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ASSESSMENT OF ANTHROPOGENIC IMPACTS ON AQUATIC ECOSYSTEMS OF THE SOUTHERN ARAL SEA REGION BASED ON ENVIRONMENTAL RISKS

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Abstract:

The article is devoted to the assessment of anthropogenic impacts on the ecosystems of the Southern Aral Sea region. The issues of environmental regulation of the so-called permissible load on the Aral Sea ecosystems are considered.

Keywords: Ecosystems, South Aral Sea region, rationing, biodiversity, anthropogenic factor, sustainability.

ОЦЕНКА АНТРОПОГЕННЫХ ВОЗДЕЙСТВИЙ НА ВОДНЫЕ ЭКОСИСТЕМЫ ЮЖНОГО ПРИАРАЛЬЯ НА ОСНОВЕ ЭКОЛОГИЧЕСКИХ РИСКОВ

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Аннотация:
Статья посвящена вопросам оценки антропогенных воздействий на экосистемы Южного Приаралья. Рассмотрены вопросы экологического нормирования так называемой допустимой нагрузки на экосистемы Приаралья.

Ключевые слова: Экосистемы, Южное Приаралье, нормирование, биоразнообразие, антропогенный фактор, устойчивость.

Introduction

Currently, the current environmental situation due to the drying up of the Aral Sea, the ecological balance of the ecosystem of the Southern Aral Sea region is disrupted, the pressure on unique natural complexes here reaches extraordinary strength, anthropogenic desertification and aridization occurs everywhere. As experts note, the dynamic changes in the environment that have occurred cause an increase in the stability of living organisms to the negative impact of various environmental factors. This adaptive reaction occurs in different species of living organisms differently. Biogeocenosis, as a self-regulating system, is generally capable of maintaining a multi-level structural and functional homeostasis due to the influx from outside

for the functioning of its structures, and accumulate free energy, which allows it to adapt to changes in its structures under the influence of environmental conditions. According to experts, the ecological system displays a dynamic complex of components, both biotic and abiotic, inextricably linked by metabolic processes under the conditions of the influx and dissipation of free energy. The scientific basis of the standardized limits of anthropogenic impact on various natural complexes sets the priority solution to the problem of ecological assessment of the standardization of anthropogenic load. Ecological regulation is the permissible norms of anthropogenic pressure on ecosystems of various ranks within its ecological capacity, which in turn do not lead to an imbalance of self-regulation mechanisms. The main criteria of ecological regulation are: maintaining the stability and diversity of the ecosystem. Each unique natural complex has certain plant communities and species composition of the faunal complex.

The solution to the problems of stability limits of specific populations or biocenoses is undoubtedly connected with the selection of "significant" indicators of the systems under consideration, which are subjective in nature. When choosing solutions to such problems, it is very important to take into account all the characteristics of the system, as well as some of the unaccounted parameters, which may be very significant in a dynamic environment.

The study of the dynamics of animal populations is one of the most complex problems of modern ecological science. This problem is of great theoretical and applied importance, since its solution determines the understanding of many important aspects of the evolutionary process and the development of measures for the rational use of natural resources and the conservation of biodiversity.

The methodology being developed for environmental regulation of anthropogenic impacts on the ecosystems of the Southern Aral Sea region is primarily aimed at assessing the impact of various anthropogenic factors on the external environment and can be used in bioindication of landscape degradation processes and forecasting the environmental consequences of economic activity in a certain territory, in environmental assessment, certification, territory or economic facility certification, etc. It should also be noted that the development of a classification of anthropogenic loads and the determination of their permissible level is currently mitigated by the fact that most reactions of biological systems to such impacts are non-specific. The reaction of small mammals to anthropogenic impacts depends to a certain extent on the trophological specificity of the species: higher-order consumers have greater sensitivity to anthropogenic factors.

The collected data on the dynamics of hydrometeorological conditions in the Southern Aral Sea region show that strong prolonged winds carrying dust and salt deposits penetrate deep into tugai and reed thickets, sand and gypsum massifs, thereby worsening the feeding and protective conditions and habitats of animals. As a result of the decrease in ecological capacity, the total abundance of community species decreases, while its species diversity, depending on the change in the structuring of the environment, either decreases or increases. The growth of the mosaic nature of the environment causes an increase in species diversity in communities with an initially high level of dominance when exposed to various stress factors of low or moderate

intensity, while under significant anthropogenic loads, the species diversity of these communities (plant and animal) decreases.

Ecological criteria for standardization, i.e., the definition of limiting factors, the exit from the boundaries of which causes the transition of the ecosystem state from a favorable to an unfavorable state. Based on the obtained results, it can be observed that the indicators of maximum permissible anthropogenic loads on natural ecosystems determine the suitability of the entire system under consideration for the rational use of natural resources. It is known that without environmental standards, any “prohibitive” or “permissive” actions of environmental agencies “hang in the air,” and various measures aimed at reducing the negative consequences of economic activity are carried out blindly, which sharply reduces their effectiveness. It has been established that when conducting an environmental assessment of the admissibility of anthropogenic impact on the environment, it is necessary to adhere to the focus of the principles of acceptable environmental risk:

1) inevitability of losses in the natural environment;

2) minimal losses in the natural environment;

3) a real possibility of restoring losses in the natural environment of the Southern Aral Sea region.

The conducted studies of the impact of some environmental parameters on the dynamics of ecosystems have shown that for the analysis of the impact of exogenous variables, which are considered as controls, some aggregated variables are considered, which are indicators of the functioning of the ecosystem of the Aral Sea region. The main mechanism of the influence of anthropogenic factors on biocenosis communities is their direct impact on the ecological capacity and structuring of the environment. Thus, the discussion of some general approaches to the assessment of environmental regulation shows that the specificity of the current state of these problems lies in the need to introduce environmentally sound criteria for anthropogenic loads on the ecosystems of the region under study into the practice of nature management. Environmental standards should be focused not on the degree and quality of specific types of impact on natural complexes, but on the reaction of biological systems.

Many researchers consider the beginning of the Anthropocene to be the 1950s, but depending on the intensity of the industrial and green revolutions, as well as natural, climatic and ecological features, the scale and speed of the onset of the Anthropocene in different regions of the world could differ somewhat. However, due to the global nature of the main environmental problems, the Anthropocene epoch has quickly acquired a planetary character. The catastrophe of the Aral Sea ecosystem and the resulting acute shortage of fresh water in its basin, where the main human impact on fresh water resources occurs in the highly arid flat part, convincingly testify to the onset of the Anthropocene epoch. Thus, the history of the evolution of the Aral Sea and the Southern Aral Sea region can be divided into two periods: the late Holocene and the Anthropocene. We are inclined to divide the Anthropocene epoch itself into the early one - from the 1950s to the end of the 20th century, when irrefutable signs of a trend towards climate change have already appeared; and the modern one - the period of the beginning of an active fight against global anthropogenic climate change in the 21st century.

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In the late Holocene, the Aral Sea was an endorheic brackish-water lake located in the middle of the vast deserts of Central Asia. The Aral Sea is fed by two rivers, the Amu Darya and Syr Darya, which originate in the Pamir and Tien Shan mountains. The amount of precipitation falling on the surface of this lake is insignificant. Because of this, the level of the Aral Sea is determined mainly by the balance between the inflow of river water and evaporation from the surface. In the past, the Aral Sea was the fourth largest continental water body in the world. Industrial fishing was developed on it; the sea also served as an important regional transport artery. The Aral Sea was a brackish water body with an average salinity of 10 g / l. It was inhabited by about 200 species of free-living invertebrates and 32 species of native and introduced fish. Fish catches from the Aral Sea and delta reservoirs accounted for up to 98% of the fishery in Uzbekistan.

During its history, the Aral Sea has experienced a number of regressions and transgressions. Most of the regressions were caused by a partial or even complete reversal of the Amu Darya under the influence of natural forces into the Caspian Sea. But the level of the Aral Sea was also influenced by ancient agricultural civilizations. Their impact consisted not only of the withdrawal of a significant volume of river water for irrigation of fields, but also of periodic reversals of the Amu Darya in the direction of the Caspian Sea. The last such reversal of the Amu Darya took place in the 13th-16th centuries. The level of the Aral Sea then fell by more than 24 m. This is evidenced by both historical records and archaeological sites, as well as saxaul stumps and traces of ancient river beds preserved on its bottom. By the middle of the 17th century, the Amu Darya again turned (or people themselves turned it) into the Aral Sea, and it was restored

Figure 1 – The Aral Sea in 1973 – 1999 (Google Earth)

The study of dynamic processes in the biosphere, its current changes and understanding of the patterns of development of natural systems in changed and rapidly changing conditions is one

of the important tasks of modern ecology. At present, it is necessary to take into account new modern innovative technologies when developing a strategy for the use of natural resources and when planning nature management. In recent years, the environmental situation in the Southern Aral Sea region, due to the drying up of the Aral Sea and the deterioration of the composition of surface and groundwater, has become particularly acute. One of the reasons for this catastrophe is the scientifically unfounded use of water and land resources in the region. It should also be taken into account that changes in the hydrological and hydrochemical regime of the Amu Darya River, as well as increasing anthropogenic loads have led to a significant transformation of the natural environment of the region. The anthropogenic factor, leading to numerous successions of aquatic ecosystems, significantly changes and destroys the composition and interrelationships of organisms. With the violation of hydrological regimes in the region, significant changes in the natural environment occur: desertification has intensified, anomalous natural phenomena, and increased climate discomfort. The most important factor for the sustainable existence and development of wetlands, maintaining their stable ecological state is the conditions of delta water content. In recent years, the impact of human activity on water resources has increased dramatically. The main types of economic activity that have the greatest impact on the region's water resources are water consumption for agricultural, industrial and municipal needs, discharges of wastewater into water bodies, etc. The problem of rational use of the region's water resources is becoming increasingly acute every year and determines the need for major organizational and technical measures. In recent years, due to a sharp increase in the discharge of nitrogen and phosphorus into water bodies and watercourses, as well as as a result of the regulation of the flow of many lowland rivers, peculiar violations of the hydrochemical and hydrobiological regime of water bodies have arisen in them. For example, the formation of organic matter has increased with the intensive development of phytoplankton and the trophicity of water bodies has increased. The accumulation of biogenic elements entering aquatic ecosystems with agricultural runoff contributes to the accumulation of biogenic elements, which leads to the formation of a certain regime inherent in eutrophic lakes. Biotic components of aquatic ecosystems reflect the trophic status of a water body, which in turn depends on the amount of organic matter dissolved in water. Accordingly, populations, species and communities of organisms have a certain level of tolerance in the current conditions. There are many methods for assessing the state of aquatic ecosystems by various parameters. At the same time, most of them are not applicable to all categories of water bodies and impact factors. Only a few developed methods of integral assessments are known, allowing their application to any water bodies and for assessing most impact factors. For example, the amount of biogenic substances dissolved in water is an integral indicator of the state of waters and aquatic ecosystems as a whole, since it consists of organic substances that arise during the life of organisms at all trophic levels, as well as those brought in from the catchment area as a result of natural and anthropogenic processes.

Eutrophication of many water bodies is primarily due to an increase in phosphorus load. In this regard, we attempted to trace the patterns of distribution of phosphorus forms in water, its balance, determination of the characteristics of the phosphorus load and flows of its forms in

ecosystems using a simulation model of the phosphorus system in lakes Dautkul and Shegekul - important objects of national economic significance. The role of internal and external flows in the formation of balances of individual phosphorus forms is different. It was found that the intraspecific distribution of the rates of biochemical transformation of P is determined to a large extent by the temperature and transparency of the water, as well as the illumination of the water surface. The maximum rate of DIP consumption by phytoplankton is 0.39 mg P / l year, and excretion is 0.097 mg P / l year. Analyzing the obtained values of P, it can be noted that the main role in the external phosphorus load of the lake belongs to the external inflow, which comes in the form of DIP (its inflow with river runoff is 0.197 mg P / (l year), or 70.7% of the total phosphorus inflow. DP and DOP account for 21.2 and 2.1%. It was found that DIP dominates among the phosphorus forms (76.4%). The greatest removal of phosphorus by water flow falls on DIP (50.6%) and the sum of phytoplankton and bacteria F + B (23.4%), as well as phosphorus in detritus PD (17.3%) and organic phosphorus DOP (8.7%). Probably, this is due to the fact that the above-mentioned part of the phosphorus forms is associated with phytoplankton and bacteria, and some is removed with runoff. It should be especially noted that the main accumulation of phosphorus forms occurs in bottom sediments in the form of DIP (94.2%), where its reserves are quite large, which cannot but affect the nature of intra-reservoir processes. Under certain conditions (especially anaerobic, in the absence of oxygen), part of the phosphorus is released, thereby stimulating the development of autotrophic organisms, changing the level of production processes, which leads to eutrophication of the reservoir, that is, phosphorus is the material basis for secondary pollution of reservoirs, and bottom sediments are micro-foci of eutrophication. At the same time, the more phosphorus enters the studied reservoir, the more active are the processes of its intra-reservoir transformation. This is partly due to the influence of the vital activity of the community of hydrobionts, which reacts in a certain way to fluctuations in external conditions. The change in the ratio of phosphorus forms in the water entering the reservoir and flowing out of it is apparently explained by a change in the conditions of phosphorus transformation in the reservoir. Thus, it has been established that existing economic mechanisms for environmental protection are ineffective primarily because they do not create incentives for the use of resource- and energy-saving technologies and do not provide sufficient funds from payments for emissions and discharges, waste disposal and the use of natural resources to finance environmental protection activities on the required scale.

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