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# Х А Б А Р Л А Р Ы

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## ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ  
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## N E W S

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## **GEOECOLOGICAL RESEARCH ON THE TERRITORY OF THE STATE NATURAL RESERVE “BOKEYORDA” OF THE WEST KAZAKHSTAN REGION**

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**Abstract.** This work is devoted to the problems of environmental protection in Kazakhstan on the example of a specifically conducted project, which provides the results of a scientific study of the projected State Natural Reserve “Bokeyorda” of the West Kazakhstan region. In the context of the growing pace of economic development of the country and increased use of natural resources, the issue of further improvement of the territorial nature protection system becomes relevant. All this determines the need for further development of the network of specially protected natural areas as an effective system for preserving the biological diversity of Kazakhstan. In order to identify the presence and determine the state of the natural

resource potential of the territory in question and its significance for justifying the expansion of the reserve, a comprehensive assessment of the geoecosystems of the “Bokeyorda” State Nature Reserve of the West Kazakhstan Region was carried out. Studies of the natural resources of the West Kazakhstan Region were carried out, on the sites of which monitoring sites were laid, a map of the degree of change in geoecosystems and a map of the “Bokeyorda” State Nature Reserve of the West Kazakhstan Region were compiled. Mapping was carried out using GIS technology data. A comprehensive assessment of the territory was carried out taking into account landscape features, natural resource potential and the territorial structure of land use that has developed as a result of economic use.

**Key words:** geoecosystem, natural complexes, ecosystem approach, steppes, biogeocenoses, zoocenoses, integrated assessment.

**Conflict of interest:** *The authors declare that there is no conflict of interest.*

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## **БАТЫС ҚАЗАҚСТАН ОБЛЫСЫ «БӨКЕЙОРДА» МЕМЛЕКЕТТІК ТАБИҒИ РЕЗЕРВАТ ТЕРРИТОРИЯСЫНДАҒЫ ГЕОЭКОЛОГИЯЛЫҚ ЗЕРТТЕУЛЕР**

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**Аннотация.** Бұл жұмыс Батыс Қазақстан облысының «Бөкейорда» атты жобаланған мемлекеттік табиғи резерватының ғылыми негіздемесінің нәти-

желері келтірілетін нақты жобасы мысалында Қазақстан қоршаған ортаны қорғау мәселелеріне арналған. Елдің экономикалық даму қарқынының артуы және табиғи ресурстарды пайдаланудың ұлғаюы жағдайында аумақтық табиғатты қорғау жүйесін одан әрі жетілдіру мәселесі өзекті болып отыр. Осының барлығы Қазақстанның биологиялық әртүрлілігін сақтаудың тиімді жүйесі ретінде ерекше қорғалатын табиғи аумақтар желісін одан әрі дамыту қажеттілігін анықтайды. Қарастырылып отырған аумақтың табиғи-ресурстық әлеуетінің бар-жоғын анықтау жағдайын және оның қорық аумағын кенейтуді негіздеу үшін маңызын анықтау мақсатында Батыс Қазақстан облысының «Бөкейорда» мемлекеттік табиғи қорығының геоэкожүйелеріне кешенді бағалау жүргізілді. Батыс Қазақстан облысының табиғи ресурстарына зерттеулер жүргізілді, олардың аумақтарында мониторинг алаңдары орналастырылды, геоэкожүйелердің өзгеру дәрежесінің картасы және Батыс Қазақстан облысының «Бөкейорда» мемлекеттік табиғи қорығының картасы жасалды. Карталау ГАЖ технологиясының деректері арқылы жүзеге асырылды. Аумақты кешенді бағалау ландшафт ерекшеліктерін, табиғи ресурстық әлеуетті және шаруашылық пайдалану нәтижесінде пайда болған жерді пайдаланудың аумақтық құрылымын ескере отырып жүргізілді.

**Түйін сөздер:** геоэкожүйе, табиғи кешендер, экожүйелік тәсіл, дала, биогеоценоздар, зооценоздар, кешенді бағалау.

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## ГЕОЭКОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ НА ТЕРРИТОРИИ ГОСУДАРСТВЕННОГО ПРИРОДНОГО РЕЗЕРВАТА «БОКЕЙОРДА» ЗАПАДНО-КАЗАХСТАНСКОЙ ОБЛАСТИ

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**Аннотация.** Данная работа посвящена проблемам охраны окружающей среды в Казахстане на примере конкретно проведенного проекта, в котором приведены результаты научного исследования проектируемого государственного природного резервата «Бокейорда» Западно-Казахстанской области. В условиях нарастающих темпов экономического развития страны и усиления использования природных ресурсов актуальным становится вопрос дальнейшего совершенствования системы территориальной охраны природы. Все это определяет необходимость дальнейшего развития сети особо охраняемых природных территорий как действенной системы сохранения биологического разнообразия Казахстана. В целях выявления наличия и определения состояния природно-ресурсного потенциала рассматриваемой территории и его значимости для обоснования расширения резервата проведена комплексная оценка геозкосистем государственного природного резервата «Бокейорда» Западно-Казахстанской области. Проведены исследования природных ресурсов Западно-Казахстанской области, на участках которой заложены площадки для мониторинга, составлена карта степени изменения геозкосистем и карта государственного природного резервата «Бокейорда» Западно-Казахстанской области. Картографирование осуществлялось с использованием данных ГИС-технологий. Комплексная оценка территории выполнялась с учетом ландшафтных особенностей, природно-ресурсного потенциала и сложившейся в результате хозяйственного использования территориальной структуры землепользования.

**Ключевые слова:** геозкосистема, природные комплексы, экосистемный подход, степи, биогеоценозы, зооценозы, комплексная оценка.

## **Introduction**

The preservation of the biological diversity of ecological systems, unique natural complexes, objects of the nature reserve fund, cultural and natural heritage of the Republic of Kazakhstan is one of the important tasks of the state at the present stage (Salikhov, et al, 2016).

The territory of Kazakhstan has a unique set of landscape complexes: from deserts to highlands and ecosystems of the inland seas. In the context of the increasing pace of economic development of the country and the increased use of natural resources, the issue of further improvement of the system of territorial nature protection becomes urgent. The same conditions determine the need for further development

of the network of specially protected natural areas as an effective system for the conservation of biological diversity in Kazakhstan.

A significant part of the natural steppe spaces on Earth is located in Kazakhstan, which amount to over 120 million hectares. In turn, the steppe ecosystems of Kazakhstan are places of distribution of the unique flora of the steppes, globally endangered species of steppe fauna. The steppe ecosystems of Kazakhstan are home to more than 2,000 species of flora, including approximately 30 endemic species and unique floral compositions.

Steppes are the least protected type of ecosystems in Kazakhstan, and are extremely underrepresented in the system of specially protected natural areas (PAS).

The study of steppe ecosystems, their sensitivity to the effects of anthropogenic loads, and the development of a framework for increasing the area of steppe ecosystems became the basis of the project “Conservation and Sustainable management of steppe ecosystems”.

The current state of the Russian (republics of Kalmykia, Tyva, Altai and Buryatia) and Chinese (autonomous regions of Inner Mongolia and Xinjiang) steppes is considered in some works of researchers (Baktasheva, et al., 2010; Lavrentiev, 2014; Mitrofanov, 2013; Ayurzhanaev, et al., 2020; Garmaev, et al., 2020; Huhe, 2012.), where, they analyzed and described the current state of the steppes of Russia and the autonomous regions of Inner Mongolia of the People’s Republic of China, The main strategies for their preservation have also been identified.

Currently, the system of specially protected natural territories of the West Kazakhstan region is represented by three state nature reserves of republican significance and seven of regional significance, the total area of which is 188.7 thousand hectares or 1% of the total area of the region. At the same time, there are no protected areas in the region with a strict protection regime and with the status of a legal entity (Salikhov, et al., 2017a).

#### **Research materials and methods**

The purpose of the study is to study the current geocological state and assess the degree of change in modern geocosystems of the Bokeiorda State Natural Reserve in the West Kazakhstan region.

The organization of a reserve in the habitats of the Ural saiga population (*S. tatarica*.) is especially relevant after the mass death of 12 thousand individuals from pasteurellosis in May 2010, and more than 400 individuals in May 2011, as a result, the number of the Ural population decreased from 39 thousand to 27 thousand individuals (Meldebekov, et al., 2014; Grishina, et al., 1991).

In Kazakhstan, the Committee of Forestry and Wildlife of the Ministry of Agriculture of the Republic of Kazakhstan has adopted a program for the development of scientific research on the conservation of biological diversity, which provides for the creation of the state natural reserve “Bokeyorda”. The research was carried out within the framework of the project of the Government of the Republic of Kazakhstan and the Global Environment Facility by the United Nations Development Programme (UNDP) “Conservation and sustainable

management of steppe ecosystems”, aimed at increasing steppe landscapes in the system of specially protected natural territories of Kazakhstan.

*The object and methods of research.* The theoretical and methodological basis of the research is based on general scientific methods: descriptive, geobotanical, soil, floral, faunal, cartographic and ecosystem studies on the project area using generally accepted methods.

The research methodology is based on a system of general principles and approaches. General scientific: complex, holistic, systemic, ecological, geographical (Shein, 2001; Salikhov, 2017b; Darbaeva, 2002; Methods for recording the main hunting and rare species of animals in Kazakhstan, 2003; Guidelines for maintaining the Chronicle of Nature in specially protected natural areas with the status of a legal entity: approved, 2007; Salikhova, 2023; Salikhov, et al., 2023b; Lurie, 2002; Salikhov, et al., 2022; Salikhov, 2017c).

The object of the study is the natural resources of the West Kazakhstan region, where monitoring sites are laid with topography data and GPS data on the sites. The mapping was carried out using Earth remote sensing data and GIS technologies.

The monitoring sites were laid with their data applied to the topography and GPS data on the sites were recorded. The habitats of key plant and animal species have been mapped, and the impact of negative factors on biological diversity has been assessed. The habitats of key plant and animal species have been mapped. The impact of negative factors on biological diversity has been assessed.

The fundamental principle for the allocation of valuable sites in the design of protected areas should be an ecosystem approach based on a comprehensive assessment of the ecological state of the natural components of the project area, the dominant biogeocenoses and zoocenoses of the natural environment of the steppes using remote sensing data and GIS technology.

The application of the ecosystem approach concept as a methodological basis in the allocation of steppe protected areas will allow for an assessment of the qualitative potential of biodiversity based on the existing correlation between the ecotope (habitat type), vegetation type and animal population.

The ecosystem approach makes it possible to assess both the ecological potential of habitats and the potential of biota diversity in a component-wise way (topography, soils, vegetation and associated animal population).

### **Results and discussion**

The territory of the Bokeyorda State Natural Reserve (SNR) is located in the west of the West Kazakhstan region within the territory of the Zhanibek, Bokeyordinsky, Kaztalov districts of the West Kazakhstan region. The total area of the studied region is 690.929 thousand hectares, or about 4.5% of the territory of the region (Fig. 1). The territory is located in the northwestern part of the Caspian lowland. By the nature of the relief, it represents an almost hollow-flat and slightly undulating plain with a slight slope to the south. This plain is represented in places by depressions, quarrels and ancient beds of temporary watercourses.

The hydrographic network is very poorly developed on the territory of the

“Bokeyorda” SNR. In the east of the territory flows the Aschyozek River with several tributaries, among which the largest are the right-bank tributaries Sherembetsai, Tatkensai, Zhamansai, Astausalgan gulch, Bersharal River; left-bank tributaries - Koldybaysai, Tereksai, flowing into the large lake Aralsor. Due to the frequent alternation of soil formation conditions, the soils of the territory are characterized by great diversity and mosaic, as well as complexity. However, within individual parts of the territory of the “Bokeyorda” SNR, there is a pronounced predominance of zonal soil types – ordinary chestnut, light chestnut and brown in the watershed spaces (Andryushchenko, 1958).



Figure 1 – Map of the degree of change in modern geocosystems of the state natural reserve “Bokeyorda” of the West Kazakhstan region

We have identified 537 species of vascular plants belonging to 66 families and 265 genera in the flora of the territory of the “Bokeyorda” SNR (Table 1).

Table 1 – The degree of degradation of geocosystems by various indicators

№ Land.	Name of the landscape	Bio-productivity	Humus, %	The nature of the development	Degree of degradation
1	An accumulative plain with old arable lands with a predominance of wormwood-grass-grass communities on light chestnut loamy soils with fragments of saline	3,85	2,5	former arable land	average

2	An accumulative plain with shrub-grass-type vegetation in combination with annual-solyanka communities on meadow-light chestnut soils and salt flats	4,2	2,8	pastures	weak
3	A marine plain with arable lands in the place of wormwood-cereal-type communities on light chestnut saline soils and salt marshes	2,5	1,9	arable land	strong
4	Litter with numerous wasteless sayas with old arable lands with a predominance of turf-grain-lerkhov-sagebrush vegetation in combination with solyanka-chernopolyn communities on desert-steppe solonets	3,5	2,1	staropa-hot lands	average
5	An accumulative plain with arable land on the site of lerkhopolyn-zhitnyak and zhitnyak-tipchak communities on light chestnut underdeveloped soils with fragments of salt deposits	2,1	1,7	arable land	strong
6	An accumulative plain with grass-grain-granary communities on salt marshes	5,0	3,2	fallow lands	weak
7	A plain with a predominance of arable land in place of succulent saline vegetation surrounded by halophytic communities on underdeveloped light chestnut soils with salt deposits	2,3	1,8	pasture	strong

However, this amount does not completely exhaust the entire species composition of the flora. 42.7% of species (537), 54.4% (265) genera and 56.4% (66) families of the total flora of the West Kazakhstan region are represented on the territory of the “Bokeyorda” SNR. The richest in species are 3 families: *Compositae* (*Compositae*), represented by 95 (17.3%) species, cereals (*Poaceae*) – 54 (9.8%) species and haze (*Chenopodioideae*) – 42 species (7.6%) (Darbaeva T.E., et al., 2003).

The territory of the “Bokeyorda” SNR is located in two natural zones: steppe (a subzone of semi-shrubby-turf-and-slag desolate steppes on light chestnut soils) and semi-desert (the northern subzone of sagebrush and perennial solanaceous semi-deserts on brown soils). In the system of botanical and geographical zoning, the project area is represented by the Eurasian steppe and Afro-Asian desert regions. The steppe is represented by the most arid subzone – the Volga-Kazakhstan semi-shrub-turf-cereal desert steppe, which includes the northern part of the territories, and the desert is the least arid northwestern outskirts of the Caspian province of the North Turanian settled desert, which includes most of the Caspian lowland (Lavrenko, 1954). 7 types of vegetation are widely represented on the territory of the “Bokeyorda” SNR: steppe, desert, forest, shrub, meadow, swamp, submerged (Levina, 1964).

Animals of the steppe and desert zones are found on this territory of the “Bokeyorda” SNR. Among the rodents: small ground squirrel (*Spermophilus pygmaeus* P.), several species of hamsters (*Cricetidae*), jerboa (*Dipodidae*), gerbils (*Gerbillidae*), voles (*Microtidae*), mice (*Muridae*). Among predatory mammals are

wolf (*Canis lupus L.*), fox (*Vulpes vulpes L.*), korsak (*Vulpes corsac L.*), steppe polecat (*Mustela eversmanni Lesson*), ermine (*Mustela erminea L.*), badger (*Meles meles L.*), common weasel (*Mustela nivalis L.*), etc. Of the artiodactyls, saiga (*S. tatarica*) and wild boar (*Sus scrofa L.*) are found. The background birds of the territory are larks (*Melanocorypha*), swallows (*Hirundinidae*), flutter (*Tetrax tetrax L.*), beauty crane (*Anthropoides virgo L.*), etc. Among the small birds of prey, the common kestrel (*Falco tinnunculus L.*) and the kobchik (*Falco vespertinus L.*) should be named, and among the large buzzards (*Buteo buteo L.*), the field harrier (*Circus cyaneus L.*), the steppe eagle (*Aquila nipalensis H.*) is less often noted. The world of aquatic and near-aquatic birds is rich in reservoirs. Of the reptiles in the steppe, the multicolored lizard (*Eremias arguta P.*), the nimble lizard (*Lacerta agilis L.*) And the steppe viper (*Vipera ursinii B.*) are common.

The territory of the “Bokeyorda” SNR has a complex composition of land users. According to preliminary data of the RSE “Scientific and Production Center of the Land Cadastre”, 74 land users are located on the territory, with a total area of 78 796.2 hectares. Based on the need to preserve unique natural complexes, taking into account the interests of the local population and the prospects for agricultural development in this region, taking into account further socio-economic development, it was proposed to include only the southern part of the territory, including Lake Aralsor and the adjacent territory, in the reserve (Fig. 2).

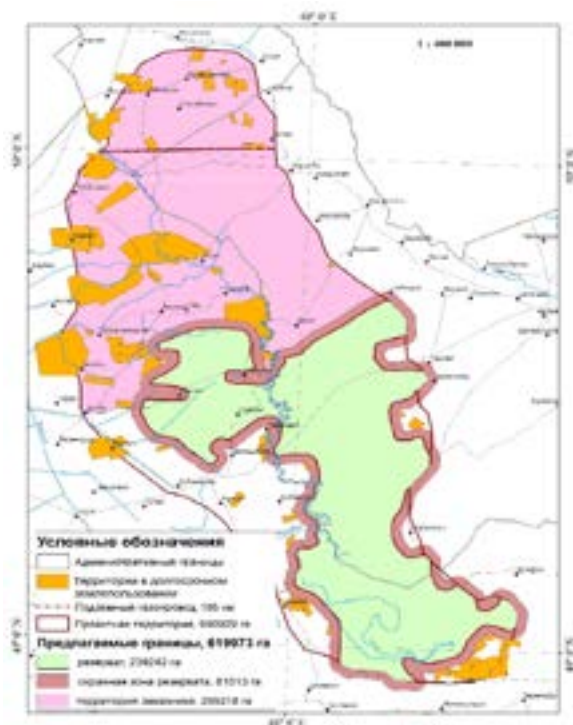


Figure 2 – Map of the State Nature Reserve Bokeyorda of the West Kazakhstan region

This is due to the fact that the northern and northeastern part of the territory within the borders of Borsin and Zhaksybai rural districts of Zhanibek district and Koshankol and Karaobinsky rural districts of Kaztalov district was previously considered as a promising area for the development of meat farming.

The territory of the “Bokeyorda” SNR is the habitat of the Ural saiga population (*S. tatarica*). Saiga (*S. tatarica*) The Azgir-Urda groups usually live here in the spring and autumn period. They go to the territory of Atyrau region for the winter. Its main habitat areas are the surroundings of Sora Khaki, the Aschyozek River, Lake Aralsor; in some years it rises north to the villages of Kaztalovka and Borsy (Grachev, et al., 2007).

The zones of the main habitat of the saiga (*S. tatarica*), including wintering, flying and mass calving sites, currently occupy the vicinity of the northwestern part of the Volga-Ural interfluve. Basically, these are territories that are less developed by economic activity and remote from large settlements. Obviously, they are preferable for saigas (*S. tatarica*) and forage.

So, in the Volga-Ural interfluve, most of the saigas (*S. tatarica*) are currently concentrated in the Aralsor lake-salt marsh basin with the dominance of the desert-salt marsh vegetation complex here, and the dominance of plants from the families of compound flowers (*Compositae*), haze (*Chenopodioideae*), cruciferous (*Cruciferae*) and rosaceae (*Rosales*) (Abaturov, 2005). This list includes not only species preferred by other herbivorous mammals (*Chenopodium album*, *Kochia prostrata*, *Potentilla* sp., *Crinitaria tatarica*, *Polygonum patulum*, etc.), but also many weedy and poisonous plants (*Lactuca serriola*, *L. tatarica*, *Artemisia austriaca*, *Thlaspi arwense*, etc.) not eaten by other ungulates (Lebedeva, 1960). A wide range of forage grasses indicates the unpretentiousness of saigas.

Currently, there are places of mass calving of saigas (*S. tatarica*) in the Volga-Ural interfluve, which are located somewhat to the north than before: to the east and north of Lake Aralsor and even in the village of Borsy – the northwestern part of the interfluve. The change in the area of mass calving that has been taking place in recent years is undoubtedly due to an increase in the anthropogenic load on the old calving sites. Thus, in the territories located to the south, there are agricultural lands, the area of which is 12.785 million hectares, of which arable land is 769.8 thousand hectares (6.0%), hayfields - 1.010 million hectares (7.9%) and pastures - 10.106 million hectares (79.0%). In the region of the planned reserve, the main types of economic activities are sheep breeding, beef cattle breeding and horse breeding. This factor had to be taken into account when developing this project.

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The akimats of the above-mentioned regions planned to provide large agricultural formations with large areas of land for grazing. Considering this circumstance, an option was recommended that provided for the creation of two types of protected areas on the territory of the “Bokeyorda” SNR - a state natural reserve and a state nature reserve (complex), the recommended boundaries of these protected areas are shown on the map of the proposed boundaries of the Bokeyorda reserve (Fig. 2). The area of the reserve is 239,242 hectares, and its protective zone is 81,513 hectares.

It was necessary to take into account the recommendations on the conservation of the biological diversity of the region and Kazakhstan on the territory of the “Bokeyorda” SNR. Rare and endangered species of great economic, scientific and aesthetic importance have been included in the Red Book of Kazakhstan. The book aims to draw attention to the protection of specific representatives of flora and fauna. The need to take special measures to preserve rare and endangered species of animals and plants is one of the features of the current state of the environment (Red Book of the Republic of Kazakhstan., 2010).

The study of plant communities showed that 104 species of forage plants were registered in the flora of the territories of the “Bokeyorda” SNR (Table 1). There are noted the presence of at least 4 unique and significant plant communities, which represent a kind of original botanical and geographical phenomenon and perform important environmental, water regulatory, water conservation, soil protection and other roles. It is here that, as a result of widespread plowing, small reference areas of pristine zonal steppe complexes have been fragmentally preserved - the Sherembetsai tract, the Tegishhil complex steppe, the Aralsor steppe, the Karaobin Tipchak steppe. The territory is also important for the conservation of habitats of steppe animal species, according to the data of the Agency, 37 species of mammals, 71 species of birds, 7 species of reptiles are found here. Of this total number, 5 species are listed in the Red Book – the beautiful crane (*Anthropoides virgo L.*), the flutter (*Tetrax tetrax*), the owl (*Bubo bubo L.*), the golden eagle (*Aquila chrysaetos L.*) and the steppe eagle (*Aquila nipalensis H.*).

### **Conclusions**

The conducted studies have shown that the impact of external factors of both natural and anthropogenic nature on representatives of wild fauna and flora continues to increase due to the increasing economic development of the territory. At present, it is necessary to take additional, more effective measures to preserve species and their habitats.

Scientific research and measures to protect ecosystems:

- scientific work on the territory of the reserve should be aimed at studying the dynamics of natural processes in order to assess, forecast the environmental



situation, develop scientific foundations for nature conservation, preserve the biodiversity of ecosystems, reproduction and rational use of natural resources;

- planning of scientific research work should be carried out taking into account the most pressing environmental problems affecting ecosystems;

- measures aimed at preserving natural areas of the territory that are habitats of rare, endemic and Red Book species of flora and fauna, as well as key species;

- measures aimed at eliminating or mitigating anthropogenic impact in order to preserve and restore natural complexes;

- the main directions of socio-economic development of the West Kazakhstan region indicate the need to develop the tourism industry, create zones of civilized hunting and fishing, provide tourists and vacationers with the necessary services. The implementation of the main directions of tourism development can contribute to the restoration of the cultural traditions of the region, the preservation of natural, historical and cultural monuments, etc. The state nature reserve “Bokeyorda” can also play a positive role in the development of tourism in the region.

Therefore, the diverse natural landscapes and unique natural objects of the reserve are ideal for organizing ecotourism, which has become popular recently.

Considering that at present in the West Kazakhstan region there are no specially protected natural areas with a strict protection regime, the organization of a new nature conservation institution will fully ensure not only the preservation and restoration of the steppe biodiversity of the region, but will also improve the socio-economic conditions, will contribute to the development of ecotourism. In many ways, this will be due to the creation of a large state nature reserve “Bokeyorda” and a comprehensive state nature reserve in the west of the West Kazakhstan region.

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