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Short communication: Ecological and faunal complexes of insectivorous mammals of the Republic of Mordovia, Russia

ALEXEY ANDREYCHEV♥
Department of Zoology, National Research Mordovia State University. Bolshevistskaya street, 68, Saransk 430005, Russia. Tel./fax.: +7-342-322637, ♥email: teriomordovia@bk.ru

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Abstract. *Andreychev A. 2020. Short communication: Ecological and faunal complexes of insectivorous mammals of the Republic of Mordovia, Russia. Biodiversitas 21: 3344-3349.* In this study, reports that the species composition and occurrence of species in geo-ecological districts are not the same. 12 insectivorous mammals species have been recorded in the territory of Mordovia. The largest number of species in the region belongs to those living in coniferous and broad-leaved forests (42%). In the second place in terms of representation are species widely distributed in several natural areas (33%). They are slightly inferior to the types of taiga fauna (25%). For each geo-ecological district, the features of the rodent fauna are given and rare species are identified. The forest-steppe region of Mordovia is compared in insectivorous mammals fauna with other regions of Russia with different typical faunal complexes.

Keywords: Habitat, insectivorous mammals, population, Russia, species

INTRODUCTION

A review of the literature on small mammals, mostly rodents, suggests that average population levels are largely determined by a balance of the positive effects of resources and the negative effects of enemies and that the strengths of these effects vary from habitat to habitat. Seasonal patterns of population change occur each year largely because of seasonal breeding; differences among years occur because of shifts in weather, resources, and enemies (Mapelli et al. 2012; Saetnan et al. 2012; Santos-Filho et al. 2012; Leon et al. 2013; Lobo and Millar 2013; Batzli 2014; Gasperini et al. 2016; Pitelka and Batzli 2018). Understanding the spatial distribution of species sheds light on the group's biogeographical history, offers clues to the drivers of diversity, and helps to guide conservation strategies (Maestri and Patterson 2016). However, the number and species composition of rodents depends largely on the landscape zone.

The beginning of the study of mammalian fauna in Mordovia is associated with the period of expedition research of academician Peter Simon Pallas 1768-1774. In the initial review work on birds and mammals of the middle and lower Volga valley, M. N. Bogdanov gives the first mention of 35 species of mammals from the modern territory of Mordovia. Before the formation in 1930 of the Mordovian Autonomous region, data on some new species of theriofauna for our region were reported for the territories of four provinces: Tambov, Nizhny Novgorod, Penza, and Siberia, some of which were part of modern Mordovia. Subsequently, the mammalian fauna of the region was updated with information about new species.

In this paper present updated information on the fauna of insectivorous mammals of the Mordovia, identify the distribution of representatives of these species in the geo-ecological districts within the studied territory, identify several ecological groups of local fauna insectivorous mammals, describe the characteristic habitats of species and discuss conservation of rare and vulnerable species in recent conditions.

MATERIALS AND METHODS

The Republic of Mordovia is located in the centre of the European part of Russia. Its extreme points are defined by geographical coordinates 42º11'-46º45' E and 53º38'-55º11' N (Figure 1). The maximum distance from west to east is 298 km and the distance from north to south is 57 to 140 km. The area of the republic is 26.2 thousand km^2. Features of the geological structure of Mordovia are determined by its location in the central part of the Russian Platform and the north-western slopes of the Volga Upland. In the western part of the Republic of Mordovia, the Volga Upland reaches the Oka-Don Lowlands.

The climate of the region is moderately continental with pronounced seasons throughout the year. The influx of direct solar radiation in Mordovia varies from 5.0 in December to 58.6 kJ/cm^2 in June. Total radiation throughout the year is 363.8 kJ/cm^2; the radiation balance is 92.1 kJ/cm^2. The average annual air temperature varies from 3.5 to 4.0 °C. The average temperature of the coldest month (January) is in the range of -11.5-12.3°C. Temperature drops down to -47°C occur. The average temperature of the warmest month, i.e. July, is in the range

of +18.9...+19.8 °C. Extreme temperatures in the summer reach 37°C. The average annual precipitation in the territory of Mordovia is 480 mm. Over the course of observation lasting many years, periods of more and less humidification were noted, ranging between the minimum and maximum values of 120-180 mm. Distribution of precipitation across the territory is not very diverse. The average long-term value of evaporation is calculated to be in the range of 390-460 mm.

According to the research of botanists, there are more than 1230 species of vascular plants from 495 genera and 109 families in the modern flora of Mordovia. These include 4 species of plains, 8 horsetails, 18 ferns, 3 gymnosperms, and 1,197 species of flowering plants. Herbaceous perennial and annual plants predominate. The number of species of woody forms is relatively small: trees - 24, shrubs - 45, shrubs - 7, semi shrubs - 5.

The territory of Mordovia includes coniferous broad-leaf, broad-leaf forests, shrub steppes and meadow steppes. The main forest forming species are the pine (*Pinus sylvestris*), spruce (*Picea abies*), European larch (*Larix decidua*), oak (*Quercus robur*), common ash (*Fraxinus excelsior*), Norway maple (*Acer platanoides*), European white elm (*Ulmus laevis*), silver and white birch (*Betula pendula*, *B. pubescens*), common alder (*Alnus glutinosa*), small-leaved lime (*Tilia cordata*) and black poplar (*Populus nigra*).

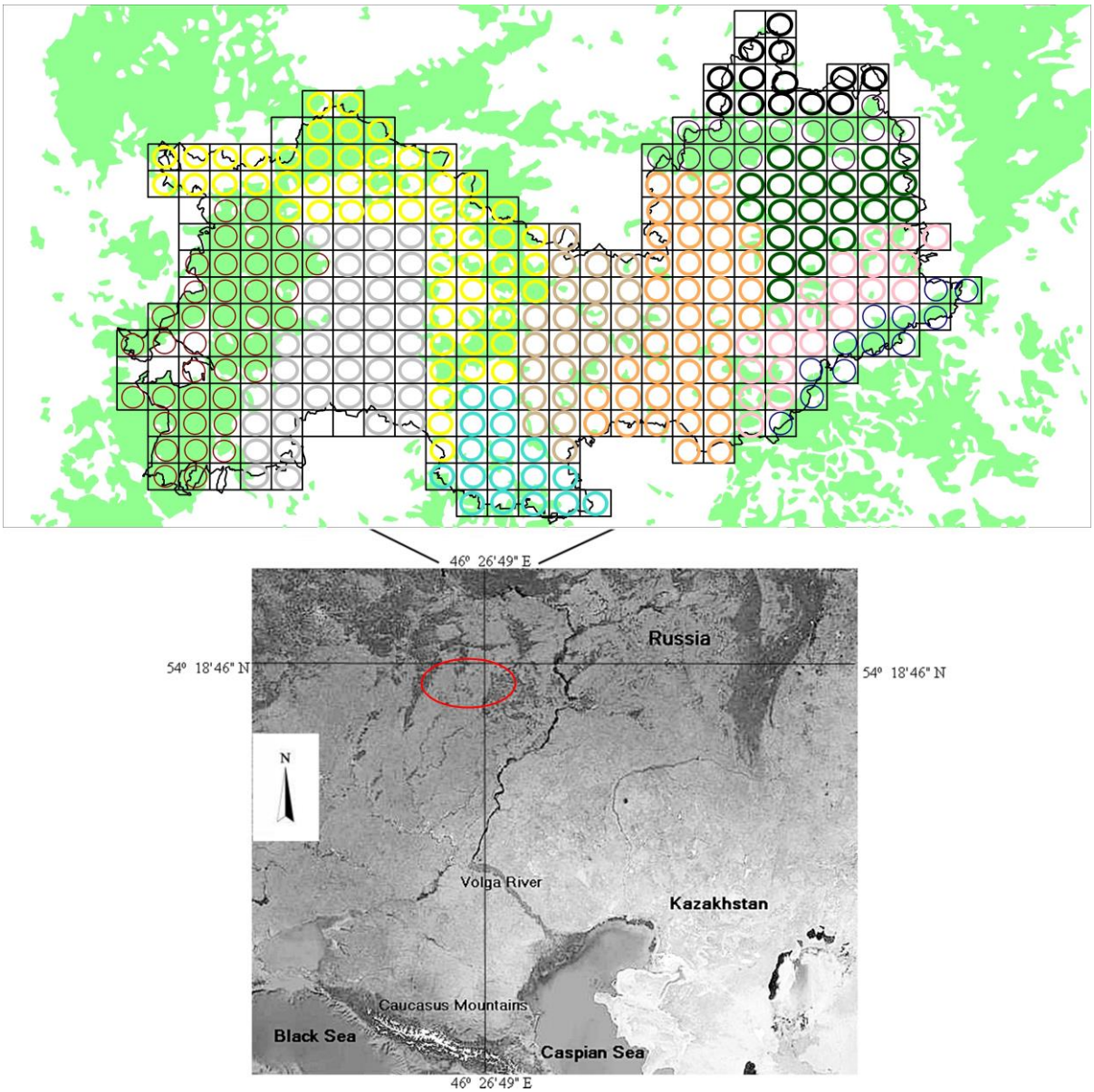

Figure 1. Location of geo-ecological districts in Mordovia (red oval-where animals were trapped). Note: red circle-Vadskiy district, yellow circle-Mokshinskiy district, grey circle-Moksha-Vadskiydistrict, blue circle-Yuzhniy district, brown circle-Issa-Sivinsko-Rudninskiy district, orange circle-Insarskiy district, purple circle-Prialatyrskiy district, green circle-Vostochniy district, pink circle-Yugo-vostochniy district, dark blue circle-Surskiy district, black circle-Menya-P'yanskiy district

Table 1. The species composition of insectivorous mammals in Mordovia belongs to ecological and faunal complexes

Ecological and faunal complexes		
Taiga	**Coniferous and broad - leaved forests**	**Widely distributed in several natural areas**
Sorex caecutiens - Laxmann's shrew	*Talpa europaea* - European mole	*Neomys fodiens* - Eurasian water shrew
Sorex minutissimus - Least shrew	*Desmana moschata* - Russian desman	*Neomys anomalus* - Southern water shrew
Sorex isodon - Taiga shrew	*Erinaceus europaeus* - West European hedgehog	*Sorex araneus* - Eurasian common shrew
	Erinaceus roumanicus	*Sorex minutus* - Eurasian pygmy shrew
	Crocidura suaveolens - Lesser white-toothed shrew	

The material for this work was the capture and visual registration of insectivorous mammals, as well as the collection of bird of prey in the Republic of Mordovia. The material was collected during expedition and stationary research in different districts of Mordovia in 2006-2019. Within the geo-ecological districts, for the greatest coverage of the species composition, the following habitats were selected as harvested: 1) mixed forest; 2) oak wood; 3) aspen; 4) meadow; 5) agricultural field; 6) swamp; 7) human construction. During the accounting period, 19255 trap-days (t-d) and 4525 cylinder-days (c-d) were setting the traps, of which 9220 t-d and 2650 c-d were setting the traps in forest biotopes; 5340 t-d and 1875 c-d in open stations; 2950 t-d in swamps; 1745 t-d in human buildings. A total of 23,780 small mammals were captured specimen.

When analyzing the belonging of registered rodent species, we used the classical works of Schwartz (1989). Latin names of species are given according to the classical nomenclature (Wilson and Reeder 2005). Based on these studies, taking into account the insectivorous mammals areas, the representation of various faunal complexes in the territory of the geoecological districts of Mordovia is determined (Table 1).

RESULTS AND DISCUSSION

On the territory of Mordovia, 12 insectivorous mammals species were recorded (Andreychev and Lapshin 2017). The largest number of species in the region belongs to those living in coniferous and broad-leaved forests (42%). In the second place in terms of representation are species widely distributed in several natural areas (33%). They are slightly inferior to the types of taiga fauna (25%). The species composition and occurrence of species in geo-ecological districts are not the same (Figures 2 and 3).

The analysis of the species composition of insectivorous mammals in the Insarskiy geo-ecological district for belonging to the types of faunae showed a significant number of representatives of widespread in several natural zones of the steppe faunal complex (43%) and coniferous-deciduous forests (43%). Taiga faunal complex species were less represented (14%). Of the representatives of the steppe faunal complex, two species (Lesser white-toothed shrew and Eurasian water shrew) are rare not only for the region, but also for the whole of Mordovia.

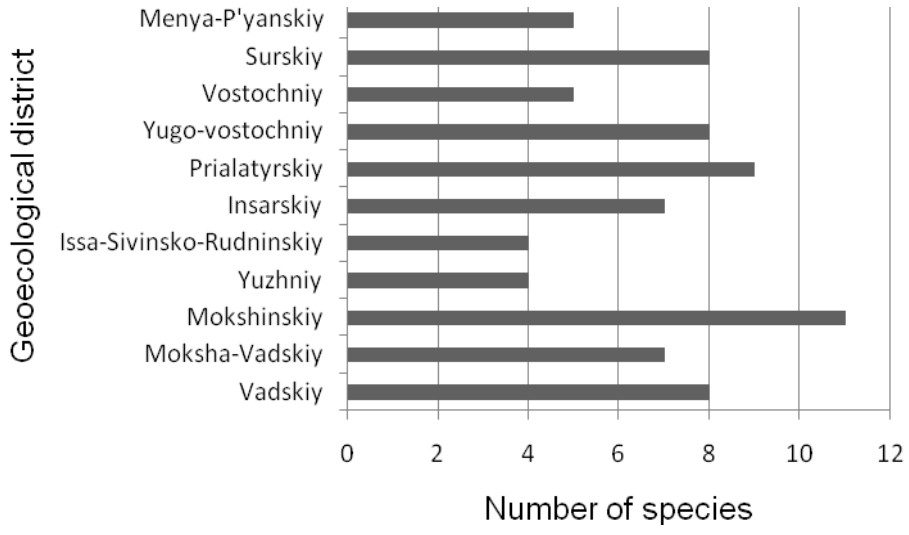

Figure 2. Number of insectivorous mammals species in the geo-ecological districts of Mordovia

Figure 3. Photo of insectivorous mammals in Mordovia. A. Hedgehog (*Erinaceus roumanicus*); B. Eurasian common shrew (*Sorex araneus*); C. Eurasian water shrew (*Neomys fodiens*); D. Lesser white-toothed shrew (*Crocidura suaveolens*); E. Taiga shrew (*Sorex isodon*); F. Mole (*Talpa europaea*) (Photograph by A. Andreychev)

For Vostochniy geoecological district, the dominant species in terms of faunal types are those widely distributed in several natural zones (40%) and types of coniferous and broad-leaved forests (40%). The taiga faunal complex is less represented by species (20%). There are no rare species in this district.

The composition of insectivorous mammals (by the number of species) of the Yugo-Vostochniy geo-ecological district for belonging to faunal types showed a relatively high number of species of coniferous and broad-leaved forests (50%). Species widely distributed in several natural zones and species of the taiga faunal complex were represented by 25%. Of the rare species of insectivorous mammals in this district, the Lesser white-toothed shrew tooth is recorded. For Yuzhniy and Isa-Sivinsky-Rudninskiy geo-ecological districts, an equal ratio of

species groups widely distributed in several natural zones (50%) and living in coniferous and broad-leaved forests (50%) was found. Steppe and taiga species are not noted here. According to the faunal division of insectivorous mammals, the Moksha-Vadskiy geo-ecological district is distinguished by the predominance of coniferous and broad-leaved forest species (42%). The share of taiga fauna species and species widespread in several natural zone accounts for 29% each. The rarest representative in this region is the Russian desman (Andreychev et al. 2020*a*). In relation to the faunal complexes Menya-P'yanskiy district is represented by two predominant groups of species widely distributed in several natural zones (40%) and living in coniferous-deciduous forests (40%). The taiga type of fauna is 20%.

Analysis of insectivorous mammal species recorded in the Mokshinskiy district showed its richness. There are 11 species noted here. The largest number are representatives of coniferous and broad-leaved forests (36%) and widespread in several natural zones (36%). Representatives of the taiga fauna have a representation of 28%. These are ostsibirische shrew, least shrew and masked shrew. Several rare species of insectivorous mammals have been recorded for this district (Russian desman (Andreychev et al. 2020*a*), least shrew, Lesser white-toothed shrew, Eurasian water shrew). Populations of Russian desman are subject to protection, as well as the Pyrenean desman (*Galemys pyrenaicus*) (Melero et al. 2012; Williams-Tripp et al. 2012; Pedroso and Chora 2014; Gillet et al. 2015; Biffi et al. 2016). In addition, an atypical species for the fauna of Mordovia-Southern water shrew *Neomys anomalus* (Borodin 2013) has been noted for this region.

The Vadskiy geo-ecological district is dominated by widespread species (38%) and coniferous-deciduous forests (38%). The territory of the district is almost completely covered with forest. For this reason, there is an optimal number of species such as the taiga shrew, Laxmann's shrew and European mole. Due to the dense network of forest rivers and lakes, there is a good population of Russian desman (Andreychev et al. 2020). The species of the taiga faunal complex also account for a fairly high percentage (24%). For the Prialatyrskiy district, the complex of coniferous-broadleaf forest species is of great importance for belonging to the faunal types - 44%. This is the highest representation of this type of fauna among all the geo-ecological districts of the Republic. Representatives of widespread species in several natural zones account for 33%. The taiga faunal complex is represented by 23% of insectivorous mammals species. The district is characterized by the presence of many rare insectivorous. Here live the Russian desman, Eurasian water shrew and Lesser white-toothed shrew. In the Surskiy geo-ecological district, coniferous and broad-leaved forest types predominate (38%) and species widely distributed in several natural areas (38%). Taiga faunal complex species are less represented (24%). This riverine region, as well as Moksha, Prialatyrskiy, also has a high species diversity. There are 8 species of insectivorous mammals.

In discussing the results, it is of great interest to compare the distribution by faunal type of the identified insectivorous mammal species in Mordovia with other regions of different natural zones. In particular, with the Saratov region, which belongs to the steppes of the European part of Russia. 9 species of insectivorous mammals have been recorded in this region (Shlyakhtin et al. 2008). Of these, the largest number of species are coniferous and broad-leaved forests (45%). In the second place in terms of representation are species widely distributed in several natural areas (33%). They are slightly inferior to the species of steppe fauna (22%). These two regions of different types of faunal zones differ in the presence of taiga and steppe species.

Comparison of the fauna of insectivorous mammals of Mordovia with the Vladimir region, which belongs to the area of coniferous-broad-leaved (mixed) forests. 7 species of insectivorous mammals have been recorded in this region (Kuzmin and Serbin 1998). Of these, the largest number of species is found in coniferous-deciduous forests (43%) and widely distributed in several natural zones (43%). The taiga type of fauna is represented by 14% of the total number of registered species. Insectivorous faunas of Mordovia and the Vladimir region are the most similar in terms of the representation of faunal complexes, compared to other regions of natural zones. Most of the insectivores were associated with the bushland habitat. Similar data on insectivores were obtained for northwestern Ethiopia (Chekol et al. 2012). A similar situation was noted in mountain forest ecosystems of the Beskydy Mountains (Suchomel et al. 2014). Highest diversity was observed in primeval forests.

Comparison of the fauna of insectivorous mammals of Mordovia with Karelia, which belongs to the taiga region. 8 species of insectivorous mammals have been recorded in this region (Ivanter 2008). Of these, the largest number of species belong to two types of fauna: taiga fauna (38%) and widespread in several natural zones (38%). Species of coniferous-broadleaf forests make up 24%. The insectivorous fauna of Mordovia differs from Karelia in a smaller proportion of taiga species. Thus, it should be noted that due to the transience of the forest-steppe fauna of Mordovia, the species composition of insectivorous mammals is richer (12 species) compared to the regions of typical natural zones. In Karelia, the responses to concentrated cuttings include a decrease in total population size, transition to an arrhythmic population dynamics with drastic short-term rises and deep long depressions, formation of unstable mosaic spatial distribution, disturbances of the reproduction rates, and a decrease in reproduction intensity (Ivanter and Kurkhinen 2016).

In Mordovia, the share of insectivorous species from the total species composition of mammals is 16%. This is a high indicator among other units. In comparison for Cisakan, Cianjur, West Java, Indonesia, the proportion of insectivorous species from other mammals is 7.7% (Withaningsih et al. 2018; Husodo et al. 2019). This is a distinctive feature of Mordovia from many mammalian faunas, where representatives of the orders carnivores,

rodents and bats predominate (Wirdateti et al. 2013; Sulistyadi 2016; Medina et al. 2018; Shanidah et al. 2018).

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