# Imbalance of Environmental Conditions in Khorezm Oasis of Uzbekistan as a Factor of Change in the Number of Rodents

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**Abstract:** The article discusses the study of the dynamics of the population size of mesophilic species of rodents in the conditions of South Aral Sea region. When determining the dynamics of the population size, only the main parameters are taken into account, and the effect on the result of most of the many interacting system components is not taken into account. A correlation analysis of the long-term dynamics of the number of mesophilic species of rodents should be carried out taking into account the temporal dynamics of correlation due to adaptation processes that decrease the numerical value of the correlation coefficient over time.

**Key words:** Aral Sea region, Khorezm oasis, mesophilic species, rodents, ecosystem, abundance dynamics, hydro mode.

## INTRODUCTION

Currently, the spatially temporal dynamics of the ecosystem of Southern Aral Sea region is mainly due to the specificity of local interactions of the populations constituting the ecosystem with inert components of the environment, which allows the ecosystem to be classified as an ecological dissipative structure [6, 8]. Due to the fact that bifurcations of various processes occur in the critical region, the development of the self-organizing ecosystem of Aral Sea and Aral Sea region becomes irreversible.

Changes in the ecosystem of Southern Aral Sea region (Khorezm oasis), like any synergetic system, are inextricably linked with the desire for a stable state. Slow processes of development towards a new state of stability occur in stages and are designated by the concept of "succession". Unlike succession, a crisis is characterized by faster, nonlinear processes and an increase in entropy [1, 6]. The high speed of crisis transformations and processes creates a unique opportunity to accelerate the study of the speed and nature of adaptation, the degree of tolerance of biota to environmental changes, which in conditions of stability takes much longer.

The dynamics of the number of animals is one of the most complex problems of modern environmental science. This problem is of great theoretical and applied importance, since the knowledge of many important aspects of the evolutionary process and the development of measures for the rational use of natural resources and the preservation of biodiversity depend on its solution [5, 7].

A generalized analysis of the dynamics of the biota of Southern Aral Sea region (Khorezm oasis) is very difficult for many reasons, primarily due to the spatial and temporal discreteness of studies in time, and as a consequence, the absence of long series of representative empirical data necessary for a comprehensive statistical analysis.

## THE MAIN RESULTS AND FINDINGS

When determining the dynamics of population numbers, only the main parameters are taken into account, and the influence on the result of most of the set of interacting components of the system is not taken into account [1, 3]. As a consequence, the main quantitative method in this study is linear pair correlation.

The hydrological regime of Amu Darya (Fig. 1) is one of the main factors determining the population size of meso-and hydrophilic species of animals and plants; for other species of biota it is trans biotic, mediated mainly by climatic changes in the region towards an increase in aridity and continentally. According to the provisions of synergetics, a fluctuation that develops faster than others, as it were, “subjugates” the rest of the processes, and as a result, all elements of the system are involved in large-scale movement [6, 8].

Therefore, despite the fact that it is indirect, the hydrological regime of Amu Darya is the main factor in the transformation of the ecosystem of  Aral Sea and Aral Sea region, as a whole. Desertification, which is a consequence of changes in the hydrological and climatic regimes of the region, is considered as a factor favorable for the sand lance, contributing to the expansion of the range.

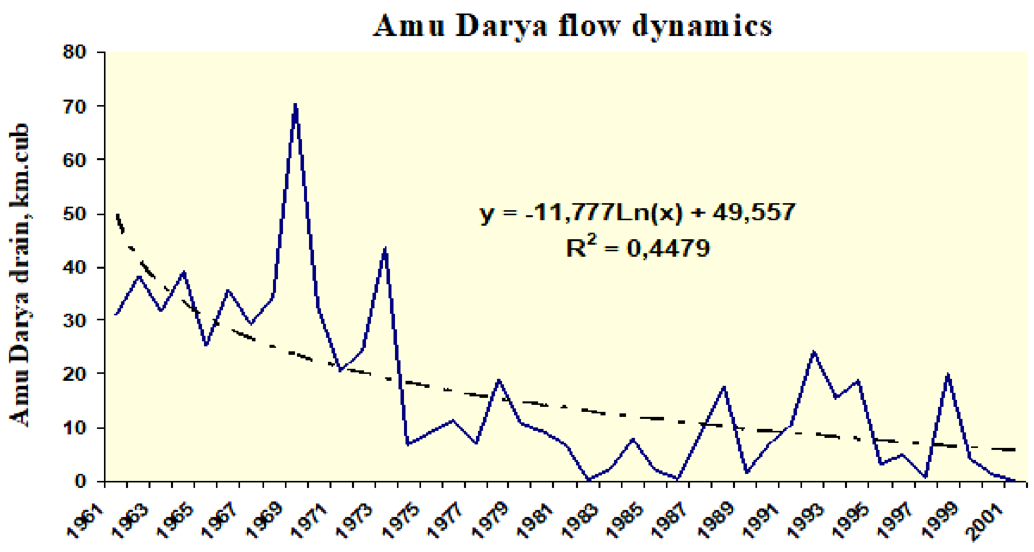


**Fig. 1. Long-term dynamics of  Amu Darya runoff and its trend**

Even from this brief verbal analysis of the factors of the dynamics of the population of the studied populations, interdependence and nonlinearity in the system of factors are visible. Before proceeding to their quantitative assessment, we note one more circumstance that complicates adequate modeling of the dynamics of population numbers. This is the oscillatory nature of the functioning and development of natural objects and processes.

If dynamic oscillations in a system have a constant period and amplitude, are established independently of the initial conditions and are maintained due to the properties of the system itself, and not due to the effect of a periodic force, the system is called self-oscillatory [6, 8]. After the passage of an auto-wave pulse, such a medium should restore its properties due to the energy coming from outside and prepare for the next impulse. The time required for this recovery is called the refractory period [1, 8].

Oscillatory regimes of rodent populations have been known for a long time and have been well studied theoretically, and, according to the above definition, can be attributed to self-oscillations, therefore, as not corresponding to the subject of this article, they are ignored.

The study of the relationship between local population dynamics and such large-scale spatial processes as changes in Amu Darya hydro-regime, climate and desertification showed significant quantitative and qualitative differences in the response of biota to these factors even within the same order (*Rodentia*) of mammals.

The habitat of areal in Aral Sea region for the muskrat is deltaic reservoirs. there were more than 490 lakes with a total area of 840 km$^2$, in 1980 there were about 30 large lakes with an area of 76.3 km$^2$ in 1950-1960 in the Amu Darya delta. Currently, there are nine large lakes with a depth of 2-5 m, the total area of which is more than 26,500 hectares [2, 3, 4]. The reduction in the areas of these reservoirs, which is a direct consequence of Amu Darya runoff, led to a decrease in the population of the muskrat in the period 1961-2000 (Fig. 2).

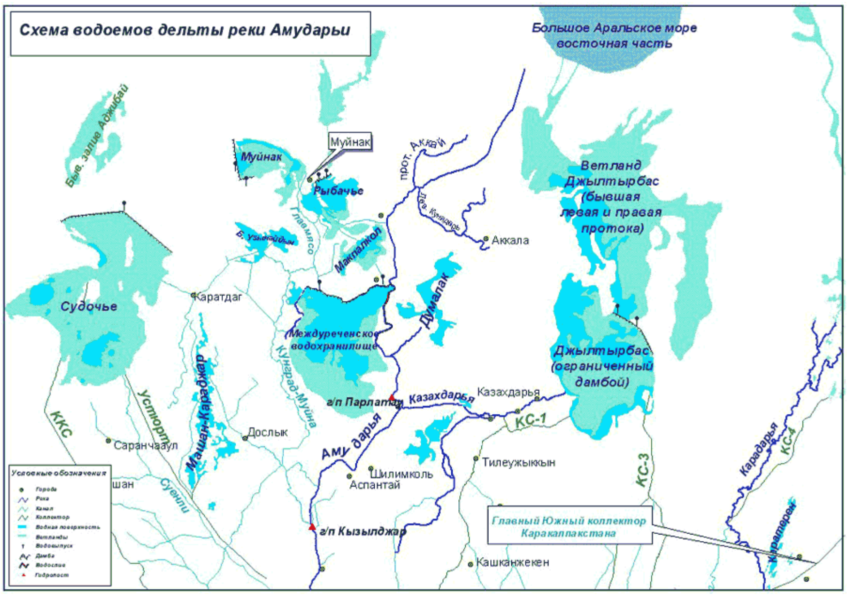


**Fig. 2. Scheme of the current state of water bodies in Amu Darya delta**

**(2016-2018)**

However, despite the coincidence of the logarithmic laws of the dynamics of Amu Darya hydrological regime and the size of the muskrat population, the same tendency to decrease and the correlation of the corresponding time series (ρ = 0.56), it is necessary to note the discrepancy between such dynamic features as the maximum deviations from the mathematical expectation, which is explained by the specifics of the dynamics filling delta reservoirs along with river water with unregulated collector discharges.

Thus, we have a vivid example of the fact that the cause-and-effect relationships of the system of factors are insignificant in the hierarchy of their priority: the factor of the ecological state of deltaic reservoirs – the muskrat habitat – becomes the main factor, and Amu Darya runoff becomes the background factor of the dynamics of the population of this population.

In the dynamics of the population of the muskrat, two periods can be distinguished: 1) 1961-2001 – the period of decrease in the number to almost zero;

2) from 2002 to the present – a period of slow but steady growth is in numbers (recovery period, Fig. 3).

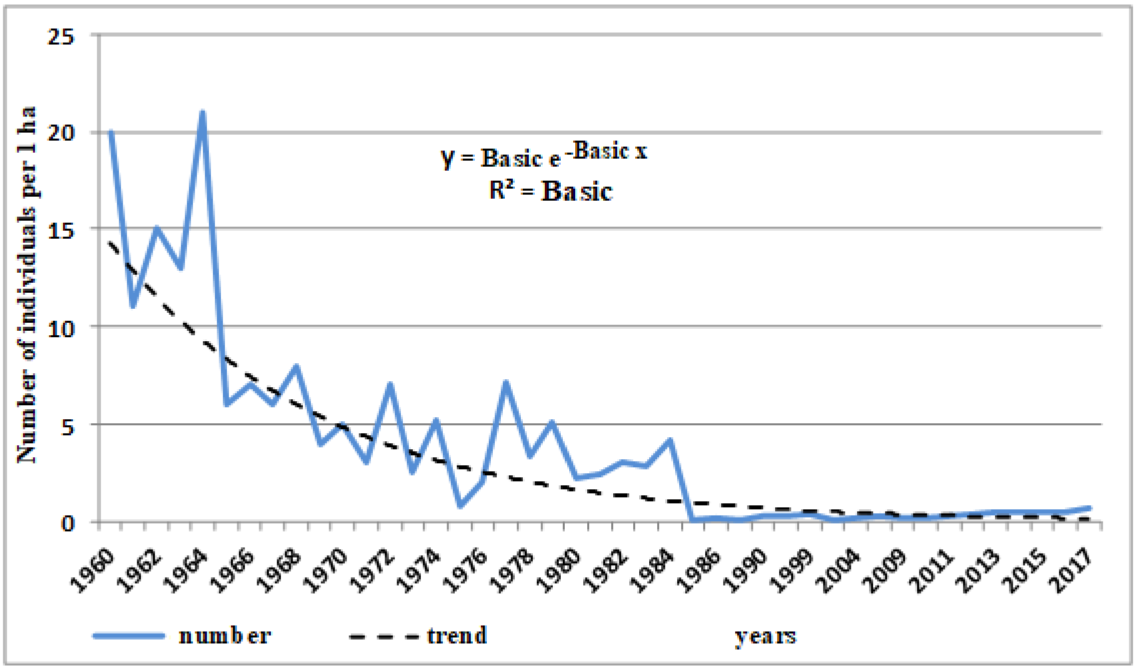


**Fig. 3. Dynamics of the muskrat population and its trend**

As a result of works aimed at maintaining irrigation-waste lakes and the creation of new reservoirs in the delta, fed by river and collector-drainage waters, the total area of the lakes has significantly increased [2, 3, 4]. Thus, the living conditions of the muskrat improved, which led to an increase in its number, starting in 2002.

The exponential trend indicates an increase from year to year in the growth rate of the population and an asymptotic approximation to the normal dynamics of the population size. At the same time, the ecosystem of Southern Aral Sea region, in particular the Khorezm oasis, like any self-organizing dissipative structure, has the property of coherence, i.e. coordination of actions of all its elements. In this case, the coherence of the population dynamics of the gerbil and muskrat is manifested in the occurrence of fluctuations with large amplitudes at the initial stages of the ecological crisis and their gradual attenuation under the influence of adaptation processes, which in this aspect can be considered as a negative feedback.

## CONCLUSION

Thus, taking into account the above, it can be noted that the complexity, nonlinearity of the internal connections of the ecosystem and its interactions with the external environment make it necessary and inevitable to use quantitative research methods. This position is especially important for the ecosystem of Aral Sea region (Khorezm oasis), which is undergoing large-scale transformations and has complex structural dynamics.

Correlation analysis of the long-term dynamics of the number of mesophilic rodent species under the conditions of the Khorezm oasis should be carried out taking into account the temporal dynamics of correlation caused by adaptation processes that decrease the numerical value of the correlation coefficient over time. Environmental measures to restore populations, carried out taking into account the existing factors and trends of developing systems, using the example of the muskrat population, have shown high efficiency and the possibility of a quick change in the sign of the dynamic gradient, and thus the importance of the anthropogenic factor in improving the ecological situation.

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