

THE GREATER MOLE-RAT (*SPALAX MICROPHTHALMUS*) AND HUMANS: FACETS OF INTERACTION IN THE MIDDLE VOLGA REGION

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The greater mole-rat (*Spalax microphthalmus*) and humans: facets of interaction in the Middle Volga Region. — A. Andreychev. — In Mordovia, there is a relict local population of the greater mole-rat (*Spalax microphthalmus*). Similar isolated populations of the greater mole-rat have been preserved only in a few regions of the Volga Region. They are confined to refugia of steppe vegetation. In these regions, the greater mole-rat needs protection. However, people violate the animals' habitats and destroy them. This is also typical for Mordovia, where a stable small population has existed for a long time. The aim of the paper was to study changes in the impact of human activity on the population of the greater mole-rat at the northern border of the species' range. The impact of human activity on one of the settlements in the local population was studied. This territory was a hotbed from which there was a settlement to adjacent suitable sites. Since 1974, this territory has been a complex natural monument "Levzhenskiy Landscape Reserve." Twenty-five individuals (13% of the total population in the region) lived in the area of human impact. The settlement of animals in the direction of the city due to plowing the steppe meadow was revealed. It was noted that the greater mole-rat appeared near roads, houses, and gardens where they had not been recorded before. Individual mounds were found between the extreme houses of the village of Levzhenskiy and this plowed area. In addition, fresh mounds from one burrowing system were found in a narrow strip (3 meters) between the road and the plowed area. In both cases, we are talking about individual survivors. In comparison with cattle grazing, plowing of a steppe meadow is a significant negative impact on the greater mole-rat since it is the destruction, first of all, the food base. Earlier, greater mole-rats did not migrate massively from their plots because of cattle grazing. This impact has not only changed the state of the population, but may be one of the reasons for the disappearance of the population in general. Paleontological findings within the city limits confirm the former wider distribution of the greater mole-rat.

Key words: mole-rat, local population, human impact, geographical distribution.

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Introduction

The greater mole-rat has not been studied in all regions of Russia. More attention to the ecology and biology of the species was paid in Kursk, Voronezh, and Belgorod Oblasts. For other regions, there is mainly fragmentary information, which, usually, is limited to a description of the distribution and status. The greater mole-rat has a status of rare species in Tambov, Ryazan, Samara, and Ulyanovsk Oblasts, as well as in the republics of Mordovia and Chuvashia. Therefore, the research in other regions, in particular, where relict local populations are preserved, is of great importance. It is no coincidence that A. Yu. Puzachenko proposes to consider isolated populations as vulnerable or potentially vulnerable.

The fact is that, at the end of the Pleistocene, greater mole-rats inhabited arid steppes, and with the onset of forests in the Holocene, the northern edge of the species' range, as well as many other steppe species, shifted markedly southward and only a few populations remained in the former distribution boundaries. In the Volga Region, greater mole-rat isolates were preserved in the refugium of steppe vegetation in Mordovia, Chuvashia, Nizhny Novgorod, and Samara Oblasts. However, even in these isolated populations, the greater mole-rat is threatened by human activity. This is expressed in the destruction of individuals, plowing suitable habitats, which ultimately leads to a reduction in the species' range. This situation is noted in Mordovia. Previously, we studied various aspects of the biology and ecology of the greater mole-rat in the region (Andreychev 2018, 2019). In

the areas where we studied the mole-rat earlier, the situation has changed drastically. As it turned out in the course of the research, the reason for this is human activity.

The aim of this paper is to study changes in the impact of human activity on the local population of the greater mole-rat at the northern border of the species' range. These tasks are urgent, since the population of greater mole-rat was stable earlier before it was taken out of equilibrium. This impact has not only changed the state of the population, but may be one of the reasons for the disappearance of the population in general.

Material and Methods

The research was conducted in Ruzaevsky district and Saransk city district in 2019–2020 (geographical coordinates 54°05'–54°09' N and 44°59'–45°06' E) (Fig. 1). They covered mainly the Levzhenkiy central section (Andreychev 2019) of the greater mole-rat's range in the region. The species' abundance on the plots was determined by the number of mounds per hectare (Dukel'skaya 1932; Gulyaevskaya 1954; Pavlov *et al.* 1963; Puzachenko & Vlasov 1993).

Results and Discussion

Natural and anthropogenic factors in Mordovia have long been limiting the dispersal of this species. The settling of the greater mole-rat on the west and south occurs along the Levzha river and its left tributaries. Settlement to the north was limited to the forest area of Saransk. Settlement to the east was limited by the highway and the Insar river. We compared the current range boundaries of the greater mole-rat with data on its distribution in Mordovia in the past (Astradamov *et al.* 1976; Andreychev *et al.* 2010). It was noted that it has significantly expanded the areas of its habitat.

During last years, the greater mole-rat has managed to expand its range to the east to Kulikovka village, to the west to Klyucharevskie Vyselki village, and to the south to Levzha village. No settlement was registered in the north. The distance between the furthest detection points is 15 km from north to south. This distance was 10 km in 2010 (Andreychev *et al.* 2010). The distance between the extreme detection points is 10 km from west to east. This distance was 8.8 km in 2010.

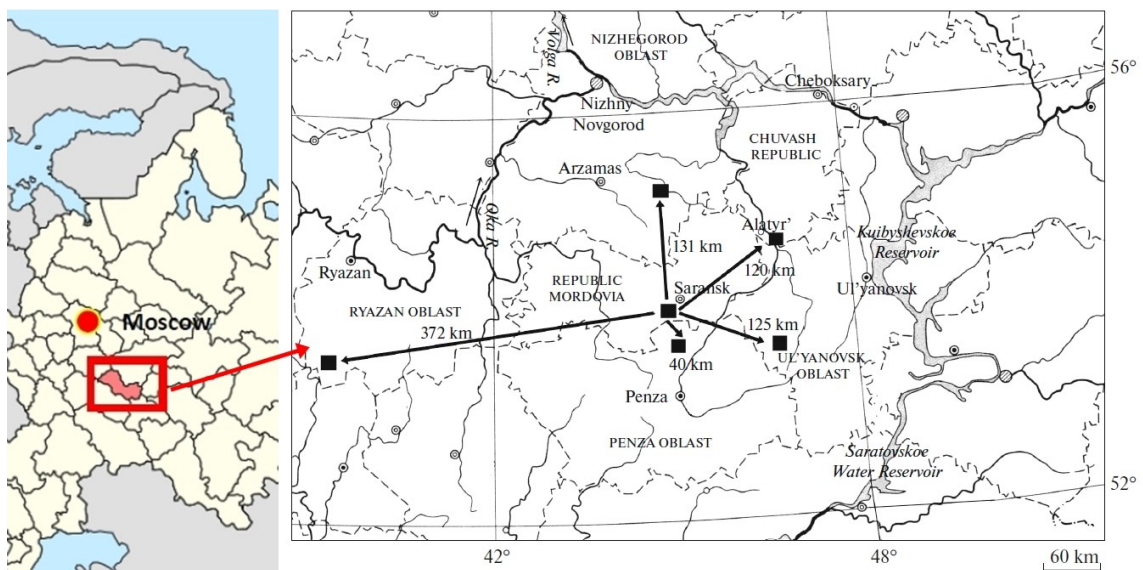


Fig. 1. Geographical position of the Republic of Mordovia in the European part of Russia and distance of the local population of *Spalax microphthalmus* from other populations in neighboring regions. Note: → — remoteness of population with the distance indicated (km), ■ — points of closest populations.

Рис. 1. Географічне положення Республіки Мордовія у Європейській частині Росії і віддаленість локальної популяції *Spalax microphthalmus* від інших популяцій у сусідніх регіонах. Примітка: → — віддаленість популяції з позначенням відстані (км), ■ — точки найближчих популяцій.

A distinction was made using the OziExplorer program for 13 greater mole-rat habitats. The territory of detection of the greater mole-rat is currently more than 100 km². The area was previously 26.8 km² in 2010. However, the actual inhabited area is 5.683 km². In 2010, it was 2.977 km² (11.1 % of the total area). This is due to the fact that *S. microphthalmus* does not inhabit crop fields, wastelands, and woodlands in the studied area. Instead, it prefers steppe meadows, pastures, garden plots, hay meadows. Mounds are also in close proximity to ponds and wetlands.

However, the population of the greater mole-rat is experiencing significant anthropogenic pressure. In the spring of 2019, the Levzhenskiy central section of the greater mole-rat's habitat was plowed. This territory was a hotbed or reservoir, from which there was settlement to adjacent suitable areas. The description of this area of the greater mole-rat's habitat has been known since 1971 (Astradamov *et al.* 1976). Since 1974, this territory has been a complex natural monument "Levzhenskiy landscape reserve." It is organized by the Decree of the Council of Ministers of the Mordovian ASSR "On the organization of natural monuments" issues on 29.06.1979 No. 473. The area of the reserve was 18 hectares. In addition to the greater mole-rat, there were different types of rare plants under protection, including *Prunus fruticosa*, *Prunus spinosa*, *Prunus tenella*, *Chamaecytisus ruthenicus*, *Adonis vernalis*, *Spiraea crenata*, *Stipa pennata*, *Delphinium cuneatum*, *Senecio schvetzovii*, *Aconogonon alpinum*, and *Iris aphylla*.

Because either the period of existence of the natural monument ended or without any permission this territory was destroyed. This crime has yet to be clarified by the environmental authorities of the region. However, during the inspection of long-existing burrows, we did not find any greater mole-rats in a plowed field. We consider it appropriate to provide illustrative material of this habitat of the greater mole-rat before and after plowing (Fig. 2). It can be seen that the soil is replete with rotting rhizomes of plants and in some places there is an accumulation of water (beginning to swamp).

Individual mounds were found between the extreme houses of Levzhenskiy village and this plowed area. In addition, fresh mounds from one burrowing system were found in a narrow strip (3 meters) between the road and the plowed area. In both cases, we are talking about individual survivors. Previously, we noted the existence of 25 individuals in this area. Considering that the total population of greater mole-rat in Mordovia based on the results of our censuses, which are being prepared for publication, is 190 individuals, the twenty-five individuals on the Levzhenskiy site constitutes about 13 % of the total population. In conditions of an isolated local population, it was one of the stable settlements, along with the settlements near Klyucharevskie Vyselki, Klyucharevo, and Popovka. It should be taken into account that other local populations of the greater mole-rat in neighboring regions (Penza oblast, Chuvashia) are located at a distance of at least 40 and 120 km, respectively (Andreychev 2019).

The plowed field still shows patches of clay soil where we previously found winter mounds (Fig. 3). They only testified to the fact that there recently was inhabited by a rare underground rodent. What happened to the animals from this territory? Were they able to move to adjacent areas or did they die? Our results provide a partial answer to this question. Over the past two years, greater mole-rats have been found directly in the city. New mounds were found near stops (Fig. 4 a), sidewalks (Fig. 4 b), highways (Fig. 4 c), churches, and in vegetable gardens.

Previously, we reported on cattle grazing on the Levzhenskiy site (Fig. 5), where more than 150 heads of cattle were grazed annually. That is, the settlement of the greater mole-rat has been experiencing anthropogenic impact for many years. Cattle pushed through the greater mole-rat's burrows, violating their integrity (Fig. 6). Animals in the places of failures of feed passages conducted a renewed digging activity. Gradually, there were new mounds of earth.

It is known that grazing has a positive effect on different types of steppe mammals. In particular, this was shown for the steppe marmot (Ronkin & Savchenko 2004; Savchenko & Ronkin 2018). In relation to the greater mole-rat, the population of which we observed in the Volga Region, we can also consider this conclusion valid, since the species' population has existed for a long time in the vicinity of Levzhenskiy village. However, this effect was not as significantly a negative factor as the ploughing of steppe meadows.



Fig. 2. Habitat of the greater mole-rat before plowing (2018) and after plowing (2020).

Рис. 2. Оселище сліпака східного до розорювання (2018 рік) і після розорювання (2020 рік).



Fig. 3. The spots of clay soil on the plowed field are traces of the existence of mounds from the wintering chambers.

Рис. 3. Плями глинистого ґрунту на розораному полі — сліди існування сліпаковин із зимувальних камер.



Fig. 4. Fresh mounds by the bus stop (a) and by the sidewalk (b), by the road in the village of Yalga (c).
 Рис. 4. Свіжі сліпаковини біля автобусної зупинки (a), тротуару (b) і автодороги в смт Ялга (c).



Fig. 5. Grazing of a herd of cattle on the Levzhenskiy site of the greater mole-rat's habitat (arrows show the mounds).
 Рис. 5. Випас стада великої рогатої худоби на Левженській ділянці оселища сліпака (стрілками показано сліпаковини).



Fig. 6. Destroyed burrows of the greater mole-rat after grazing a herd of cattle (arrows show burrows after trampling by hooves).

Рис. 6. Знищені нори сліпака східного після випасу стада великої рогатої худоби (стрілками показано провали нір після витоптування копитами).

Recently, the decline in natural habitats has been particularly severe in steppe meadows in Eastern Europe (Cremene *et al.* 2005; Habel *et al.* 2013; Zagorodniuk *et al.* 2018). We should definitely compare our data with the results in Ukraine, where the greater mole-rat is given close attention in various aspects of biology and ecology (Korobchenko 2012; Korobchenko & Zagorodniuk 2016; Korobchenko *et al.* 2018). The process of range contraction of the greater mole-rat was noticed by B. Golov more than 40 years ago, who wrote about a significant decline in the number of greater mole-rats in the west of Poltava Oblast. Modern research in Ukraine has shown that over the past 100 years, the distribution range of the greater mole-rat has decreased by half and was about 35,000 km². This steppe rodent species was preserved only in those habitats that were minimally affected by arable farming and other forms of active agricultural use (Golov 1975; Zagorodniuk *et al.* 2018). Range fragmentation has also been observed in other underground mammals (Patton & Yang 1977; Petrova *et al.* 2014; Visser *et al.* 2018). The reasons for which may be different. It is also important that in Ukraine the greater mole-rat demonstrates a clear link to habitats located near such localities as untilled lands, pastures with moderate grazing load, wastelands and abandoned lands, which make up a separate group of transformed habitats. This even allows the greater mole-rat to be considered a synanthropic species, since it inhabits biotopes located near villages and along roads (Zagorodniuk *et al.* 2018).

Conclusions

Thus, under the influence of human impact, namely plowing the habitat of the greater mole-rat on the Levzhenskiy site, the species began to spread towards the city of Saransk. However, we have yet to find out how the total number of the greater mole-rat in the local population will change due to human impact. Moreover, no less important question is will the species recover its Levzhenskiy settlement over time. There are prerequisites for this, since this field was ploughed and abandoned, that is, nothing was planted there.

Human activity leads to fragmentation of the habitat of the greater mole-rat within its range. A relatively recent discovery (15.06.17) of a paleontological find—the skull of an greater mole-rat at a depth of 2 m in the central part of the city of Saransk — indicates the species' former distribution in this territory. As it turned out as a result of examination, the discovered bones are dated to the Pleistocene. Currently, the greater mole-rat does not live in the vicinity of the discovery site. This paleontological finding and the modern mosaic distribution of the greater mole-rat in the urban area confirms the existence of the former wider range of the species in these territories.

We can suggest that in addition to natural factors in the fragmentation of the greater mole-rat's habitat, the influence of human activity is also important. In addition, in the future, there is a need to conduct genetic studies of the greater mole-rat in local populations. This will allow to compare changes in the genotype of animals after habitat fragmentation.

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