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Water quality of aquatic ecosystems of Akmola region

Currently, the issue of protecting natural resources from polluting and preventing pollution requires worldwide attention. In general, water resources are becoming an invaluable resource that explains the sustainable development of any state. Rational use and protection of water sources is becoming one of the most pressing issues in our country. Pollution of water sources, in turn, affects the deterioration of water quality, living organisms that live in water sources (algae, fish, etc.), and the health of consumers. Since water is the most important resource in the world, it is a task to protect and prevent environmental risk. Therefore, to monitor the aquatic ecosystems of Akmola region, the research team conducted research in laboratory conditions, taking water samples from water bodies (Nura, Ishim Rivers and Taldykol, Maybalyk, and Zhaltyrkol Lakes) from a practical trip organized by the research group. Research studies on water samples taken from water bodies showed that the water was polluted, and in some indicators the maximum rural concentration was exceeded. It is clear that pollutants affect water biota, although in most cases they are not the cause. According to water samples, the level of pollution of water sources was assessed. Protection of Water Resources in general from pollutants is one of the strategic tasks of the country.

Keywords: water resources, environment, polluting sources, maximum concentration, physical and chemical indicators, level of pollution, water quality, ecopolutants.

Introduction

The global demand for Water Resources is steadily growing from year to year. Increased demand inadequate infrastructure and lack of management potential lead to water shortages in many regions. The state of Water Resources is constantly changing depending on external factors. The water cycle is directly influenced by population growth, human activity, that is, an anthropogenic factor. The initial quality of water depends on the source of its origin. Surface waters (lakes, reservoirs, streams, and rivers), which are the source of drinking water for the population, are usually of low quality and require extensive treatment. It can still be contaminated by agricultural runoff or by burying liquid waste in surface and underground soil, as well as filters from solid waste landfills. Depending on the time, other water sources such as rainwater have different levels of water quality [1, 2].

Pollution of water sources, as well as its impact on the environment, is one of the most common environmental problems. Despite the fact that Kazakhstan occupies a large territory, the quality of water in all surface water bodies of the Republic remains unsatisfactory. Along with wastewater, pollutants enter reservoirs and affect the aquatic ecosystem, primarily aquatic organisms [3–6].

As a result of anthropogenic impact, significant changes occur in the morphometric, hydrological, chemical and other characteristics of water bodies, which, in turn, lead to changes in the structure, productivity and condition of aquatic ecosystems. Pollution of water bodies is the result of anthropogenic activity, which leads to negative consequences — deterioration of water quality, threat to water bodies, deterioration of life and health of people [7]. Pollution contributes to an increase in the content of micro- and macroelements in fresh and sea waters, bottom sediments, living organisms above the natural background of a particular area [8].

Experimental

To control the quality of surface water in Akmola region, all the requirements for collecting water samples from 5 water bodies (i.e., the Nura and Ishim Rivers, as well as lakes Maybalyk, Zharlykol, Taldykol) were met, and water samples were taken from 26 points. During the study of surface water samples, physical and chemical indicators of water quality (water temperature, transparency, hydrogen indicator, total water hardness, heavy metal concentration) were determined. The research group determined hydrochemical indicators of water to assess the quality of surface waters of Akmola region (Nura, Ishim Rivers and lakes Maybalyk, Zharlykol, Taldykol). It took 1.5 L of water sample to carry out the research. Water samples taken from water bodies were analyzed according to 13 physical and chemical parameters,

including the concentration of ions (Ca^{2+} , Mg^{2+} , Na^+ , K^+ , Fe total, Cl^- , SO_4^{2-} , HCO_3^- , NO_3^- , CO_3^{2-}). Water samples were carried out using the atomic-emission spectroscopy (inductively coupled plasma) method in the Azimuth-Geology chemical-analytical laboratory. The research work on water samples was analyzed according to the regulatory standards for managing the use of water resources of the committee on water resources of the Ministry of Agriculture of the Republic of Kazakhstan “unified system for classifying water quality in water bodies” [9]. During the study statistical data on the state of surface waters of the Akmola region was used.

Results and Discussion

We consider sulfate ions in water samples from River Lakes, which are our objects of study, as indicators of anthropogenic pollution. Figure 1 presents water quality assessment based on the results obtained by the unified classification.

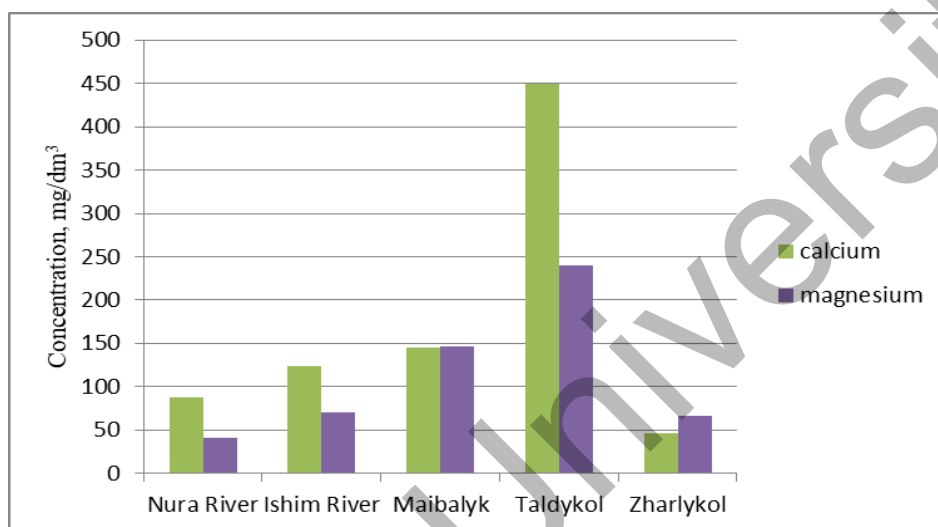


Figure 1. Information on the quality of surface water in Akmola region in 2021

The chemical composition of samples taken from surface waters of the Akmola Region, i.e., the indicators of the main ions, is shown in Figure 1. The indicators of calcium and magnesium ions are 8 times higher in Lake Taldykol than in Lake Zharlykol. Compared to samples from the Nura river, the indicators of calcium and magnesium ions in samples from the Ishim River exceed Shrek. The high level of these indicators can be explained by the discharge of wastewater into rivers and lakes.

There is an insignificant difference in the indicators of the main ions of water samples taken in 2021 and 2022. The indicators of calcium and magnesium ions in the Ishim River decreased by half, and the indicators of ions in Lake Taldykol, on the contrary, increased (Fig. 2).

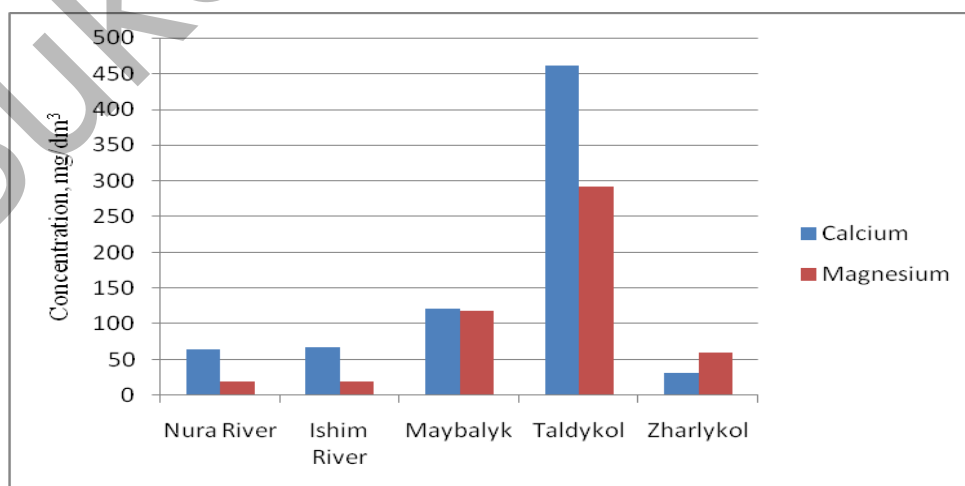


Figure 2. Information on the quality of surface water in Akmola region in 2022

According to the results of monitoring, the state of surface water is directly affected by the inflow of industrial complexes, domestic and wastewater located in the region (Fig. 3). It can also be seen that chlorides and sulfates in the water content of lake Taldykol exceeded Shrek by 2 times.

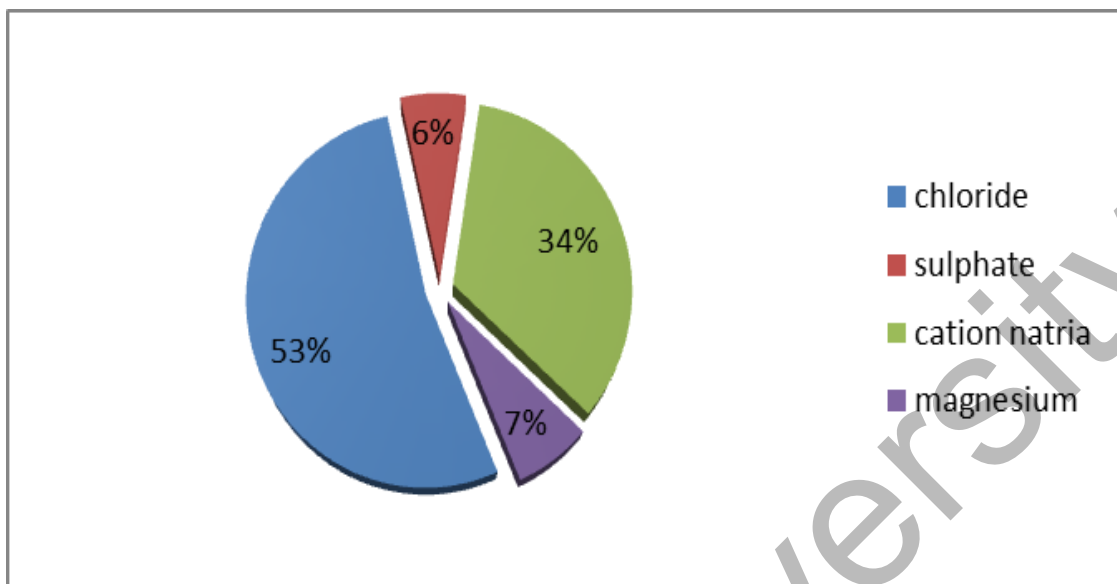


Figure 3. Concentration of ecopolyants on lake Taldykol

Figure 4 demonstrates the level of pollution of large rivers and lakes of Akmola region. It is clear that any ecopoluter that falls into the biosphere as a whole accumulates one of the components of the ecosystem. The deterioration of the water quality of lake Taldykol up to 70.5% can be explained as the result of an external anthropogenic factor.

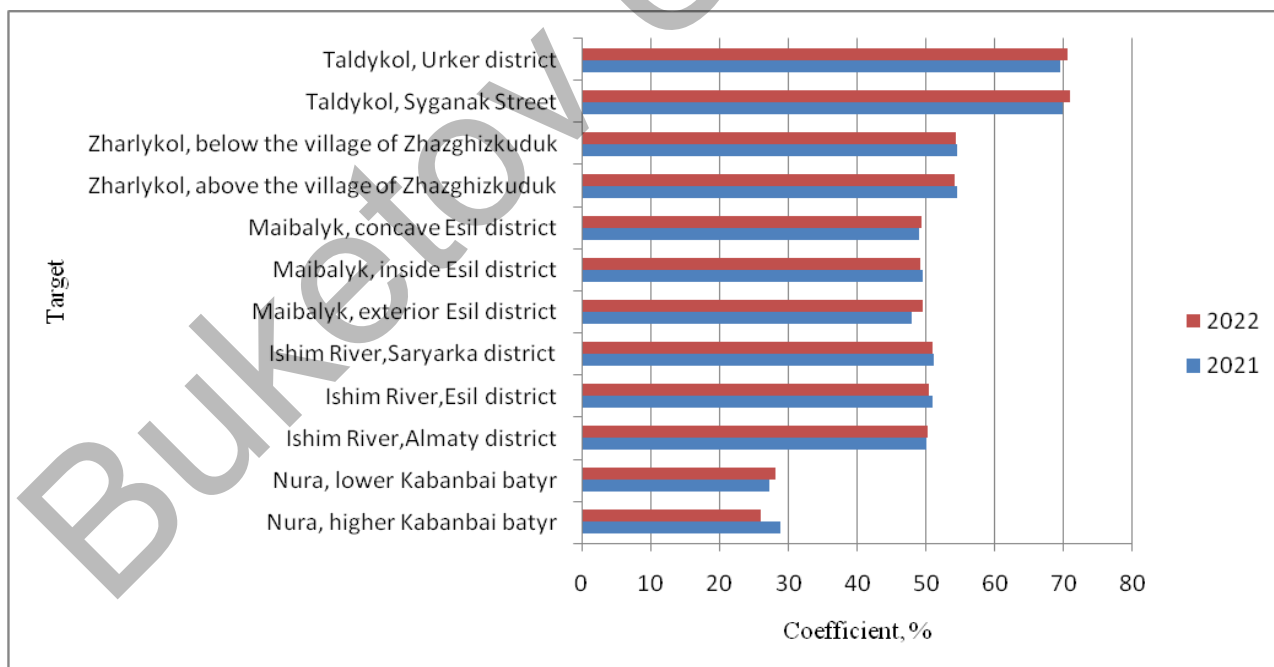


Figure 4. Complex coefficient of water pollution

The chemical parameters of groundwater play an important role in the classification and assessment of water quality. It is noted that the best results can be obtained only when studying the complex of ions in water, and not the concentration of individual ions [10]. The chemical classification also reflects the concentrations of various dominant cations, anions, and their interactions.

The current anthropogenic load and growing man-made processes change the hydrochemical parameters of water to the deterioration of their quality.

Field studies conducted to analyze surface monitoring data and assess surface waters have shown the presence of chemical pollutants in river lakes in the Akmola region.

Conclusions

According to the study results and the unified classification system, the water quality of water sources of Akmola region is assessed as follows: the Ishim and Nura rivers, Taldykol, Maybalyk and Zhaltyrkol lakes belong to the 4th class, and the Ishim River (Arnasai) — (5th class). In conclusion, the indicators of water samples taken from water bodies exceed the norm. It can be seen that in most water samples, concentrations of chlorides and sulfates are found in large quantities. Sulfates, in turn, are considered as indicators of pollution levels.

The data obtained from the annual calculation of the results of samples taken from common water sources prove that in the future it is necessary to organize measures to protect water sources from external pollutants. If the necessary measures are not taken, it can lead to a decrease in the diversity of aquatic biota and irreversible pollution of water sources. The results of the research prove that the water ecosystems of Akmola region are polluted.

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М.Г. Жартыбаева, С.Е. Тулегенова, Н. Мунтаев, Ж.О. Оралбекова

Ақмола облысының су экожүйелеріндегі су сапасы

Қазіргі уақытта табиғи ресурстарды ластаушы көздерден қорғау және ластанудың алдын алу мәселесі бүкіл әлемде назар аударуды қажет етеді. Жалпы, су ресурстары кез келген мемлекеттің тұрақты дамуын түсіндіретін баға жетпес ресурсқа айналуда. Су көздерін ұтымды пайдалану және қорғау біздің еліміздегі ең өзекті мәселелердің бірі. Негізінен су көздерінің ластануы өз кезегінде су сапасының нашарлауына, су көздерінде (балдырлар, балықтар және т.б.) өмір сүретін тірі организмдерге және тұтынушылардың денсаулығына әсер етеді. Су әлемдегі ең маңызды ресурс болғандықтан, міндет экологиялық тәуекелдерді қорғау және алдын алу. Сондықтан, Ақмола облысының су экожүйелерін мо-

ниторингтеу максатында зерттеу тобы ұйымдастырған практикалық сапар барысында су айдындарынан (Нұра, Есіл өзендері мен Талдықөл, Майбалық және Жалтыркөл көлдерінен) су сынамаалары алынып, зертханалық жағдайда зерттеулер жүргізілді. Су объектілерінен алынған су сынамааларын зерттеу жұмыстары судың ластанғанын және кейбір көрсеткіштер бойынша максималды тәуліктік концентрациядан асып кеткенін көрсетті. Лаптаушы заттар су биотасына әсер ететіні анық, бірақ көп жағдайда олар себеп емес. Су сынамаалары бойынша су көздерінің ластану деңгейі бағаланды. Жалпы су ресурстарын лаптаушы заттардан қорғау елдің стратегиялық міндеттерінің бірі болып табылады.

Кілт сөздер: су ресурстары, қоршаған орта, ластану көздері, максималды концентрация, физико-химиялық көрсеткіштер, ластану деңгейі, су сапасы, эколопютанттар.

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Качество воды водных экосистем Акмолинской области

В настоящее время вопросы защиты природных ресурсов от источников загрязнения и предотвращения загрязнения требуют внимания во всем мире. В целом, водные ресурсы становятся неоценимым ресурсом, объясняющим устойчивое развитие любого государства. Рациональное использование и охрана водных источников становятся одной из актуальных проблем в стране. Загрязнение водных источников, в свою очередь, влияет на ухудшение качества воды, на живые организмы (водоросли, рыбы и т.д.), на здоровье людей-потребителей. Поскольку вода является важнейшим ресурсом в мире, задача защиты и предотвращения экологического риска становится очень актуальной. Поэтому в целях мониторинга водных экосистем Акмолинской области, в ходе практической поездки, организованной исследовательской группой, были отобраны пробы воды с водных объектов (рек Нура, Есиль и озер Талдықоль, Майбалық и Жалтыркөл) и проведены исследования в лабораторных условиях. Результаты исследования проб воды из водных объектов показали, что вода загрязнена, по некоторым показателям превышена предельно допустимая концентрация. Очевидно, что загрязняющие вещества влияют на них, хотя и не являются в большинстве случаев причиной снижения биотоксичности воды. По пробам воды оценивался уровень загрязнения водных источников. В целом, охрана водных ресурсов от загрязняющих веществ относится к одной из стратегических задач страны.

Ключевые слова: водные ресурсы; окружающая среда; источники загрязнения; предельно допустимые концентрации; физико-химические показатели; уровень загрязнения; качество воды, эколопютанты.

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