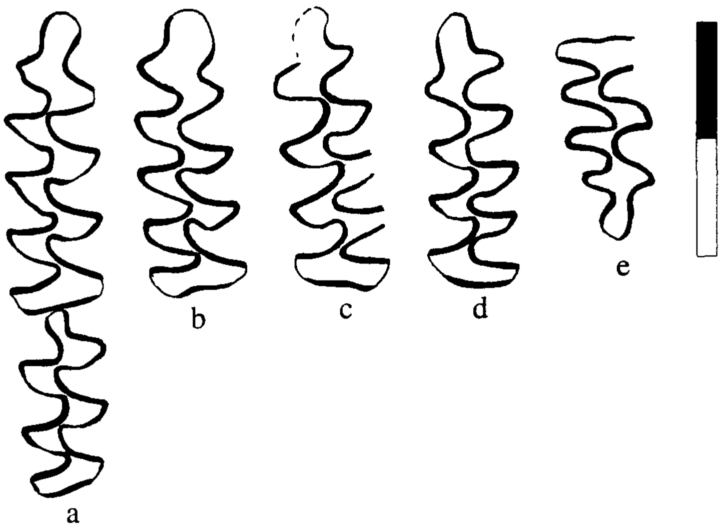

Fig. 4-14—Occlusal surface of *Lagurus lagurus* teeth: *a*–M_1 and M_2, Starosele, Level 2; *b-d*–M_1; *e*–M^3, Kabazi V, Level III/1a.

Description

Uncemented, unrooted vole with well-differentiated enamel.

The first lower molar M_1 has 7 separated dentine fields on the occlusal surface. The anterior cap usually has a trefoil form (fig. 4-14a-d). The "walls" of the anterior loop are parallel (fig. 4-14d) or closed at the base (fig. 4-14a-c).

The third upper molar of *Lagurus* has 5 dentine fields. The posterior angle has a trefoil configuration (fig. 4-14e).

The teeth are larger than modern *Lagurus lagurus* from different parts of the Russian Plain and Kazakhstan. The Crimean fossil teeth are also bigger than the teeth of *Lagurus ex gr. lagurus* from several Late Pleistocene and Middle Pleistocene localities of the Russian Plain (Table 4-5). This appears to be specific to the Crimean Mountains population; the significantly larger tooth size of *Lagurus* from Late Pleistocene-age Crimean sites in comparison to modern *Lagurus* was noted by I. M. Gromov (1961).

Comparison

The morphology and the sizes of the M_1 and M^3 identify the remnants of steppe lemmings from Kabazi V and Starosele as *Lagurus lagurus*. The ancestral form of *Lagurus lagurus* - *L. transiens* has an anteroconid complex of M_1 and posterior part of M^3 with weakly separated dentine fields. The anteroconid complex of *L. transiens* never has the walls closed at the base of the anterior cap and usually has the walls broaden in this direction. The morphological

TABLE 4-5

Measurements of M_1 of Steppe Lemming *Lagurus lagurus* from Kabazi V and Starosele, and some Modern and Pleistocene *Lagurus lagurus* (in mm)

			Length				*Width*			
Age	*Site*	*Location*	*N*	$\bar{X}$	*Min*	*Max*	*N*	$\bar{X}$	*Min*	*Max*
Late Pleistocene	Kabazi V/95	Crimean Mts.	6	2.73	2.60	2.80	6	0.90	0.85	0.95
Late Pleistocene	Starosele/94	Crimean Mts.	1	2.55	—	—	1	0.85	—	—
Late Pleistocene (Briansk Interstadial)	Arapovichi[1]	Upper Dnieper basin	18	2.41	2.20	2.65	18	0.86	0.75	1.15
Late Pleistocene (Mikulino Interglacial)	Malyutino[1]	Seim River basin	16	2.43	2.40	2.75	16	0.87	0.70	0.95
Late Middle Pleistocene (Kamenka Interglacial)	Priluki[1]	Sula River basin	15	2.52	2.40	2.75	15	0.86	0.75	1.00
Late Middle Pleistocene (Likhvin Interglacial)	Gun'ki II[1]	Psel River basin	48	2.35	2.10	2.65	50	0.84	0.65	1.05
Modern	Moscow Zool. Museum	Riasan' and Voronezh districts	47	2.27	2.20	2.60	51	0.80	0.75	0.90
Modern	Moscow Zool. Museum	Southern Ukraine	20	2.32	2.15	2.55	20	0.80	1.00	0.90
Modern	Moscow Zool. Museum	Astrakhan steppe, W. Kazakhstan	20	2.48	2.00	2.75	20	0.87	0.80	0.95
Modern	Moscow Zool. Museum	Kazakhstan	30	2.38	2.20	2.63	35	0.80	0.65	1.00

[1] collections of A.K. Markova (Inst. of Geography RAS)

TABLE 4-6

Measurements of M_1 of Yellow Steppe Lemming *Eolagurus luteus* (in mm)

Age	*Site*	*N*	*L*	*W*	*A*	*B*	*C*	*A/L x 100*	*B/L x 100*	*C/L x 100*
Late Pleistocene	Kabazi V/95, III/3	1	3.15	1.10	1.75	0.050	0.060	55.00	1.60	1.90
Late Pleistocene	Kabazi V/95, III/4a, 8D	1	3.30	1.40	1.75	0.060	0.070	53.00	1.82	2.12
Late Pleistocene	Starosele/95, Lev. 1	1	3.25	1.35	1.70	0.050	0.060	52.00	1.54	1.85
Late Pleistocene (Mikulino Interglacial)	Shkurlat[1]	8	3.05	1.12	1.61	0.050	0.050	55.00	1.67	1.70
Late Middle Pleistocene (Likhvin Inter.)	Gun'ki II[1]	17	2.93	1.08	1.54	0.083	0.094	52.27	2.90	3.20
Late Middle Pleistocene (Likhvin Inter.)	Chigirin[1]	11	2.97	1.07	1.55	0.078	0.099	52.36	2.66	3.50
Early Middle Pleistocene	Tikhonovka[1]	12	2.92	1.08	1.48	0.080	0.160	50.50	3.07	5.09
Early Pleistocene	Karai-Dubina[1]	30	2.77	1.01	1.39	0.070	0.190	50.20	2.90	7.03

[1] collections of A.K. Markova (Inst. of Geography RAS)

(*L*)-Length; (*W*)-Width; (*A*)-Length of anteroconid; (*B*)-Width of "neck" of anterior loop; (*C*)-Width of confluence of angles in the base of anteroconid.

changes of the *Prolagurus-Lagurus* phyletic lineage are now well described (Markova 1975 1982).

There are currently four subspecies of *Lagurus lagurus* known: *L. l. agressus,* distributed in the central and southern Russian Plain; *L. l. lagurus*, in Ukraine, North Caucasus, Volga-Ural semideserts, and in Kazakhstan; *L. l. altorum,* in Middle Asia and China; and *L. l. abacanicus,* in the Abacan River drainage basin (Gromov and Erbaeva 1995).

The absence of *L. transiens* morphotypes among *Lagurus* teeth confirms the Late Pleistocene age of fauna from Kabazi V and Starosele. The morphological features of the Crimean *Lagurus* teeth are very similar to the typical modern *Lagurus lagurus* and Late Pleistocene steppe lemming teeth.

Eolagurus luteus (Eversmann, 1842) – yellow steppe lemming

Material

Kabazi V—1 M_1, 1 M^1, 1 M^2 (Level II/4a); 1 lower mandible (Level III); 1 M_1, 1 M_3 (Level III/1); 1 M_1 (Level III/2); 1 M_1, 1 M_2 (Level III/3).

Starosele—there are no remains of *Eolagurus* at this site.

Description

Uncemented, unrooted vole, with well-differentiated enamel and with rather large sizes.

The first lower molar has 7 dentine fields and an asymmetrical anterior angle. The dentine fields in some cases are rather broadly confluent (fig. 4-15a), and in others are separated (fig. 4-15c-d). The sizes of M_1 are presented in Table 4-6.

Comparison

The remains of this species are significantly larger than the remains of steppe lemming *Lagurus.*

Previous analysis of the M_1 of yellow steppe lemmings from different Pleistocene localities in Eastern Europe revealed several significant characteristics that are most important in distinguishing the evolutionary level: the length of tooth, the ratio A/L, and the values of the width of the interfluence between the angles in the base of the anteroconid (Agadjanian and Markova 1984). From these features, it is possible to correlate the *Eolagurus* species with the stratigraphic scheme. As is readily visible by the measurements presented in Table 4-6, the Crimean yellow steppe lemmings belong to the most progressive group of Pleistocene *Eolagurus* and are well distinguished from earlier yellow steppe lemmings of Middle and Early Pleistocene localities of the Russian Plain.

Given the morphological structure and sizes of teeth, the remains of *Eolagurus* from Kabazi V can be described as *E. luteus.*

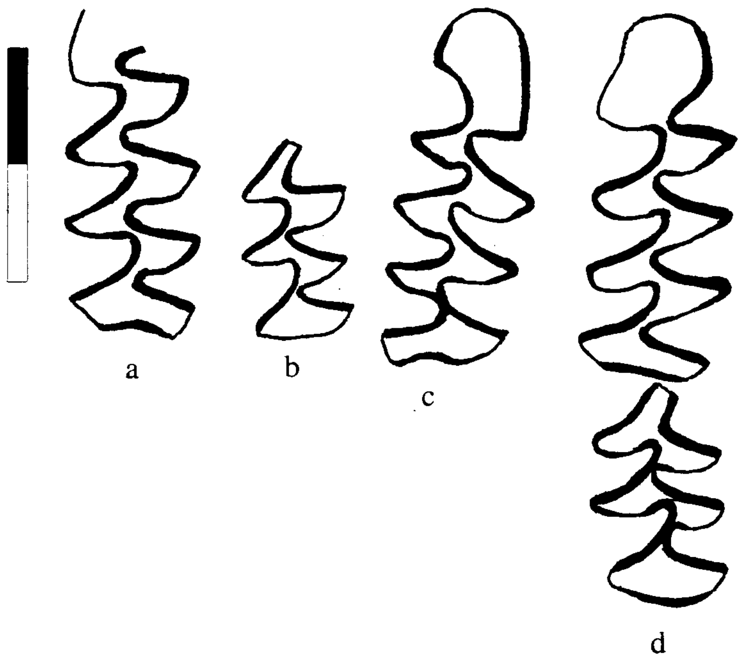

Fig. 4-15—Occlusal surface of teeth of *Eolagurus luteus*: *a*–M_1; *b*–M_2, Kabazi V, Level III/1; *c*–M_1, Kabazi V, Level III/2; *d*–M_1 and M_2, Kabazi V, Layer III/3.

Arvicola terrestris Linnaeus (1758) – water vole

Material

Kabazi V—1 M^1 (Level II/4a); 1 M^1 (Level II/3).

Starosele—3 M^1, 5M^2, 1 M^3, 5 M_1, 5 M_2, 2 M_3 (Level 1); 1 M_1 (Level 2); 2 M_1, 2 M^2, 1 M_3, 2 fragments of mandibles (Level 3); 1 M_1, 1 M_2, 1 M^1 from the sterile horizon between Levels 3 and 4.

Description

Arvicola has an unrooted, cemented vole with a large size and massive structure of teeth. The enamel is differentiated by "microtus" type.

There are 5 dentine fields on the M_1 occlusal surface (fig. 4-16a-c). The anteroconid complex has a rather simple trefoil structure without additional angles.

The third upper molar has 4 dentine fields on the occlusal surface and a simple asymmetrical posterior angle (fig. 4-16d). The sizes of M_1 and enamel coefficient K (value of the ratio between the enamel thickness on the anterior part of all angles of the tooth and the posterior part of the angles) are presented in Table 4-7.

Comparison

Arvicola tooth remains from Starosele can be compared with the teeth of Late Pleistocene *Arvicola* by their dimensions (Table 4-8). The length and width of the M_1 of *Arvicola terrestris* from Starosele is significantly bigger than the M_1 of the Middle Pleistocene water

TABLE 4-7

Measurements of M_1 of *Arvicola terrestris* from Starosele (in mm)

	Length					*Width*					*Anteroconid Length*					*K*				
	N	$\bar{X}$	*Min*	*Max*	*S.D.*	*N*	$\bar{X}$	*Min*	*Max*	*S.D.*	*N*	$\bar{X}$	*Min*	*Max*	*S.D.*	*N*	$\bar{X}$	*Min*	*Max*	*S.D.*
Level 1	3	4.10	4.00	4.30	0.17	3	1.70	1.60	1.80	0.10	3	1.87	1.80	2.00	0.11	3	1.39	1.33	1.50	0.12
Level 3	1	4.25	—	—	—	1	1.70	—	—	—	1	2.10	—	—	—	1	1.25	—	—	—

TABLE 4-8

Measurements of M_1 of *Arvicola* from Starosele and Pleistocene Localities of the Russian Plain (in mm)

			Length				*Width*				*K*			
			N	$\bar{X}$	*Min*	*Max*	*N*	$\bar{X}$	*Min*	*Max*	*N*	$\bar{X}$	*Min*	*Max*
Late Pleistocene	Late Valdai	Troitsa II[1]	3	3.91	3.67	4.10	3	3.91	3.70	4.10	3	1.25	1.20	1.40
		Starosele, Level 1	3	4.10	4.00	4.30	3	1.70	1.60	1.80	3	1.39	1.33	1.50
		Starosele Level 3 & 3a	1	4.25	—	—	1	1.70	—	—	1	1.25	—	—
	Mikulino Interglacial	Shkurlat	3	3.72	3.50	4.00	3	1.65	1.50	1.80	3	1.94	1.67	2.50
		Malyutino	4	3.94	3.75	4.20	4	1.59	1.50	1.65	4	1.63	1.00	2.33
		Chernianka	4	4.00	3.80	4.20	4	1.55	1.50	1.60	4	1.00	0.90	1.11
		Novonekrasovka (up. layer)	18	3.84	3.50	4.10	18	1.66	1.50	1.75	18	1.15	0.67	1.66
		Novonekrasovka (lower layer)	14	3.78	3.60	4.00	14	1.66	1.50	1.75	14	1.08	0.91	1.67
Middle Pleistocene	Dnieper Glaciation	Igorevka	3	3.41	3.30	3.65	5	1.42	1.40	1.45	5	0.79	0.73	0.90
	Likhvin Interglacial	Gun'ki I	23	3.43	3.15	3.70	35	1.45	1.50	1.55	35	0.80	0.33	1.00
		Gun'ki II	12	3.38	3.20	3.45	9	1.49	1.30	1.65	12	0.47	0.33	0.83
		Chigirin	48	3.49	3.20	3.90	62	1.47	1.30	1.65	62	0.94	0.60	1.25
		Verkhnya Emancha	33	3.38	3.00	3.75	48	1.35	1.25	1.60	8	0.96	0.75	1.00

[1] Dated to 32,500±700; 26,860±300; 27,700±350 BP

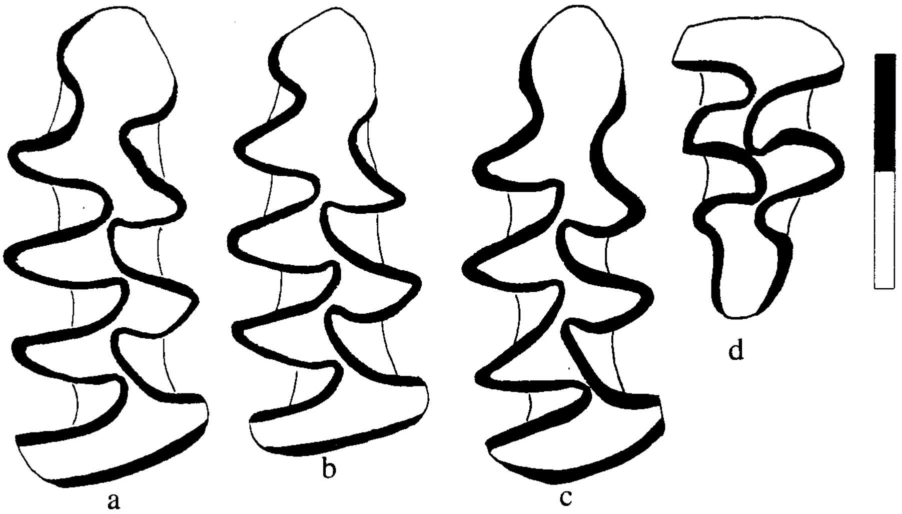

Fig. 4-16—Occlusal surface of teeth of *Arvicola terrestris* from Starosele: *a-b*–M_1. Level 1; *c*–M_1, Level 3; *d*–M^3, Level 1.

vole. It is also bigger than first lower molars of Mikulino *Arvicola* from various localities of the Russian Plain (Table 4-8).

One of the most important characteristics to identify the evolutionary level of water voles is the value of the ratio between the enamel thickness on the anterior part of all angles of the tooth and the posterior part of the angles, which is described by coefficient (K). This ratio can be measured different ways (Markova 1981, 1982a; Heinrich 1987, 1990). Here, we used this coefficient in the same way as we used it in our earlier publications (Markova 1981, 1986, 1990). The comparative information of fossil *Arvicola* was also taken from these publications.

As is seen in Table 4-8, the coefficient K of the Starosele water vole is close to the parameters of Mikulino and Late Valdai water voles. The coefficient K easily distinguishes these fossils from the Middle Pleistocene water vole *Arvicola chosaricus* and the more ancient *Arvicola cantiana*. The latter species is characterized by a K less than 1. In addition, practically all Middle Pleistocene water voles are characterized by an M_1 length of less than 4.0 mm. The M_1 length of different modern *Arvicola* of the Russian Plain is larger than 4.0 mm (Markova 1982a). The fossil remains of water voles from Crimean sites can therefore be definitely described as *Arvicola terrestris*.

APPENDIX: PROVENIENCE AND SAMPLE SIZES OF SMALL MAMMAL REMAINS

Kabazi II

Kabazi II/95, Sterile layer between Units III and IV, Sq. 39; depth -6.95-7.30 m

Ellobius (Ellobius) talpinus Pallas	1 M^1, M^2, 2 incisors

Kabazi V

Kabazi V/90, Level II/3; КПЭ-Я

Microtus sp.	mandible without teeth

Kabazi V/90, Level II/4/5

Microtus (Microtus) arvalis obscurus Pallas	1 M_1, 1 mandible
Apodemus sp.	1 M_3

Kabazi V/95, Level II/4A, Sq. 8D

Spermophillus sp.	P_4, 1 M_1, 3 M1, 4 M2, 1 M3, 2 remnants of upper mandible
Ellobius (Ellobius) talpinus Pallas	1 M_3
Eolagurus luteus Eversmann	1 M_1, 1 M1, 1 M2
Lagurus lagurus Pallas	1 M_3, 1 M2
Microtus (Microtus) arvalis obscurus Pallas	3 M_1, 1 M_2, 1 M_3, 3 M1, 2 M2

Kabazi V/94, Level II/4A

Arvicola terrestris Linnaeus	1 M1
Microtus (Microtus) arvalis obscurus Pallas	4 M_1, 3M_2, 6 lower mandibles; 1 upper mandible

Kabazi V/95, Level II, Horizon 3+4, Sq.10A

Spermophillus sp.	1 M3
Apodemus (Sylvaemus) ex gr. flavicollis Melch	1 M_1, 1 lower mandible without teeth
Lagurus lagurus Pallas	1 M_2
Microtus (Microtus) arvalis obscurus Pallas	18 M_1, 5M_2, 1 M_3, 11 M1, 7 M2, 7 M3, 7 remnants of lower mandibles
Microtus (Pallasiinus) cf. oeconomus Pallas.	1 M_1, 2 M1

Kabazi V/95, Level II, Horizon 3, Sq.12B

Talpa sp.	1 M_2
Sorex araneus Linnaeus	1 lower mandible with M_2
Spermophillus sp.	1 M_2, 1 M_3
Allactaga major Kerr	1 M_1
Cricetulus migratorius Pallas	1 M_1, 1 M_2
Arvicola ex gr. terrestris Linnaeus	1 M1,
Lagurus lagurus Pallas	1 M_2
Microtus (Microtus) arvalis obscurus Pallas	19 M_1, 3 M_2, 2 M_3, 9 M1, 6 M2, 1 M3, 5 remnants of lower mandibles, 20 incisors

Kabazi V/90, Level III; D-9; sample 6

Eolagurus luteus Eversmann	1 lower mandible without teeth, 1 incisor
Microtus sp.	1 lower mandible without teeth

Kabazi V/94, Level III/2

Spermophillus pygmaeus Pallas	1 mandible, 1 P3, 1 M2
Microtus sp.	1 M_2, 1 incisor

Kabazi V/94, Level III/1A

Spermophillus pygmaeus Pallas	1 lower mandible with P4 - M3, 1 lower mandible with

	P_4 - M_3, 1 upper mandible with P_4, & 1 M1
Lagurus lagurus Pallas	6 M_1, 5 M_2, 2 M_3, 4 M1, 2 M2 ,1 M3

Kabazi V/94, Level III/1

Spermophillus pygmaeus Pallas	2 P4, 1 M2
Microtus (Microtus) arvalis obscurus Pallas	1 M_1, 1 M_2
Microtus (Stenocranius) gregalis Pallas	2M_1

Kabazi V/94, Level III/2

Spermophillus sp.	1P4, 1 M2
Microtus sp.	1 M_1, 1 incisor

Kabazi V/95, Level III/I; Sq 8D

Spermophillus pygmaeus Pallas	1 M_1
Eolagurus luteus Eversmann	1 M_1, 1 M_3
Microtus (Microtus) arvalis obscurus Pallas	1 M_1, 1 M1, 1 M2

Kabazi V/95, L III/2; Sq 9A-B

Spermophillus pygmaeus Pallas	1 M1, 1 M2, 1 M, lower mandible with M_2
Eolagurus luteus Eversmann	1 M_1
Microtus (Microtus) arvalis obscurus Pallas	3 M_1, 3 incisors

Kabazi V/95, Level III/3

Eolagurus luteus Eversmann	1 M_1, 1 M_1

Starosele

Starosele/94, Level 1, Sq. H24; U24; G23

Allactaga major Pallas	1 M_1
Cricetulus migratorius Pallas	Mandible with M_1 - M_3
Arvicola terrestris Linnaeus	2 M1, 2 M2, 2 M_2, 1 M_3
Microtus (Microtus) arvalis obscurus Pallas	11 M_1, 5 M1, 2 M2

Starosele/94, Level 1, horizon 1

Ellobius (Ellobius) talpinus Pallas	2 M_1, 2M1, 3 M2, 4 incisors
Arvicola terrestris Linnaeus	1 M_1, 1 M2, 1 M2, 5 incisors
Microtus (Microtus) arvalis obscurus Pallas	5 M_1, 1 M2, 2 lower mandibles, 12 incisors

Starosele/95, Level 1

Talpa sp.	1 lower mandible with M_1 - M_3
Spermophillus pygmaeus Pallas	1P 3, 1 M2
Allactaga major Kerr	2 M1, 1 M3
Sicista subtilis Pallas	2 M_1
Ellobius (Ellobius) talpinus Pallas	3 M_1, 2 M_2, 1 M_3, 3M1, 5 M2, 5 incisors
Apodemus (Sylvaemus) ex gr. flavicollis Melch	2 M_1, 1 M_2,1 M_3, 1 lower mandible without teeth
Arvicola terrestris Linnaeus	4 M_1, 2M_2, 1 M_3, 1 M1, 2 M2, 1 M3
Microtus (Microtus) arvalis obscurus Pallas	34 M_1, 3 M_2, 2 M_3, 26 M1, 7 M2, 5 M3, 9 lower mandibles, 3 upper mandibles, 50 incisors

(16 M1 from this layer have large size - more than 3.00 mm)

Starosele/94, Level 2, Sq. E22, G22

Apodemus (Sylvaemus) ex gr. flavicollis Melch	1 M_1, 1 M_1 +1 M_2
Cricetulus migratorius Pallas	2 M1, 1 M2
Lagurus lagurus Pallas	2 M_1 + 2 M_2
Arvicola ex gr. terrestris Linnaeus	1 M_1
Microtus (Microtus) arvalis obscurus Pallas	1 M_1, 1 M_2, 2 M1, 1 M2, 1 M3

Starosele/94, Level 2, Sq. E22

Apodemus (Sylvaemus) ex gr. flavicollis Melch	1 M_1 -1 M_3 in lower mandible, 1 incisor
Microtus (Microtus) arvalis obscurus Pallas	1 M_1, 1 M_1, 2 incisors

Starosele/95, Level 2

Microtus (Microtus) arvalis obscurus Pallas	3M_1, 1 M2
Apodemus sp.	1 lower mandible

Starosele/95, Pondsilt between Level 3 and Level 3a, Sq. G22;

Microtus (Microtus) arvalis obscurus Pallas	2 M_1, 1 M_1, 2M1

Starosele/94, Level 3+3a, E19, Depth -431

Arvicola terrestris Linnaeus	1 M_1, 1 M_3, 2 fragments of mandibles, 1 incisor

Starosele/94, Level 3, G19, Depth -443

Ellobius (Ellobius) talpinus Pallas	1 M_1, 1 M_2, 2 incisors
Microtus sp.	1 M1

Starosele/95, Level 3a, F22, Depth -1,67-1,72

Lagurus lagurus Pallas	1 M_3
Microtus (Microtus) arvalis obscurus Pallas	1 M_1, 1 M_2, 1 M1

Starosele/95, Level 3, Depth 1,65-1,73m

Ellobius (Ellobius) talpinus Pallas	1 remnant of tooth
Lagurus lagurus Pallas.	1 M_3
Arvicola ex gr terrestris Linnaeus	1 M1, 2 M2
Microtus (Microtus) arvalis obscurus Pallas	3 M_1, 1 M_1,1 M1, 1 incisor, 1 M2, 1 M3, 10 incisors

Starosele/94, sterile horizon between Levels 3 and 4

Ellobius (Ellobius) talpinus Pallas	2 M_1, 2 M1, 3 M2
Apodemus sp.	Lower mandible without teeth
Arvicola terrestris Linnaeus	1 M_1, 1 M_1, 1 M1
Microtus (Microtus) arvalis obscurus Pallas	2 M_1, 2 M_1 + 2M_1, 1 M2, 3 lower mandibles, 14 incisors
Microtus sp. (large form)	1 M_1

Starosele/95, sterile horizon between Levels 3 and 4, Depth -1,73- -2,10 m

Microtus sp.	1 M1, 1 M2

Starosele/95, Level 4

Microtus (Microtus) arvalis obscurus Pallas	1 M_1, 1 M_2, 4 M1, 1 M2, 1 M3, 16 incisors