SJIF Impact Factor (2023): 8.574| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 8 | Issue: 12 | December 2023 - Peer Reviewed Journal

UDC 574.5(075.8)

SETTING UP THE ECOLOGICAL BALANCE OF WATER OBJECTS OF THE SOUTH ARAL REGION

Tureeva Kuralay Zhumabaevna[1], Maturazova Elmira Matiyazovna[2], Valieva Orazgul[3]

[1]Doctor of Philosophy in Biological Sciences (PhD)
[2]Candidate of Biological Sciences, Associate Professor
[3]Assistant, Karakalpak State University named after. Berdakha, The Republic of Uzbekistan

ANNOTATION

The article examines the current ecological state of water bodies of the Southern Aral Sea region. One type of water body is a lake ecosystem. The water mineralization in most lakes in the Southern Aral Sea region was determined by the hydroregime of the Amu Darya River. The chemical composition of water in summer is hydrocarbonate, in winter and autumn it is chloride-sulfate.

KEY WORDS: *lakes, hydroregime, Amu Darya, ecosystem, research, limnology.*

In the world's leading scientific centers, large-scale research is being carried out on the development of methods for predicting changes in the state of water ecosystems under the influence of human economic activities, with the integrated use of water management and water management.

One type of aquatic ecosystem is the lake ecosystem. Lakes are widespread on the coastal surface. According to RosKIIVX, there are 2 million lakes in Russia with a total area of more than 3.5 thousand km^2. 90 % of it is from rainwater bodies with an area of 0.01 to 1 km2 and a depth of less than 1.5 m.

The study of lake ecosystems began at the beginning of the 20th century. Scientific works of G.G. Vinberg (1934, 1946, 1960, 1974, and 1975), S.I. Kuznetsov (1952, 1970, 1985, and 1989), and L.L. Rossolimo (1967, 1971, and 1975) provided the first complete information about the morphometry, hydrochemistry, hydrobiology and microbiological processes of some large lakes (White, Goluboy and others).

The evolution of lakes is divided into several stages (youth, maturity, old age, discomfort), characterized by changes in the level of trophic and biological productivity. In addition, lake ecosystems are characterized by an accumulative nature of metabolism, a bias towards water collection, weak water exchange, significant temperature stratification, oxygen dichotomy in the summer season, etc.

Lakes are very sensitive to external influences, including natural climate changes. Based on the nature of water exchange, lakes are divided into two large groups: flowing and non-flowing. Lakes that receive water from the outside and do not release anything into natural or artificial water flow, but use it only for evaporation, infiltration or artificial water intake, are considered non-flowing. In other words, there is no flow of water over the surface of such a reservoir.

An important element of the depth of the lake is the coastal part, which, depending on the receding nature of the shore, includes a coastal ridge, a shallow coastal ridge and coastal shallows. The last two elements of lake depth are often called the littoral zone; its characteristic features include shallow water and the influence of waves. Beyond the littoral zone, there is an underwater basin (i.e., sublittoral zone). The shallow part of the lake is pelagic; the bottom of the lake is called profundal.

The lakes fill depressions of various origins. Since the processes of formation of these depressions are in most cases determined by local conditions, lakes are concentrated in certain areas. Depending on the origin, the depths of lakes can be tectonic, volcanic, meteorite, glacial, thermokarst, suffasion, river, sea, or organogenic. The lakes located in these depths bear the same names.

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More recently, the lower reaches of the Amu Darya were called the "Great Lakes". The Amu Darya used to form numerous and varied reservoirs. Reed fields. occupied an area of about 0.7 million hectares. The mineralization of water in most lakes ranged from 400 to 1400 mg/l and was determined by the hydroregime of the Amu Darya: in spring and summer, during floods, the mineralization of lake water is minimal, and in autumn and winter, it is maximum. The chemical composition of water in summer is hydrocarbonate, in winter and autumn it is chloride-sulfate.

According to experts, the group of reservoirs arose spontaneously when an excess of collector-drainage water began to fill various geomorphic depressions (Lake Togyz-Tore, Saikol). The second group of reservoirs includes the depths of former lakes (lakes Karateren, Dautkol, Sarykamys), where collector-drainage waters were transferred. The third group of lakes has freshwater flow, but in recent years, they have been heavily polluted (Khojakol, Makpalkol, and Shegekol). The modern limnological characteristics of some water bodies of the Amu Darya delta are presented in Table 1.

As a result of drainage of collector-drainage waters, new types of reservoirs appeared on the plains of the Akchadarya and Amu Darya deltas, for example: irrigation and wastewater (Ayazkala, Akchakol, Karaterenskaya, Sudoche lake systems). According to experts, these irrigation and wastewater lakes act as an accumulator of water-soluble salts, poisons and agrochemicals. On the one hand, water exchange and the total area of the watersheds under consideration experienced significant and strong fluctuations due to the strong development of irrigated agriculture in the region and the condition of soils and wastewater.

Table 1
Dynamics of expansion and change in the area of reservoirs in the Aral Sea region

Water bodies	Barkhanskova et al., 1963		Abdirov et al., 1970		Sagidullaev, 1986		Atanazarov, 2017	
	Total area, ha	Plant cover., %	Total area, ha	Plant cover., %	Total area, ha	Plant cover., %	Total area, ha	Plant cover., %
Davutkol	600	80	1170	90	650	20	3500	30
Karateren	640	15	650	12	-	-	2700*	-
Shegekol	180	65	180	60	150	25	230	10

Note: ─ no information, * - O. Information from Nuritdinov

According to experts, 1964-1965. In the Davutkol lake system, intensive growth of wetland vegetation was observed (up to 90% of the area), accumulation of a large mass of plant debris, which caused local death of fish.

In the 1980s, after the main drainage lines and irrigation canals were cleared and expanded, the area of vegetation of the reservoirs was significantly reduced, and the total area of the lake has recently increased significantly. In Shegekol, the anthropogenic impact was expressed in increased mineralization due to the deterioration of the water quality of the Amu Darya, in which the share of collector and drainage waste has sharply increased.

According to scientific literature, 1959. in most cases, the water in the lake was slightly mineralized and saturated with oxygen up to 127%, the reaction of the environment was neutral and slightly alkaline, pH 7.8 was not orthotic. According to 1963 data, the pH of water in the lakes was 7.4-8.4, the oxygen saturation of the water mass was 64-204%, and chlorine mineralization was 86-259 mg/l, i.e. the reaction environment changed from neutral over a 5-year period to slightly alkaline. 1964-1968 in freshwater ponds the oxygen content was 22-160%, oxygen saturation 42-153%, salinity 3.9-9.9 g/l. currently, the active reaction of the environment and the general mineralization of water have increased, and the oxygen content, on the contrary, has decreased. During the period under review, the water bodies of the Aral Sea region have undergone serious changes.

Collector-drainage waters play an important role in the formation of modern limnic ecosystems of the Amudarya River. According to experts, the volume of collector-drainage waters has recently exceeded 1 km^2. They are often the only source of nutrients for most Delta water bodies.

It is known that the formation of highly productive limnic ecosystems in the Amu Darya basin was carried out over thousands of years mainly due to the flow of fresh waters from the Amu Darya. Intensive activity in the Aral Sea basin has led to a significant reconstruction of the entire hydrological network in the Amu Darya delta.

The processes of aridization and desertification accelerated the processes of transformation of the region's aquatic ecosystems and led to the restructuring of all limnic systems and, ultimately, to a specific disruption of the bio- and hydrochemical regime of water bodies. For example, with the intensive development of phytoplankton, the formation of organic matter increased and, consequently, the trophicity of water bodies increased. The nutritional nature of the lakes also changed: instead of fresh (0.6-1.2 g/l) water of the Amu Darya, mineralized (1.8-8.0 g/l) water, enriched with nutrients and pesticide residues, began to flow.

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1950-1960 In the Amu Darya delta in 1980, there were 490 lakes with a total area of 840 km^2. There are 30 lakes left with an area of 76.3 km^2. Currently, there are 9 large lakes left, their depth is 2-5 m, the total area is 26,500.

According to the hydrodesign institutions of the Republic of Karakalpakstan, in 1992-1993. The total area of the flooded area of the Amu Darya delta is approximately 1250-1300 thousand sq.m. It has been established that it is known that irrigation has a strong effect on all components of the soil. Most irrigation canals were built and are being built without a protective coating along the bottom and sides and lose 40-50% of water to filtration. The cessation of the flow of the Amu Darya and Syr Darya into the Aral Sea and the annual decrease in the water level in it leads to a decrease in the water level and an increase in the mineralization of the soil of the Aral Sea.

According to the reclamation cadastre, almost 96% of the lands of Karakalpakstan are saline. According to experts, 78,000 hectares (15%) are highly saline, 201,100 hectares (41%) are moderately saline, and 194,700 hectares (40%) are slightly saline. It has also been established that the mineralization of atmospheric precipitation has increased 6-7 times over the past decades.

As a result of an increase in water withdrawal for irrigation and a sharp reduction in river flow, the ability of the Amu Darya to self-purify has greatly decreased. In addition, 3 billion from the territory of Uzbekistan and Turkmenistan. More than m3 of collector-drainage and untreated industrial and domestic waters, saturated with toxic chemicals, are discharged into the Amu Darya, which saturate drinking water with residual amounts of pesticides and heavy metals, making it unsuitable for use.

Various pesticides used in agriculture enter the Amu Darya with collector and drainage waters. The increase in regulation of the content of pollutants was 4 times for phenols, copper, chromium, 5 times for petroleum products, 10 times for pesticides (hexachlorane, lindane). The results of a survey of 40 lakes and reservoirs in the Amu Darya delta also indicate high mineralization, high content of phenols (10-15 REM), petroleum products (3-5 REM), pesticides (up to 3 REM), copper, chromium (up to 6 REM). Bacterial contamination of river waters is 10 times higher than sanitary requirements. In 1994, the proportion of samples that did not meet sanitary requirements was 68.9% for chemical indicators and 13.4% for bacteriological indicators.

Thus, the restoration of natural objects is one of the priorities of ecology and environmental protection, however, it should be recognized that the concept and methodology for restoring lake ecosystems is still under development. Restoration issues were considered mainly in the CNS countries and non-CNS countries; in the Southern Aral Sea region there are few such studies, only partial studies. Therefore, the development of theoretical foundations for the restoration of ecosystems, including inland lakes, is undoubtedly one of the urgent tasks of ecology, and the determination of the features and patterns of restoration of small lakes will contribute to the formation of a new direction in ecology and the development of ecosystem theory.

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