

Ecological Analysis of the Structure of Small Mammals in the Territory of the State Reserve "Sudochie-Akpetki" in the Aral Sea Region

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Abstract The article examines the results of ecological analysis of the structure of small mammals by species composition and relative abundance of different species. It is shown that the specificity of the formation of the species structure of small mammal communities is primarily determined by the ecological characteristics of the species that make up a particular community. It is established that the transition from stable communities to less stable ones often occurs with a non-distinctive change in the number and rank distribution of species due to the action of destabilizing factors.

Keywords Small mammals, Analysis, Species composition, Communities, Categories, Structure

1. Introduction

In the current conditions of the biosphere's crisis state, the priority direction of development of science and technology is rational nature management, aimed primarily at preserving the environment-forming functions of the surrounding natural environment [1,3]. In this regard, important objects of ecological and biological monitoring are ecosystems that are continuously exposed to a whole range of anthropogenic factors that exacerbate the impact of extreme natural factors. The specificity of the formation of the species structure of small mammal communities, on the one hand, is determined by the ecological characteristics of the species that make up a particular community, and on the other hand, by the specificity of the habitat, which, as is known, is characterized by heterogeneity. Heterogeneity of habitats is especially pronounced in conditions of anthropogenic destabilization of the environment [4,6].

2. Materials and Methods

The analysis of micromammalian communities was carried out on the basis of structural characteristics: the number of species, indicators of their total abundance and the

share of each species. According to the ratio of ecological groups in the small mammal community at the Sudochie site, psammophiles prevail, then ubiquitous. Eusinanthropes and mesophiles are distributed in equal proportions (Fig. 1).

3. Results and Discussion

At the Akpetki site, we observe the following ratio of the ecological structure of micromammalian. The main share belongs to psammophilic rodents - up to 50%, followed by ubiquitous. Their share is about 25%. The smallest percentage in the composition of rodent communities belongs to mesophilic rodent species - muskrat and Ili vole - 10%.

The increase in the dominance index of the great gerbil (*Rhombomysopimus*) in this series is indicative - an indicator species of transformed habitats against the background of a decrease in the dominance index of small mammal species characteristic of desert communities [5,7,8]. Among the mesophilic species, the Ili vole (*Microtus ilaeus*) can be distinguished - as an indicator species of humid areas of the protected natural area (PNA) of the Sudochie-Akpetki State Nature Reserve. The analysis showed that the main share of psammophilic species in two areas of the Akpetki and Sudochie nature reserve is about 50-60%, respectively. The share of ubiquitous species for Sudochie and Akpetki is also about 20 and 25%, respectively. As for the share of mesophiles, their share is in an equal ratio - 10% (Fig. 2).

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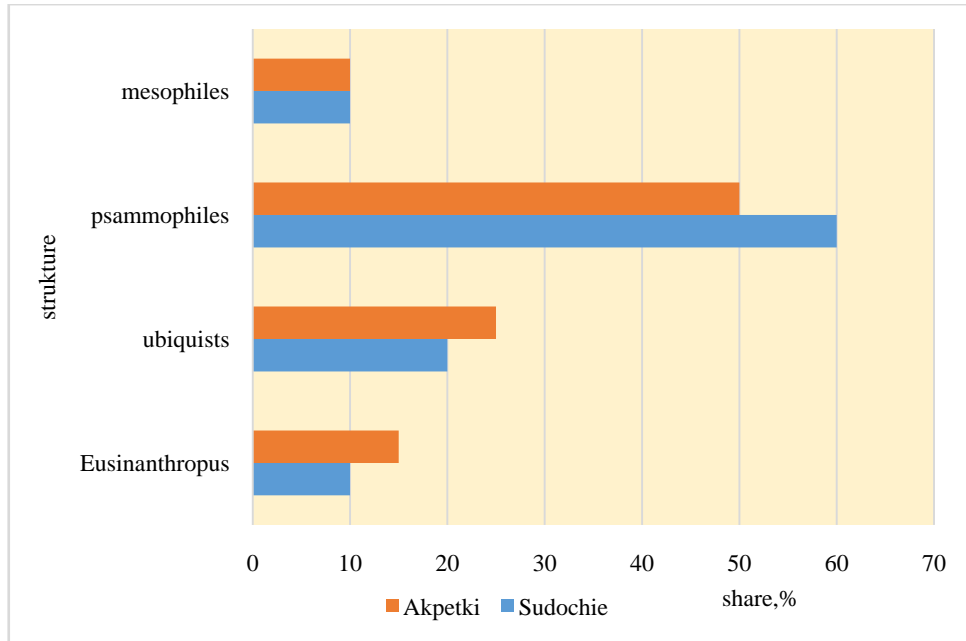


Figure 1. Ecological structure of small mammal communities in the Sudochie-Akpetki protected area

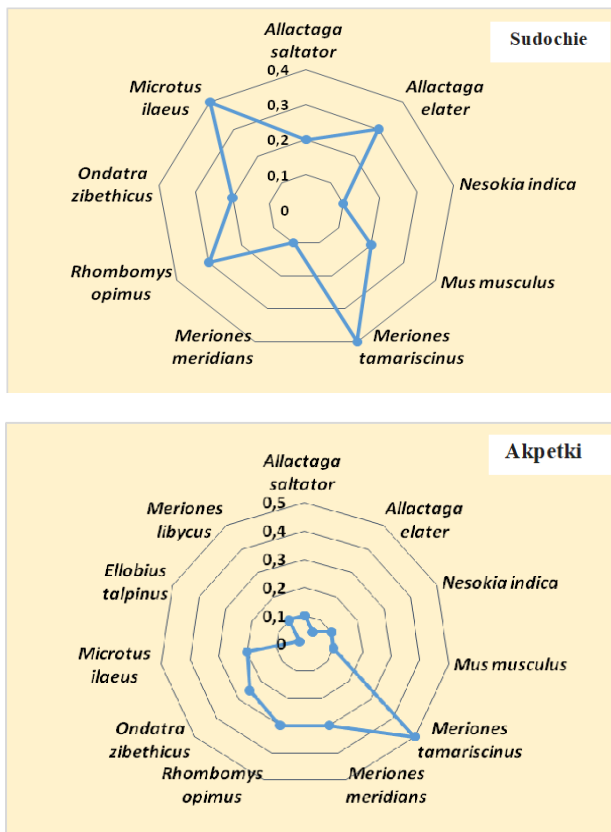


Figure 2. The structure of small mammal communities in the protected natural area of the Sudochie-Akpetki State Nature Reserve by species composition and relative abundance

The main representatives of psammophilic species are *Rhombomys opimus*, *Paradipus ctenodactylus*, *Meriones libycus*, *Allactaga saltator*, etc. The main representatives of ubiquitous rodents are *Allactaga elater*, *Allactaga bobrinskii*. The integrity of this structure is ensured by a certain diversity

of microteriocenoses of the two areas under consideration, isolated clusters. Such a change in the structure of microteriocenoses of the studied areas of the PNT State Reserve "Sudochie-Akpetki" is well comparable with the increasing anthropogenic load on the territory.

The identification of communities of living organisms in continuous habitats is currently an important section of theoretical and applied ecology. Many modern methods of multidimensional data analysis make it possible to display an ecological system defined on the basis of a set of its elements in a finite-dimensional coordinate system in continuous form [8,9,17]. However, in natural conditions we most often deal with discrete sets, which are most conveniently displayed using various classification methods.

The complexity of classifying ecological communities lies in the fact that, unlike such categories as species of living organisms, they are very ambiguous formations that often exist in the general space of a continuous habitat. At the same time, when solving various research problems, one has to deal with a very specific habitat and the population of organisms inhabiting it, which is studied only for a certain period of time, i.e. with a local or private ecological space [10,13,16]. The classification process itself comes down to the formation of non-intersecting subsets of elements (classes) isolated from the general set on the basis of a certain algorithm [11,17].

Cluster analysis of samples from different habitats by species composition and relative abundance of different species showed that small mammal communities of the studied areas of the PNT of the State Nature Reserve "Sudochie-Akpetki" form a single spatial structure with different structural and functional landscapes. Fig. 3. shows the change in the structure of small mammals in the direction of reducing its connection with the natural landscapes of the desert and humid zone of the PNT of the State Nature

Reserve "Sudochie-Akpetki".

The results of the analysis of the structure and abundance of rodents showed that in the area of the protected natural area "Sudochie" the main share in abundance is occupied by such species as *Allactaga elater*, *Meriones tamariscinus*, *Microtus ilaeus*. In the second area of the protected natural area "Akpetki" a slightly different picture is observed. Thus, the main share in abundance of rodents falls on the populations of *Rhombomysopimus*, *Meriones tamariscinus*, *Ondatra zibethicus* and *Mus musculus* [12,14,15].

Landscape transformation has a direct and indirect impact on the fauna and population of rodents, creating optimal conditions for the existence of some species and, conversely, unfavorable conditions for others. For the vast majority of rodent species in anthropogenic landscapes, the feeding conditions of biotopes are limited [2,4,11].

The populations of *Spermophilopsis leptodactylus*, *Citellus pygmaeus* and some species of *Dipodidae* underwent significant structural changes. Being highly specialized species, they were unable to adapt to habitats of anthropogenic origin, and their natural populations were on the verge of extinction due to the reduction of the range of characteristic biotopes to minimal sizes [9,10]. The complexity of classifying ecological communities lies in the fact that, unlike such categories as species of living organisms, they are very ambiguous formations that often exist in the general space of a continuous habitat. At the same time, when solving various research problems, we have to deal with a very specific habitat and the population of organisms inhabiting it, which is studied only for a certain period of time, i.e. with a local or private ecological space [19]. The general relative abundance of small mammals in the spring period, the period we studied, was almost similar in two areas - Sudochie and Akpetki. However, in the autumn period there is an increase in the diversity index, which is reflected in the cluster analysis.

The general dynamics of the rodent population in general for all biotopes of the territory of the protected natural area "Sudochie-Akpetki" is presented in Fig. 3.

In the period under review from 2019-2024, various trends in the dynamics of the population of background rodent species are observed: *Rhombomysopimus*, *Ondatra zibethicus*, *Meriones tamariscinus*, *Allactaga elater*. Thus, the *Rhombomysopimus* population has seen an increase in numbers and a significant increase in numbers over the past 2 years.

Trends in the decrease in the number of the psammophilic species *Allactaga elater* and the mesophilic species *Meriones tamariscinus* are also noted. As for the muskrat population (*Ondatra zibethicus*), it can be noted that the water regime of the lakes located on the territory of two sections of Sudochie-Akpetki is a limiting factor for the dynamics of the population. In this regard, the number has a stable form depending on the hydrological regime of water bodies.

The main factors influencing the formation, composition and structure of the rodent community can be classified as follows:

- a) geographical,
- b) temporal (successional cyclical with different periods of cycles),

The last group of factors in their influence on communities is multifaceted and can be similar to the effect of geographical (territorial) and temporal (successional) changes, since for many species there is an increase in the influence of limiting factors, similar either to the tightening of natural conditions or to their abrupt change.

The complex application of diversity indices and their comprehensive analysis allow us to differentiate communities by the changes occurring in them, caused by the action of the above groups of factors.

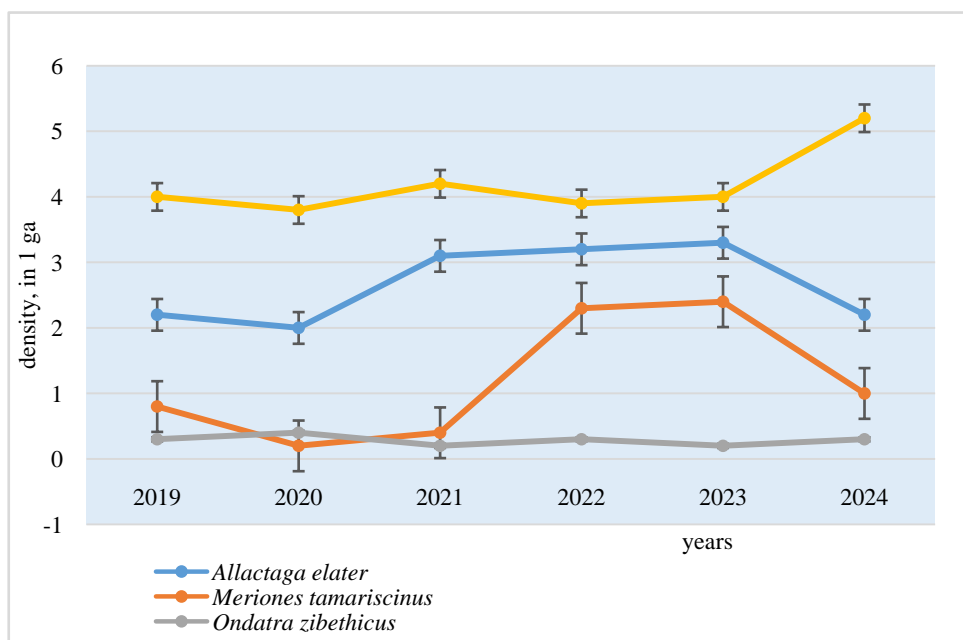


Figure 3. Dynamics of the number of background species of rodents in the territory of the protected natural area "Sudochie - Akpetki"

The categories of stability and sustainability of animal communities are characterized by spatiotemporal relationships of interdependent numerical characteristics of species [4,6]. It has been established that the transition from stable communities to less stable ones often occurs with an uncharacteristic change in the number and rank distribution of species due to the action of destabilizing factors [7,8,9]. The level of stability and sustainability of mouse-like rodent communities can be characterized by a change in the dominance structure [10].

4. Conclusions

Communities with uniform abundance and rank distribution of species are considered more stable, while those in which abundance and dominance structure change are considered less stable. Along with species richness and evenness, the spatial distribution of species in a community is of no small importance, depending on the landscape-ecological conditions in which the ecosystem is located.

Thus, the population of small mammals and its structure are formed under the influence of a number of factors, among which the location of the territory relative to the species range and its landscape features are of great importance. Usually, in the center of the species range, the population density is higher than on its periphery [19]. This is explained by the fact that in the central part of the species range, the most optimal conditions for the existence of animals are formed. Towards the periphery of the range, the habitat becomes more extreme: the pressure of abiotic and biotic factors increases, the area of habitats suitable for life decreases, therefore the distribution of animals takes on a mosaic character, and the population density decreases significantly.

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