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Peculiarities of creating an internet resource of rare and endangered species of North Kazakhstan region

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Abstract: The article presents a scientific and spatial approach to the conservation of rare species in the North Kazakhstan region. The study is aimed at systematizing data on rare and endangered species of flora and fauna in the region, as well as a comprehensive analysis of anthropogenic and natural threats affecting their numbers and range. In the course of the work, a review of literary sources, regulatory documents, and existing conservation initiatives was conducted, which made it possible to identify species identified as priorities for conservation. An interactive database has been developed containing information on the biological characteristics of species, their conservation status, species distribution in the region, main threat factors, and conservation measures. Particular attention is paid to data visualization: users can view a map of the habitat and distribution of species in the region and track changes in distribution patterns. The examples include the White-tailed eagle, Pine marten and Lilium martagon, which are endangered. To assess the spatial distribution of species, the methods of geoinformation analysis and comparative research were used, which made it possible to clarify the distribution boundaries of the studied species. The results of the study have high practical significance: they can be used in the development of regional environmental protection strategies, zoning of protected natural areas, as well as in educational activities. The interactive database is a tool for monitoring biodiversity and making informed decisions in the field of environmental protection at the regional level.

Keywords: rare and endangered species, North Kazakhstan region, database, Internet resource, biodiversity, White-tailed Eagle, Pine marten, Lilium martagon, overview map.

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1. Introduction

Increasing anthropogenic pressures combined with changing climatic conditions are shaping a new ecological reality in which more and more species of native fauna are threatened by unsustainable development and climate change. This in turn has serious implications for food chain dynamics and biogeochemical processes in the environment and requires increased attention from the scientific community (Naderian et al., 2024). In this regard, active work is underway to compile the IUCN

Red List (https://www.iucnredlist.org/) and Red Books of various countries, aimed at monitoring the state of populations, developing conservation measures, educating the public, and attracting public attention to biodiversity issues. The key factors that have a negative impact on wildlife remain the destruction and transformation of natural ecosystems, illegal removal from the natural environment, commercial exploitation, the impact of natural disasters and climate change, as well as the consequences of armed conflicts (Shydlovsky et al., 2023).

The North Kazakhstan region (NKR) is a unique ecosystem complex characterized by a high diversity of natural landscapes, including steppe landscapes, forests, and lake ecosystems (Dmitriyev et al., 2024; Dmitriyev et al., 2023a; Nazarova et al., 2019).

The region is characterized by a high level of biological diversity, acting as a habitat for a significant number of species of flora and fauna, which creates favorable conditions for the study of ecosystem diversity and ecological relationships (Dmitriyev et al., 2023).

In recent decades, significant changes in natural landscapes have been observed in the Oblast due to the intensification of agricultural activities, climatic changes, and a number of other environmental factors (Pashkov & Vilkov, 2017). These changes contribute to the reduction of some species, the extinction of others, as well as the emergence of new, more ecologically plastic species that successfully adapt in the region as a result of the expansion of their geographical range (Gashev et al., 2018). In this case, biodiversity conservation involves maintaining the stability and integrity of historically established ecosystems that ensure the existence of various groups of living organisms, including rare and endangered species. On this basis, there was a need to analyze and systematize data on biological species of the study region (Zhilenko et al., 2021). However, existing methods often involve the need for extensive manually collected training data and also require expert knowledge of different environmental conditions. This limits their use in regions where data are scarce and in situations where rapid mapping and regular monitoring are required (Zhou Tao et al., 2025).

The creation of databases is one of the promising aspects used in modern research of different scientific fields and has direct utility for validating modeling and forecasts (Sorensen et al., 2024). Databases in the form of Internet resources are already freely available, for example, GBIF, Biodat (GBIF) (https://gis-lab.info/qa/gbif-intro.html), (Biodat) (https://biodat.ru/db/vid/index.htm). Software is used to create databases, including for posting as an Internet resource (Observation.org) (https://observation.org), (iNaturalist) (https://www.inaturalist.org/observations). In the current conditions of digitalization of environmental research, such resources become not just data repositories, but complex platforms that provide prompt access to relevant information and integration with various analytical tools. The development of these technologies contributes not only to improving the efficiency of scientific research but also to creating a more accurate and informative basis for decision-making in the field of nature conservation.

Geographic information systems (GIS) and remote sensing technologies significantly expand the possibilities of research and monitoring of ecological processes, both at the local and global levels (Hambardzumyan, 2024). GIS-technologies allow not only to determine the habitats of rare species, but also to analyze the spatial relationships between various environmental parameters. This is especially important for identifying areas with increased risk of species extinction and forecasting changes in their populations. The possibility of combining cartographic data with other parameters, such as climatic factors, the level of anthropogenic pressure, and historical trends in habitat change, will significantly expand the analytical capabilities of databases and Internet resources (Lukashik & Alekseev, 2024; Pekishev & Kovalenko, 2025).

Modern surveying, mapping, and geoinformation technologies are actively used to study natural resources, ecological conditions, and distribution within regions, which in turn provides visualization of the spatial distribution of rare species, making research results more visible and accessible to both specialists and the general public (Gui et al., 2019). In addition, such resources can include mechanisms for updating data in real time, which increases their relevance and value for biodiversity monitoring. In the future, further development of databases and Internet resources integrated with

GIS will make it possible to create more accurate predictive models, take into account the dynamics of change and develop effective strategies for the conservation of ecosystems and individual species.

The study aimed to create a specialized Internet resource based on the prepared database, designed to systematize information on rare and endangered species of flora and fauna of the region. Creating a database of the studied species offers a cost-effective way to assess the biodiversity of individual territories, making it an important tool in conservation activities. The data of the prepared resource are focused on the accounting of rare and endangered species, which allows timely identification of changes, as well as the development of measures to conserve biodiversity (Żmihorski et al., 2012). The Internet resource based on the database combines information on the biological characteristics of species, their current state, threats, and necessary measures for their conservation. The interactive format of the database will provide access to up-to-date scientific information for specialists, researchers and ecologists, as well as become an important tool for monitoring and coordination of conservation measures.

The creation of an interactive database for monitoring endangered species of animals and plants in the North Kazakhstan region represents an important step in the conservation of the region's biodiversity. Perhaps, it will provide a comprehensive analysis of population changes and allow timely identification of potential threats (Ravkin et al., 2024). The obtained results have both theoretical and practical significance. The research results can be applied in conservation activities, as well as in the educational process (Korchagina, 2023; Nikolaeva & Dubinina, 2022). Regular monitoring studies and real-time updating of the Internet resource data will improve the reliability and relevance of information necessary for sustainable development.

2. Materials and methods

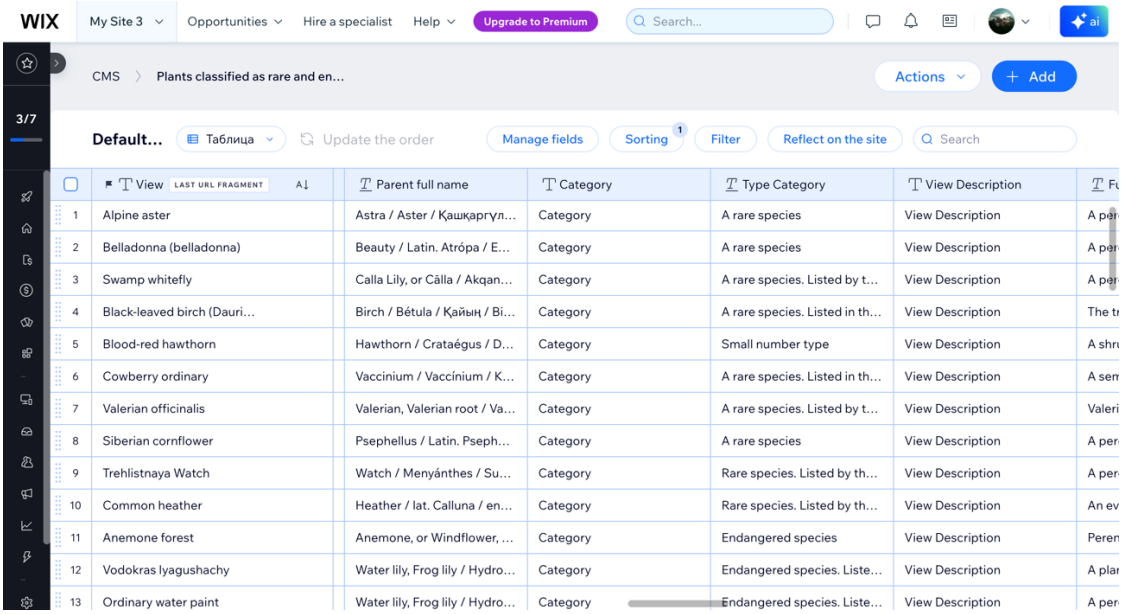
A collection of materials was carried out within the framework of the analysis of available literary and scientific sources containing information about rare and endangered species of flora and fauna of the North Kazakhstan region. As the main sources were used data presented in the Red Book of the Republic of Kazakhstan, publications of scientific journals, methodological manuals of scientists dealing with the problem of biodiversity and conservation of biological species (The Red Data Book of the Republic Kazakstan; The Red Book of the Republic of Kazakhstan «plants»; Vilkov & Zuban, 2013; Yavorskaya, 2008; Nekrasov et al., 2007).

The methodological basis of the study includes systematization and comparative analysis of available data in order to identify the main factors affecting the state of populations of rare and endangered species. Retrospective analysis of statistical data and scientific materials was used to identify the status and dynamics of species. When processing information, special attention was paid to «Category», the residence status of mammal and bird species, ecological and anthropogenic threats that can harm the conservation of species. The data components that are part of the database are shown in Figure 1. By «Category» in this study, we mean the status of a species within our region, reflecting its degree of vulnerability and need for protection. The residency status of mammals and birds reflects the nature of their presence within our area and is presented as part of the database in Figure 2. The following categories of stay status are distinguished: sedentary species that inhabit the area all year round; nesting species that breed here during the warm season; migratory species that occur during seasonal migrations; stray species that appear sporadically outside their normal range; nomadic species that make irregular movements in search of food; and wintering species that remain in the area during the cold season. Species whose residency status in the study area is unclear have been identified. Such species include, for example, the European Mink, *Mustela lutreola*. There is a hypothesis of displacement of this species by the American Mink, *Neogale vison*, introduced into the region for economic purposes. Having been released from the artificial habitat, the American Mink successfully acclimatized to the natural environment, spreading throughout the water bodies of the region. With its competitive advantages, it may have contributed to the decline of the European Mink species. Fragmentation or lack of comprehensive studies on many of the studied species is noted.

Based on this, an attempt was made to classify the study species based on the results of available studies. The classification included the following categories: endangered, rare, and a few species of

plants and animals in our area. Thus, by rare species we mean species with very species of low population density, occurring only in some places. At the same time, species of low population density are highlighted as species with small numbers, occasionally occurring in a biotope. Also included in the proposed categories were species listed in the Red Book of the Republic of Kazakhstan that occur in the territory of the North Kazakhstan region. Their status reflects the degree of threat to their existence at the national level, but in our study, they are considered by taking into account their distribution within the region.

The most relevant data available in the IUCN and the Red Book of Kazakhstan (The Red Data Book of the Republic of Kazakhstan), (IUCN) (https://www.iucnredlist.org/) were taken to assess the status of the species under study in the region. In addition, general materials and information on species diversity for the region were used, including data for the period since 2007 (Nekrasov et al., 2007) and data from scattered studies (Berezovikov & Erokhov, 2000; Zuban & Vilkov, 2012; Vilkov & Zuban, 2012) and others. Although full application of the IUCN Red List Criteria (A-E) was not feasible due to the limited availability of quantitative field data (such as exact population size, rate of decline, or degree of fragmentation), the general framework of these criteria was considered during the classification process. The IUCN criteria include objective measures such as population abundance, geographic range, and observed population trends, which serve as a foundation for standardized conservation assessment. Incorporating these principles enhances the objectivity, consistency, and reproducibility of the species categorization used in this study.



	View	Parent full name	Category	Type Category	View Description
1	Alpine aster	Astra / Aster / Қашқаргүл...	Category	A rare species	View Description
2	Belladonna (belladonna)	Beauty / Latin. Atrópa / E...	Category	A rare species	View Description
3	Swamp whitefly	Calla Lily, or Cälla / Akqan...	Category	A rare species. Listed by t...	View Description
4	Black-leaved birch (Dauri...	Birch / Bétula / Қайың / Bi...	Category	A rare species. Listed in th...	View Description
5	Blood-red hawthorn	Hawthorn / Crataégus / D...	Category	Small number type	View Description
6	Cowberry ordinary	Vaccinium / Vaccínium / K...	Category	A rare species. Listed in th...	View Description
7	Valerian officinalis	Valerian, Valerian root / Va...	Category	A rare species. Listed by t...	View Description
8	Siberian cornflower	Psephellus / Latin. Pseph...	Category	A rare species	View Description
9	Trehlistnaya Watch	Watch / Menyánthes / Su...	Category	Rare species. Listed by th...	View Description
10	Common heather	Heather / lat. Calluna / en...	Category	Rare species. Listed by th...	View Description
11	Anemone forest	Anemone, or Windflower, ...	Category	Endangered species	View Description
12	Vodokras lyagushachy	Water lily, Frog lily / Hydro...	Category	Endangered species. Liste...	View Description
13	Ordinary water paint	Water lily, Frog lily / Hydro...	Category	Endangered species. Liste...	View Description

Figure 1. Screenshot of the Internet resource of the developed database

To create the Internet resource the WIX website builder was used, which is based on the database with content management components. The peculiarity of this constructor is the creation of Internet resources in Russian, in the future it is planned to create an Internet resource in English. This allowed to systematize and display information about rare and endangered species of flora and fauna of the North Kazakhstan region (Figure 2).

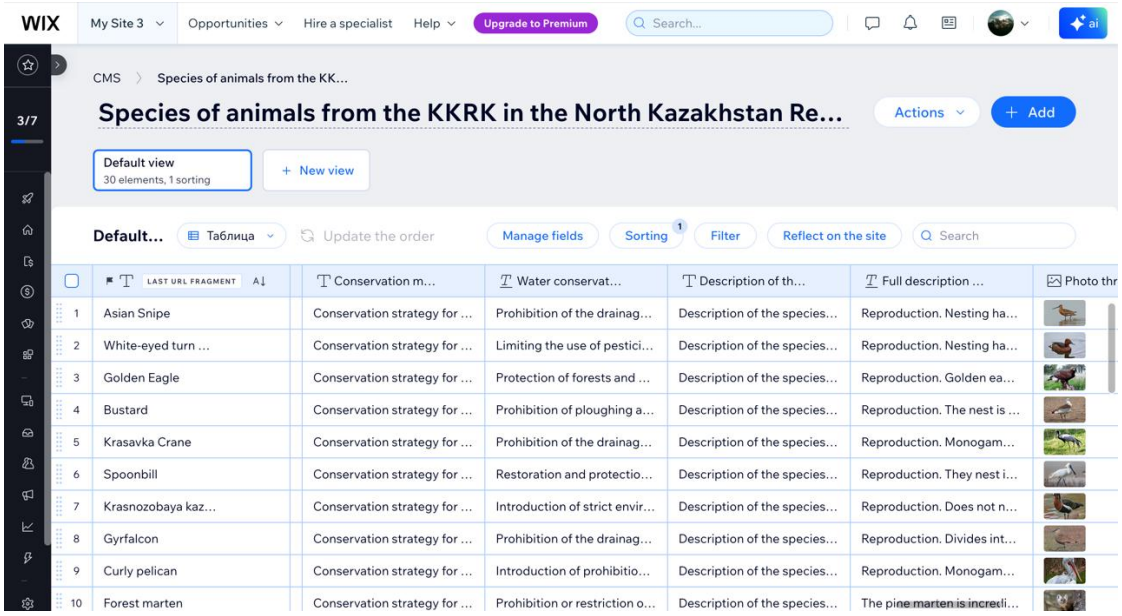


Figure 2. Screenshot of the internet resource of the developed database

The method of geoinformation analysis was used to identify the locations of rare and endangered species. The cartographic method was used to visualize the obtained data, ranges, meeting places, etc. (Sarychev et al., 2015). Overview maps of the distribution of the studied species of flora and fauna of the region were prepared using GIS technologies. The final results of the prepared overview maps were entered into the database (Badalova et al., 2024), designed to monitor the status of rare and endangered species of the North Kazakhstan region. The database, presented as an Internet resource, will make it possible to obtain changes as a result of monitoring studies, as well as using it for planning measures for the protection and restoration of biological species and sustainable development of the study area.

3. Results

Currently, 258 species of plants, mammals, and birds are registered in the region, which are rare, scarce, or endangered, and this indicator is constantly changing under the influence of natural and anthropogenic factors. According to the results of the analysis of the obtained data, it was revealed that 212 species of the study region are listed in the IUCN. In the course of the study, information on the status of these species was collected. Thus, 30 species of mammals and birds were identified out of the total number of registered rare, minor, and endangered species. Their species are included in the database section: «Species of animals from RBRK on the territory of the North Kazakhstan region (mammals and birds)». 24 species of plants are included in the section: «Species of plants from RBRK on the territory of the North Kazakhstan region». In addition, 105 species of mammals and birds are categorized as rare and few within our region and are included in the corresponding section of the database. Of this number, 57 species were categorized as rare and 48 species were categorized as few in number. Ninety-nine plant species were categorized as rare and low-abundance. This number includes 50 plant species that we categorized as few in number, 38 plant species were categorized as rare, and 11 plant species are endangered on the territory of our region. The researched species are entered into the created database of the Internet resource.

3.1 Content of the Internet resource structure

3.1.1 Example structure of the online resource based on three endangered species

As an example of the content of the Internet resource structure, 3 endangered species are presented in this paper: White-tailed Eagle *Haliaeetus albicilla*, Pine marten *Martes martes* and Lilium martagon *Lílium mártagon*. These species were chosen for several reasons. First, the species

under study are endangered and listed in the Red Book of the Republic of Kazakhstan, which emphasizes their importance for the study and conservation measures. The White-tailed Eagle is one of two species of eagles in the fauna of Kazakhstan, and its numbers are declining due to habitat loss and pollution of aquatic ecosystems. The pine marten is facing population declines due to forest ecosystem degradation and hunting. The Lilium martagon is threatened with extinction due to climate change and anthropogenic impacts on natural habitats. Second, the selected species fulfill key functions in the ecosystems in which they live. The white-tailed eagle, being a top predator, regulates the number of other animals, which helps to maintain ecological balance. The Pine marten plays an important role in maintaining the health of forest ecosystems as it regulates rodent numbers and feeds on carrion, making it a forest sanitizer. The Lilium martagon is a plant that attracts many pollinators, which helps to maintain and increase biodiversity. Third, the study of these species provides unique opportunities to investigate ecological processes and develop effective conservation strategies. The analysis of their behavior, adaptation and interaction with the environment allows for a deeper understanding of ecosystem functioning, as well as the identification of optimal conservation measures for rare and endangered species (Meredov et al., 2024).

Thus, the selection of the above-mentioned species is conditioned by their ecological significance, vulnerability to anthropogenic and natural factors, as well as the need to develop effective measures for their conservation. Consideration of these species in the context of the study allows not only to identify key threats to the biodiversity of the region, but also to emphasize the implementation of a strategy for the conservation of rare and endangered species.

In order to understand the status and role of species in ecosystems, it is important to characterize each of the selected study sites in detail, based on the proposed database structure. This will help to systematize the data and provide an integrated approach to the study of species in the region. For example, some bird species have positive dynamics of abundance, while the majority of species. But despite the protective measures taken, the condition of populations continues to deteriorate. This is due to the combined impact of both natural and anthropogenic factors (Sandakova et al., 2024). A unique biological species found on the territory of the region is the White-tailed Eagle. This is one of the most vulnerable representatives of the fauna of the region, information about which is presented in the structure of the prepared database, which formed the basis of the created Internet resource.

3.1.2 White-tailed eagle: an example of how the species is represented in an Internet resource

White-tailed eagle - Haliaeetus albicilla

Division: Accipitriformes / Accipitriformes

Family: Accipitridae / Accipitridae

Genus: Haliaeetus / Haliaeetus

Category of species: Rare. Listed in the Red Data Book of the Republic of Kazakhstan - III category: rare. Listed in the IUCN List - LC (increasing)

Species occurrence status: Nesting, migratory and partially wintering species.

Species description: One of the largest birds of prey, reaching 70-90 cm in length with a wingspan of 200-230 cm and a mass of 4-7 kg. A distinctive feature is the short, wedge-shaped tail. Adults have brown plumage, while the head and neck are distinguished by a light yellow hue. The white tail contrasts with the rest of the coloration, and the powerful, light yellow beak emphasizes the predatory appearance of the bird. The iris of the eyes is also light-colored. Unlike the Golden Eagle *Aquila chrysaetos*, the feet of the White-tailed Eagle are uncovered with feathers up to the toes. Young birds are darker, with brown plumage and a dark gray beak. During the molting process, which lasts up to five years, they gradually acquire an adult appearance. Females are noticeably larger than males. In flight, the eagle keeps its wings almost straight, which distinguishes it from many other raptors (Birds of Europe) (https://www.ebirds.ru/vid/90.htm).

Peculiarities of biology: *reproduction.* Eagles favor nesting near large bodies of water, choosing tall trees or sturdy shrubs, and avoiding anthropogenic disturbance. Pairs persist for life, often returning to the same nests or using 2-3 nests alternately. A nest 1-1.5 m (up to 2 m) in diameter and 0.5-1 m (sometimes more than 2 m) high is built from branches and lined with soft materials. It

is placed at a height of 4-22 m, less often on bushes, rocks or abandoned buildings. Before nesting, the pair performs complex mating maneuvers. The clutch contains 1-3 eggs and incubation lasts 37-40 days. The female incubates eggs longer than the male during incubation. During this time, the male brings prey. Eagles are sensitive to human presence and may leave the nest. Chicks begin to fly by the 10th week (Ryabitsev, 2008).

Nutrition. The diet is based on fish, preferably dead fish and carrion, and less frequently on weakened birds and small mammals. Prey is scouted from the air or roosts, sometimes taken from small predators, gulls and crows (Ryabitsev, 2008).

Distribution and abundance in NKR: widespread in the North Kazakhstan region during migration and summer migrations, occurring throughout the region. A small number of wintering individuals were noted. Nesting sites are concentrated mainly in the northern and north-western part of the region, affecting the territories of state wildlife sanctuaries, part of the State National Nature Park «Kokshetau» and adjacent forest areas, including mixed forests suitable for breeding, and on the territories of aquatic ecosystems. Winter sightings were recorded in Zhambyl district, Shal akyn district, Esilsky district in the territory of the State Institution for the Protection and Reproduction of Wildlife «Krasny Bor» and Smirnovsky State Nature Reserve, as well as in Kyzylzhar district. This can be seen in the overview map presented in Figure 3. Thus, 5 nests were found and surveyed in Zhambyl district in the period from 2008 to 2013, and nesting is also known in Mamlyutsky, Esilsky, M. Zhumabayeva districts. According to our estimates, 15 to 20 pairs nest in the region. During the fall migration, the number of White-tailed eagles increases. Thus, from September 27 to October 16, 2011, 49 individuals were recorded in 10 districts of the region, including 35 young and 14 adults. The highest concentrations were recorded on September 27 at Balykty lake (Akkaiyn district, 10 individuals) and on October 4 at Sarykol lake (Esilsky district, 7 individuals). In July 2013, a large aggregation of non-breeding birds (about 40) was observed on Lake Maibalyk (Zhambyl district) (Vilkov & Zuban, 2013). Since the main breeding grounds of the White-tailed eagle are mostly associated with protected areas, this contributes to the conservation of the species population. White-tailed Eagle is a migratory species in our region, so the migration flow is directed through the whole territory of the region.

Habitats. The main habitat is the vicinity of water bodies rich in fish. As a rule, it builds its nests on the edges of mature floodplain forests or on freestanding trees in close proximity to water bodies, not further than 0.5 km away.

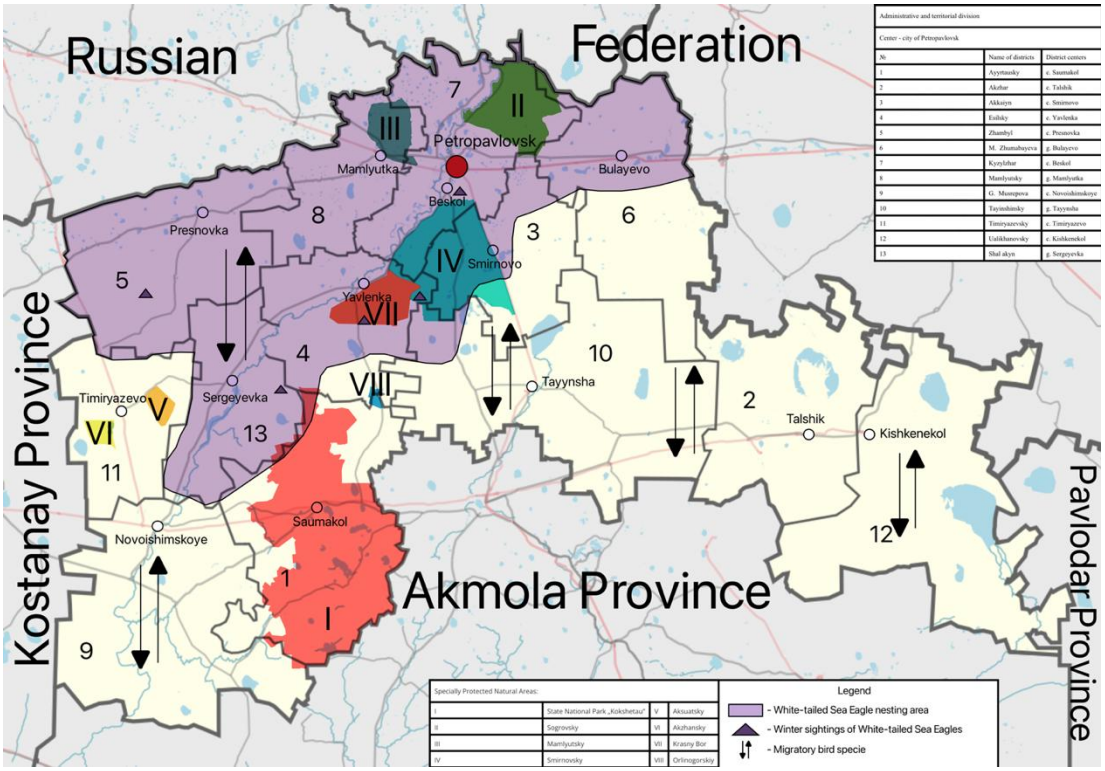


Figure 3. Overview map of distribution and nesting of White-tailed eagle in North Kazakhstan region

Ecological and anthropogenic threats affecting the conservation of the species:

- Pollution of water bodies and leakage of oil products, which negatively affect the population of fish and waterfowl.
- The formation of biotopes under the influence of hydrological regime and plant communities determines the structure of the fauna of a given area, but changes in these conditions create ecological and anthropogenic threats (Stasyukevich & Grichik, 2024).
- Deforestation along rivers and lakes deprives eagles of nesting sites.
- Poaching and illegal hunting.
- Disturbance from tourists and people interfering with nesting and food extraction.

Strategies and actions to ensure conservation of the species:

Nesting monitoring. Using modern remote observation technologies and photo and video recording equipment, nesting sites can be identified and nest locations can be recorded. This will allow assessment of the current state of the population and its dynamics.

Habitat protection and anthropogenic impact mitigation. Potential nesting areas are identified and protected. In order to minimize disturbance to birds, tourist flows are redistributed to other areas, which provides favorable conditions for breeding success.

Establishment of protected forest areas. Organization of protected forest areas to prevent the cutting of forest areas containing nesting sites of birds of prey.

Reducing mortality on power lines. Incentivize owners of power lines to install bird-protective devices to prevent the death of birds of prey, which will significantly reduce the risk of their injury and death.

Environmental Education. Use registration of cases of eagle deaths due to anthropogenic factors through mass media to attract public attention to this problem, which will contribute to the formation of environmental responsibility.

3.1.3 An example of the structure of an Internet resource database based on the description of a Pine marten

The class of mammals in this paper is represented by the species, Pine marten. The information characterizing this species is given according to the structure of the created Internet resource.

Pine marten - Martes martes

Division: Carnivora / Carnivora

Family: Mustelidae / Mustelidae

Genus: Marten / Martes

Category: rare. Listed in the Red Data Book of the Republic of Kazakhstan - III category: rare. Listed in the IUCN List - LC (stable)

Residence status of the species: sedentary species.

Description of the species: the animal has a broad and elongated muzzle with powerful jaws and sharp teeth. The ears are triangular, large relative to the muzzle, with rounded tops and yellow edging. Dark eyes at night acquire a copper-red tint, and the nose is also dark. The body is oblong, the legs are short, and the feet are covered with wool. Males are larger than females; the animal's weight varies from 0.8 to 1.8 kg. Body length is 45-58 cm, tail is 16-28 cm, and fluffy, which helps to keep balance when climbing. The coat is chestnut or dark brown with a yellow spot on the throat. In summer, the coat is shorter and stiffer, in winter it is long and silky (Monakhov & Hamilton, 2020; Monakhov, 2022).

Peculiarities of biology: *reproduction.* Polygamous. Mating takes place in mid-summer, but pregnancy begins later, as the seed is preserved in the body of the female. The offspring are not born until April. There are usually three cubs in a litter. During the first eight weeks, they remain under the care of their parents. After sixteen weeks, they become independent, but sometimes, until the next spring, are still accompanied by their mother. Sexual maturity occurs in the second year of life, though they usually mate for the first time in the third year.

Nutrition. Omnivorous. Main targets are small mammals (e.g., vole mice) and, in spring and summer, birds and their eggs. May eat reptiles, frogs, snails, insects and even carrion. In late summer and fall, it can create food reserves for the cold season.

Distribution and abundance in NKR*:* The main habitats of the Pine marten are concentrated in the northern, north-western and southern parts of the region, mainly in areas of high forest cover near the borders with the Russian Federation. These habitats are included in the system of specially protected natural areas. Thus, the species was recorded in the Sogrovsky, Smirnovsky and Mamlyutsky State Nature Reserves. In addition, the species is found in the territories of the State National Natural Park «Kokshetau» and the State Institution for the Protection and Reproduction of Wildlife «Krasny Bor». The presence of the species in protected areas, where there is no human economic activity, contributes not only to its conservation but also to the positive dynamics of its reproduction. Figure 4 shows the distribution of the species across the region. The highest abundance was detected in M. Zhumabayeva, Kyzylzhar, Mamlyutsky, Zhambyl and Shal akyn districts. Peak abundance occurred in the late 1990s and early 2000s, when an average of 3-4 tracks were counted per 10 km of route, and density ranged from 0.1-0.3, more rarely 0.5-0.6 individuals per 10 km^2 of forest (Vilkov & Zuban, 2013).

Habitats. Inhabits a variety of forest habitats with pronounced undergrowth and understorey. Climbing and jumping well, covering distances up to 4 meters. Shelters in hollow trees, in piles of brushwood, or use nests of raptors and birds of prey. It is predominantly solitary.

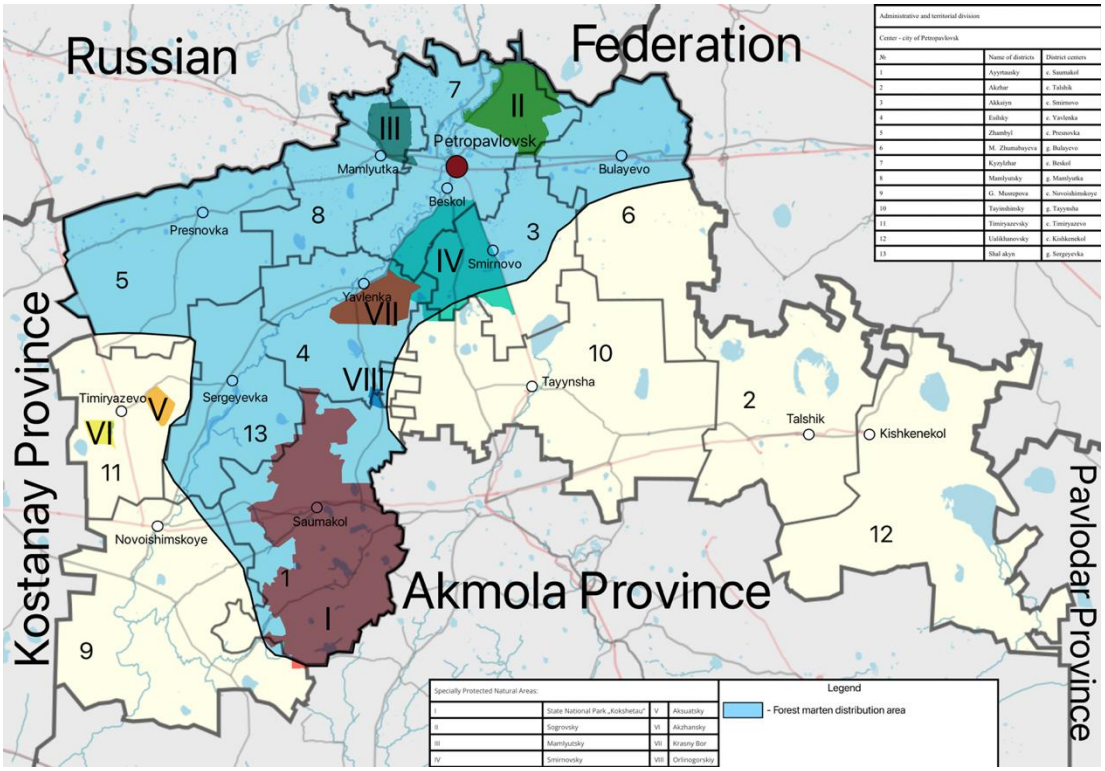


Figure 4. Overview map of Pine marten distribution in North Kazakhstan region

Ecological and anthropogenic threats affecting the conservation of the species:

- Deforestation leading to habitat loss.
- Hunting and poaching due to valuable fur.
- Competition with invasive species such as the American Mink.
- Pollution of forest ecosystems and loss of forage resources (Vladimirova, 2013).

Strategies and actions to ensure conservation of the species:

Restriction of hunting. In most regions, hunting of the Pine marten) is strictly prohibited, which helps to reduce anthropogenic pressure on this species. Such legislative measures play a key role in the conservation of the species, allowing martens to reproduce and occupy stable ecological niches.

Forest conservation. One of the main conditions for the survival of martens is the presence of extensive forest areas. Therefore, it is necessary not only to protect existing forests from logging, but also to actively restore forest ecosystems by creating new forest plantations. Mature and overmature forests are particularly important as they provide suitable conditions for breeding, and the presence of trees with hollows for brood shelters should also be taken into account.

Environmental cleanup. Environmental pollution should be minimized to ensure favorable habitat conditions. Controlling toxic emissions and litter reduces the risk of martens and their prey base being exposed to harmful chemical compounds, which directly affects their health and survival.

Education outreach. An important aspect of Pine marten conservation is environmental education of the population. Informing the public about the importance of this species in ecosystems and the measures that each individual can take to protect it raises the level of environmental responsibility. The awareness campaign conducted in schools, mass media and public organizations contributes to the formation of a sustainable ecological culture.

Establishment of protected areas. Organization of specially protected natural areas will provide legal protection of Pine marten. Hunting, logging and other activities threatening the conservation of the species are prohibited in such areas. This will contribute to population stabilization and growth.

Importance of mature forest condition. The survival of martens is closely linked to the presence of mature and overmature forests where they find shelter, food and breeding sites. Trees with hollow trees play a key role by providing safe havens for broods, especially during the breeding season.

Conservation of such forests should be a priority for conservation efforts (Vladimirova & Mozgovaya, 2010).

3.1.4 Example of Internet resource structure: Lilium martagon as an object of protection

The representative of the flora considered in this study is Lilium martagon. We present data characterizing this species according to the structure of the created Internet resource.

Lilium martagon, the martagon lily or Turk's cap lily - Lílium mártagon

Order: Liliales / *Liliáles*

Family: Liliaceae / *Liliaceae*

Genus: Lilium / *Lílium*

Category: Rare species. Listed in the Red Data Book of the Republic of Kazakhstan - II category. rare species. Listed in the IUCN - LC (decreasing).

Description of species: Perennial herbaceous plant 60-120 cm high (sometimes up to 200 cm). Bulb up to 8 cm in diameter, with fleshy scales. The sturdy stem is covered with reddish spots. Leaves are lanceolate, up to 15 cm long and 5 cm wide, gathered in whorls. Flowers are drooping, purple with dark purple spots, about 3-4 cm long, clustered in clusters of 5 to 10 pieces. Blooms in June-July. The fruit is a hexagonal boll. Seeds are triangular, light or dark brown, with filmy edges (Senchugova et al., 2016).

Distribution and abundance in the NKR: Lilium martagon has a limited distribution in the region, growing in ecosystems with favorable soil and climatic conditions. On the territory of the region it is found in Serebryany Bor, on Voroniy ostrov, along the whole valley of the Esil River. The species was also recorded in specially protected natural territories - Sogrovsky and Smirnovsky State Nature Reserves, where optimal conditions for its growth are preserved. The overview map in Figure 5 shows these encounters. The occurrence of the plant is conditioned by its high demand for humidity and shading, which limits its distribution outside natural forest areas.

Habitats. It grows in forest edges, glades and meadows. Occurs sporadically in mixed, broad-leaved and small-leaved forests, on rich medium-moist soils (Yavorskaya, 2008).

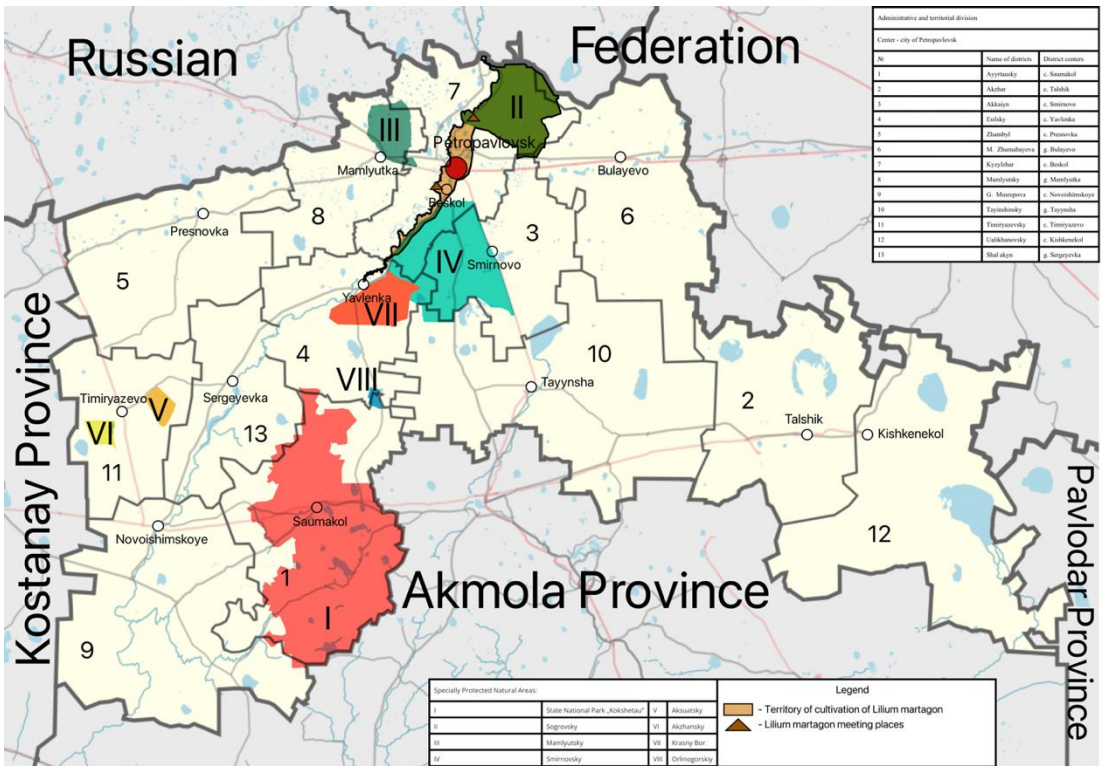


Figure 5. Overview map of distribution of Lilium martagon in North Kazakhstan region

Significance and application: *use in folk medicine*. Lilium martagon is used as a medicinal plant in folk medicine in China, Tibet, Mongolia, Buryatia, Yakutia, Siberia and the Far East. The juice of the bulbs is used as a wound-healing agent, and the infusion is used for toothache.

Nutritional value. The plant is eaten raw, boiled, fried, dried and as a seasoning. Bulbs are eaten raw, cooked baked in ashes, or boiled with milk and cow's butter. Dried onions are used by Yakuts in cooking milk porridge, and Kyrgyz put them in sheep cheese for seasoning. The bulbs can also serve as a surrogate for coffee.

Veterinary use. Veterinarians add bulbs to pet food to increase lactation and milk fat content. However, they are toxic to cats.

Other uses. Fabrics were dyed black by adding the iron salt of lily bulbs.

Ecological and anthropogenic threats affecting the conservation of the species:

- Loss of natural habitats due to deforestation and agricultural expansion.
- Collection for ornamental and medicinal purposes.
- Construction of infrastructure in growing areas, which disrupts ecosystems
- Alteration of hydrological regime, negatively affecting wet forest areas (Specially protected territories of Yugra) (https://ugraoopt.admhmao.ru/redbook/74077/2537927/).

Strategies and actions to ensure the conservation of the species:

Cultivation. Cultivation of the plant for ornamental purposes in garden plots and plantations. Moist, fertile soils rich in organic matter with semi-shade or sunlight are recommended. This will help to reduce pressure on natural populations (The Red Book of Russia) (https://cicon.ru/lilium_martagon.html).

Controlled collection. Impose strict restrictions on harvesting lilies in the wild. Prohibition of bulb digging and flower cutting. Industrial collection is allowed only if natural populations are conserved.

Habitat protection. Protect the natural habitats of Lilium martagon by establishing and maintaining protected areas, including reserves and sanctuaries. This also includes preventing degradation of these areas.

Exposure conservation. The use of technologies such as seed storage in specialized banks and cell culture to preserve the genetic material of a species outside the natural environment (Chanotey & Osipenko, 2022).

International cooperation. Participation in international programs and projects to coordinate efforts to protect Lilium martagon. Especially in regions where its real crosses the borders of several countries.

3.2 SWOT-analysis of the internet resource: identification of strengths, weaknesses, opportunities and threats

Thus, the conducted research allowed the creation of an Internet resource, which is based on a structured database, including information about rare and endangered species of flora and fauna of the North Kazakhstan region. On the basis of the conducted research, the SWOT-analysis was prepared, which allowed to identify strengths and weaknesses, opportunities and threats for the created Internet resource and is presented in Table 1. In our opinion, this is a prerequisite for further possible adjustment of the content of its structure, as well as for improving the system of creating databases of rare and endangered species.

Undoubtedly, the strengths of the created Internet resource are explained by the necessity of its creation and its practical orientation. Improvement and modification open up opportunities for its use in educational, scientific, cognitive, and informational purposes. But the modern threat to any created Internet resource in today's world is cyber threats, which can lead to both loss of functionality and complete destruction of the created product. Nevertheless, despite the possible negative consequences, the created Internet resource allowed to collect scattered scientific materials and data on rare endangered species of the North Kazakhstan region and is a modern means of information transfer.

Table 1. SWOT-analysis of the Internet resource on rare and endangered species of the North Kazakhstan region

Strengths	Weaknesses
• **Scientific reliability** - data is systematized and based on current research. • **Interactivity** - information can be updated and accessed in real time. • **Geo-information analysis** - use of spatial analysis techniques to assess species distribution. • **Multitasking** - the database is useful for specialists, ecologists, researchers and government agencies. • **Data visualization** - the availability of species distribution maps improves the perception of information.	• **Dependence on updates** - data must be updated regularly to remain reliable. • **Lack of field data** - the database is based on available sources, which may limit its accuracy. • **Need for technical support** - ongoing administration and software enhancements are required.
Opportunities	**Threats**
• **Integration into regional conservation programs** - use the database to improve biodiversity conservation strategies. • **Extension of functionality** - ability to add modules to collect data from users and environmental organizations. • **Educational value** - use as a tool for training.	• **Cyber threats** - risk of data loss due to hacker attacks or technical failures. • **Low awareness** - if the database is not widely known, its potential may remain untapped. • **Legal restrictions** - it may be difficult to access some data due to legislation.

4. Discussion

The results of the study demonstrate the significant role of the proposed approach in the analysis and interpretation of the phenomenon under study. The data obtained indicate the presence of stable patterns, which confirms the relevance of the chosen method and its compliance with modern scientific concepts.

The analysis of the relationships between the key parameters revealed important aspects of their influence, which opens up new prospects for further research. The development of methodological approaches and the clarification of the influence of individual factors are of particular interest to the scientific community and practitioners. The results obtained allow us to propose new directions for optimizing the studied processes and improving their assessment methods.

The practical significance of the research lies in the possibility of its use in professional activities. The developed recommendations can help improve the effectiveness of management decisions and strategies in relevant areas, providing more accurate forecasting and optimization of processes. But despite the significance of the findings, the study has certain limitations. Firstly, the specifics of the analysis methods used impose limitations on the interpretation of the results, which requires caution when extrapolating them. Secondly, the nature of the sample may limit the generalizability of conclusions, which highlights the need for further research on a broader empirical basis.

Thus, the conducted analysis confirms the importance of the studied factors and their influence on the studied process. Future research may be aimed at expanding the empirical material, applying new analytical techniques and in-depth analysis of the revealed patterns, which will increase the reliability of the conclusions and strengthen their applied significance.

5. Conclusion

On the example of 3 species of flora and fauna, represented on the territory of North Kazakhstan region, general morphological and ecological characteristics of species, peculiarities of area, as well

as frequency of occurrence, which are included in the created database, are considered. Cartographic material, included in the database, provides a visual representation of the distribution and boundaries of habitats and meetings of species. The use of GIS technologies allows for detailed data on species localization under the influence of natural and anthropogenic factors. For each species, the database provides separate information on taxonomic affiliation, morphological features, biotopes, main threats to extinction, and measures to conserve the species. In addition, the database has a function of downloading and displaying map schemes of species distribution, which contributes to a more accurate analysis of their spatial distribution.

Undoubtedly, this study is not complete, as the study of rare and endangered species is a continuous process of monitoring research, which is in constant dynamics. At the same time, the created database is an interactive product, reflects the specifics and allows to make changes in its content, which is an important condition for such scientific research. Thus, placement of the database in the Internet space provides accessibility of information for researchers, specialists of environmental organizations and management bodies in the field of biodiversity, ecology and sustainable development.

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7. Author Contributions

Conceptualization, A.C., P.D. and I.Z.; methodology, A.C.; software, A.C.; formal analysis, A.C., S.I., J.N.; research, A.C.; resources, A.C., I.Z., S.I.; data curation, P.D., I.Z.; writing - preparation of the original draft, A.C.; writing - reviewing and editing, A.C., P.D., I.Z.; visualization, A.C.; guidance, P.D., S.I., I.Z.; project administration, P.D. All authors have read and agreed with the published version of the manuscript.

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12. References

1. Aderikhina, V.Yu., Nekrasov, M.S., Vilkov, V.S. (2007). Plants and animals from the Red Book of Kazakhstan in the North Kazakhstan region. [Rasteniya i zhivotnye iz Krasnoj Knigi Kazakhstana v Severo-Kazakhstanskoj oblasti in Russian], 69 p.
2. Badalova, A., Mammadov, H., Valehov, N., Valehova, F. (2024). Application of gis technologies for geoinformation mapping and relief modeling of agricultural landscape. *Elmi Əsərlər,* 3, 51–55. https://doi.org/10.61413/SJOY6473
3. Berezovikov, N.N., Erokhov, S.N. (2000). Faunisticheskie zametki o pticakh Severo-Kazakhstanskoj oblasti [Faunistic notes on birds of the North Kazakhstan region]. *Fauna Urala i Sibiri [Fauna of the Urals and Siberia]*, 5, 24–33.
4. Birds of Europe. (n.d.). Retrieved from https://www.ebirds.ru/vid/90.htm
5. Chanotey, D., Osipenko, A.E. (2022). Kriokonservaciya – peredovaya tekhnologiya sokhraneniya geneticheskikh resursov lesnykh rastenij (obzor inostrannoj literatury) [Cryopreservation is an advanced technology for preserving the genetic resources of forest plants (review of foreign literature)]. *Lesa Rossii i khozyajstvo v nikh [Russian forests and agriculture in them]* 4, 56-65.
6. Dmitriyev, P., Fomin, I., Ismagulova, S., Berdenov, Z., Zuban, I., Ostrovnoy, K., Jemaledinova, I., Golodova, I. (2024). Effect of the use of sapropel extract on biometric indicators and yield of beetroot (Beta vulgaris L.) in the conditions of the North Kazakhstan region. *Sustainability,* 16(14), 6192. https://doi.org/10.3390/su16146192
7. Dmitriyev, P.S., Fomin, I.A., Dmitriyeva, I.M., Berdenov, Z.G., Ismagulova, S.M., Smagulov, N.K., Abdrakhmanov, Y.A. (2023a). Assessment of the resource potential of the bitter – salty sulfide lakes of the North Kazakhstan Region for the development of ecological and balneological tourism. *GeoJournal of Tourism and Geosites,* 49(3), 866–874. https://doi.org/10.30892/gtg.49303-1087
8. Dmitriyev, P.S., Zuban, I.A., Fomin, I.A., Wendt, J.A. (2023). Assessment of the natural resource potential of the important bird areas of the north Kazakhstan region for the development of ornithological tourism. *GeoJournal of Tourism and Geosites,* 47(2), 563–572. https://doi.org/10.30892/gtg.47224-1056
9. Flora i fauna Rossii [Flora and fauna of Russia]. (n.d.). Biodat. Retrieved from https://biodat.ru/db/vid/index.htm
10. Gashev, S.N., Aleshina, A.O., Zuban, I.A., Lupinos, M.Y., Mardonova, L.B., Mitropolskiy, M.G., Selyukov, A.G., Sorokina, N.V., Stolbov, V.A., Shapovalov, S.I. (2017). Holocene Faunal Trends in West Siberia and Their Causes. *Izvestiya, Atmospheric and Oceanic Physics,* 53, 791–803. https://doi.org/10.1134/S0001433817080059
11. GBIF: Global Biodiversity Information Facility. (n.d.). Retrieved from https://www.gbif.org/

Gui, D., Cheng, P., Wen, H., Zhang, C. (2019). Technology Innovation of Surveying, Mapping and Geoinformation for Natural Resource Management. Wuhan Daxue Xuebao (Xinxi Kexue Ban). *Geomatics and Information Science of Wuhan University*, 44, 97-100. https://doi.org/10.13203/j.whugis20180355

12. Hambardzumyan, A. (2024). Asessment of spatio-temporal changes in ndvi and ndwi index values in areas of rare plant species of RA. *SUSh Scientific Proceedings*, 52-64. https://doi.org/10.54151/27382559-24.1pa-52
13. iNaturalist. (n.d.). Retrieved from https://www.inaturalist.org/observations
14. IUCN Red List of Threatened Species. (n.d.). Retrieved from https://www.iucnredlist.org/
15. Korchagina, T.A. (2023). Ispol'zovanie cifrovykh i informacionnykh tekhnologij v obuchenii biologii [The use of digital and information technologies in biology teaching]. *Problemy*

sovremennogo pedagogicheskogo obrazovaniya [Problems of modern teacher education] 81(2), 342-347.
16. Krasnaya Kniga Respubliki Kazakhstan [The Red Data Book of the Republic Kazakstan]. (n.d.). Retrieved from https://kyzylkitap.kz/ru/
17. Krasnaya kniga Rossii [The Red Book of Russia]: Lilium martagon. (n.d.). Retrieved from https://cicon.ru/lilium_martagon.html
18. Krasnaya Kniga Respubliki Kazakhstan. 2-e izdanie bylo otredaktirovano i dopolneno. Tom 2: rasteniya (kollektiv avtorov) [The Red Data Book of the Republic of Kazakhstan. The 2nd Edition has been edited and expanded. Volume 2: plants (collective of authors)]. (2014). ArtPrintXXI LLP.
19. Lukashik, E., Alekseev, A. (2024). Geoinformacionnoe kartirovanie i tipologicheskaya klassifikaciya okhotnich'ikh ugodij na osnove dannykh distancionnogo zondirovaniya zemli [Geoinformation mapping and classification of hunting grounds based on remote sensing data]. *Izvestiya Sankt-Peterburgskoj lesotekhnicheskoj akademii [Proceedings of the St. Petersburg Forestry Academy]* 250, 23-45. https://doi.org/10.21266/2079-4304.2024.250.23-45
20. Meredov, E.N., Allamyradov, G.G., Azadova, Ai.A. (2024). Izuchenie bioraznoobraziya i ustojchivosti pustynnykh ehkosistem: tekushchie trendy i budushchie napravleniya [Studying the biodiversity and sustainability of desert ecosystems: current trends and future directions]. *Vestnik nauk [Bulletin of Science]* 3(82), 755-760.
21. Monakhov, V.G. (2022). Martes martes (Carnivora: Mustelidae). *Mammalian Species,* 54(1021), 1-22. https://doi.org/10.1093/mspecies/seac007
22. Monakhov, V.G., Hamilton, M. (2020). Prostranstvennye trendy razmernoj struktury lesnoj kunicy *Martes martes* Linnaeus, 1756 (Mammalia: Mustelidae) v areale [Spatial trends in the dimensional structure of the *Martes martes* Linnaeus marten, 1756 (Mammalia: Mustelidae) in its range]. *Rossijskij zhurnal Ehkologiya [Russian Journal of Ecology]* 51(3), 199-208. https://doi.org/10.31857/S0367059720030105
23. Naderian, D., Noori, R., Heggy, E., Bateni, S.M., Bhattarai, R., Nohegar, A., Sharma, S. (2024). A water quality database for global lakes. *Resources, Conservation and Recycling,* 202, 107401. https://doi.org/10.1016/j.resconrec.2023.107401
24. Nazarova, T.V., Fomin, I.A., Dmitriev, P.S., Wendt, J.A., Janaleyeva, K.M. (2019). Landscape and limnological research of lake system of the plain areas of the northeastern borderlands of the Republic of Kazakhstan and assessment of their recreational capacity. *GeoJournal of Tourism and Geosites,* 25(2), 485–495. https://doi.org/10.30892/gtg.25217-375
25. Nikolaeva, O.N., Dubinina, A.A. (2022). Ecological maps as a component of educational and methodological support for secondary general education. *Interexpo Geo-Siberia*, 3, 222-229.
26. Observation.org. (n.d.). Retrieved from https://observation.org
27. Pashkov, S.V., Vilkov, V.S. (2017). Antropogennaya transformaciya biotopov zhivotnykh lesostepi Severnogo Kazakhstana [Anthropogenic transformation of animal biotopes in the forest-steppe of Northern Kazakhstan]. *Vestnik MGPU. Seriya: Estestvennye nauki [Bulletin of Moscow City University. Series: Natural Sciences]* 2(26), 77-86.
28. Pekishev, D.V., Kovalenko, A.V. (2025). Razrabotka programmnogo kompleksa dlya upravleniya bazoj dannykh v poiskovom servise s primeneniem organizacionnykh sistem [Development of a software package for database management in a search service using organizational systems]. *Modelirovanie, optimizaciya i informacionnye tekhnologii [Modeling, optimization and information technology]* 13(1), 1-8. https://doi.org/10.26102/2310-6018/2025.48.1.022
29. Ravkin, Yu.S., Kokorina, I.P., Bogomolova, I.N. (2024). Ornitologicheskoe rajonirovanie severnoj Evrazii po letnemu naseleniyu ptic [Ornithogeographical zoning of northern eurasia from the summer assemblage of birds]. *Geografiya i prirodnye resursy [Geography and natural resources]* 45(1), 84-92. https://doi.org/10.15372/GIPR20230510
30. Ryabitsev, V.K. (2008). Pticy Urala, Priural'ya i Zapadnoj Sibiri [Birds of the Urals, the Urals and Western Siberia]. Ural University Press. 136 p.

31. Sandakova, S.L., Baranov, A.A., Fominykh, I.B. (2024). K sushchestvuyushchim problemam vedeniya Krasnoj Knigi (na primere ptic) [To the existing problems of maintaining the red book (on the example of birds)]. *Materialy Vserossijskoj nauchnoj konferencii "Aktual'nye problemy zoologii i ehkologii" [Proceedings of the All-Russian Scientific Conference "Actual Problems of Zoology and Ecology"]* 536-546. https://doi.org/10.36684/148-1-2024-536-546
32. Sarychev, D.V., Sarychev, V.S., Kurolap, S.A., Nesterov, Y.A. (2015). Vyyavlenie mestoobitanij redkikh vidov metodom geoinformacionnogo modelirovaniya [Identification of habitats of rare species by geoinformation modeling]. *Vestnik rossijskikh universitetov. Matematika [Bulletin of Russian Universities. Mathematics]* 20(8), 435-439.
33. Senchugova, M., Khapugin, A., Chugunov, G. (2016). *Lilium martagon* is a species of the Red Data Book of the Republic of Mordovia, 133 p. https://doi.org/10.13140/RG.2.1.3622.1049
34. Shydlovskyy, I., Reshetylo, O., Hirna, A., Lesnik, V., Nazaruk, K., Skyrpan, I., Tsaryk, Y., Khamar, I. (2023). Regionally rare animal species of Lviv region. *Visnyk of Lviv University. Biological series,* 89, 58–65. https://doi.org/10.30970/vlubs.2023.89.06
35. Sorensen, T., Espey, E., Kelley, J., Kessler, J., Gronewold, A. (2024). A database of in situ water temperatures for large inland lakes across the coterminous United States. *Scientific Data,* 11(1), 211. https://doi.org/10.1038/s41597-024-03103-8
36. Specially protected territories of Yugra. Red Book of Khanty-Mansi Autonomous Okrug. (n.d.). Retrieved from https://ugraoopt.admhmao.ru/redbook/74077/2537927/
37. Stasyukevich, V., Grichik, V. (2024). Sravnitel'nyj analiz naseleniya ptic vtorichno zabolochennykh territorij Grodnenskoj oblasti [Comparative analysis of the bird population in secondary wetlands of the Grodno region]. *Vesnik of Yanka Kupala State University of Grodno. Economics. Sociology. Biology,* 14(3), 140–151. https://doi.org/10.52275/2221-5336-2024-14-3-140-151
38. Vilkov, V.S., Zuban, I.A. (2012). Sostoyanie chislennosti nekotorykh vodoplavayushchikh i okolovodnykh ptic po rezul'tatam issledovanij na vodoemakh Severo-Kazakhstanskoj oblasti v 2009-2011 gg. [The state of the abundance of some waterfowl and near-water birds according to the results of research in the reservoirs of the North Kazakhstan region in 2009-2011]. In *"Aktual'nye problemy nauki i obrazovaniya v oblasti estestvennykh i sel'skokhozyajstvennykh nauk": materialy mezhdunarodnoj nauchno-prakticheskoj konferencii ["Actual problems of science and education in the field of natural and agricultural sciences": proceedings of the international scientific and practical conference]* 3, 239-243.
39. Vilkov, V.S., Zuban, I.A. (2013). Ehkologo-biologicheskaya kharakteristika ptic i mlekopitayushchikh Severo-Kazakhstanskoj oblasti: uchebno-metodicheskoe posobie dlya studentov biologicheskikh i ehkologicheskikh special'nostej SKGU im. M. Kozybaeva [Ecological and biological characteristics of birds and mammals of the North Kazakhstan region: an educational and methodological guide for students of biological and environmental specialties of the M. Kozybaev North Kazakhstan State University], 199 p.
40. Vladimirova, E.D., Mozgovaya, O.A. (2010). Lesnaya kunica (*Martes martes* L.) v sisteme prirodookhrannykh meropriyatij Samarskoj oblasti [Pine marten (*Martes martes* L.) in the system of environmental protection measures of the Samara Region]. *Problemy i perspektivy sovremennoj mediciny, biologii i ehkologii [Problems and prospects of modern medicine, biology and ecology]* 1, 173-175.
41. Vladimirova, E.J. (2013). Rol' derev'ev v ehkologii lesnoj kunicy (*Martes martes* L.) [The role of trees in the ecology of the forest marten (*Martes martes* L.)]. *Vestnik Udmurtskogo universiteta. Seriya «Biologiya. Nauka o Zemle» [Bulletin of the Udmurt University. Series "Biology. Earth Sciences"]* 4, 78–89.
42. Yavorskaya, V.N. (2008). 100 predstavitelej dikorastushchej flory Severnogo Kazakhstana i yuga Zapadnoj Sibiri: uchebno-metodicheskoe posobie [100 representatives of the wild flora of Northern Kazakhstan and southern Western Siberia: An educational and methodical manual]. M. Kozybaev State North Kazakhstan University. 178 p.

43. Zhilenko, N., Buyanov, I., Shestak, K. (2021). Conservation of biological diversity of rare animal species in the Boguchansky district. *IOP Conference Series: Earth and Environmental Science,* 848(1), 012161. https://doi.org/10.1088/1755-1315/848/1/012161
44. Zhou, T., Zhang, G., Wang, J., Zhu, Z., Han, X., Xu, F., Peng, J. (2025). A novel framework for accurate, automated and dynamic global lake mapping based on optical imagery. *ISPRS Journal of Photogrammetry and Remote Sensing,* 221, 280-298. https://doi.org/10.1016/j.isprsjprs.2025.02.008
45. Żmihorski, M., Sparks, T., Tryjanowski, P. (2012). The Weekend Bias in Recording Rare Birds: Mechanisms and Consequences. *Acta Ornithologica,* 47(1), 87–94. https://doi.org/10.3161/000164512X653953
46. Zuban, I.A., Vilkov, V.S. (2012). Ornitologicheskie nablyudeniya na vodoemakh Severo-Kazakhstanskoj oblasti osen'yu 2011 [Ornithological observations on the water bodies of the North Kazakhstan region in autumn 2011]. *Materialy mezhdunarodnoj nauchno-prakticheskoj konferencii [Proceedings of the International Scientific and Practical Conference]* 958–964.

Особенности создания интернет-ресурса редких и исчезающих видов Северо-Казахстанской области

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Аннотация. В статье представлен научный и пространственный подход к сохранению редких видов Северо-Казахстанской области. Исследование направлено на систематизацию данных о редких и исчезающих видах флоры и фауны региона, а также на комплексный анализ антропогенных и природных угроз, влияющих на их численность и ареал. В процессе работы проведен обзор литературных источников, нормативных документов, существующих природоохранных инициатив, что позволило выявить виды, нуждающиеся в приоритетной охране. Разработана интерактивная база данных, содержащая сведения о биологических характеристиках видов, их природоохранном статусе, распространении видов в области, основных факторах угроз и мерах по сохранению. Особое внимание уделено визуализации данных: пользователи могут просматривать карта-схемы обитания и распространения видов в регионе, отслеживать изменения. В качестве примеров рассмотрены белохвостый орлан, лесная куница и лилия кудреватая, находящиеся под угрозой исчезновения. Для оценки пространственного распределения видов были применены методы геоинформационного анализа и сравнительного исследования, позволившие уточнить границы распространения исследуемых видов. Результаты исследования обладают высокой практической значимостью: они могут быть использованы при разработке региональных природоохранных стратегий, зонировании охранных природных территорий, а также в образовательной деятельности. Интерактивная база данных представляет собой инструмент для мониторинга биоразнообразия и принятия обоснованных решений сфере охраны природы на региональном уровне.

Ключевые слова: редкие и исчезающие виды, Северо-Казахстанская область, база данных, интернет-ресурс, биоразнообразие, орлан-белохвост, лесная куница, лилия кудреватая, карта-схема.

Солтүстік Қазақстан облысының сирек кездесетін және құрып кету қаупі төнген түрлерінің интернет-ресурсын құру ерекшеліктері

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Аңдапта. Мақалада Солтүстік Қазақстан облысындағы сирек кездесетін түрлерді сақтаудың ғылыми-кеңістіктік тәсілі берілген. Зерттеу өңірдегі сирек кездесетін және жойылып кету қаупі төнген флора мен фауна түрлері туралы деректерді жүйелеуге, сондай-ақ олардың саны мен таралу аймағына әсер ететін антропогендік және табиғи қатерлерді кешенді талдауға бағытталған. Жұмыс барысында бірінші кезектегі қорғауды қажет ететін түрлерді анықтауға мүмкіндік беретін әдеби дереккөздерге, нормативтік құжаттарға, қолданыстағы экологиялық бастамаларға шолу жасалды. Түрлердің биологиялық ерекшеліктері, олардың сақталу жағдайы, түрлердің аймақтағы таралуы, негізгі қауіп факторлары және сақтау шаралары туралы мәліметтерді қамтитын интерактивті деректер базасы әзірленді. Деректерді визуализациялауға ерекше көңіл бөлінеді: пайдаланушылар аймақтағы түрлердің мекендеу ортасы мен таралу карталарын қарап, өзгерістерді бақылай алады. Мысал ретінде жойылып кету қаупі аққұйрықты субүркіт, орман сусары және бұйра лалагүл қарастырылады. Түрлердің кеңістікте таралуын бағалау үшін геоақпараттық талдау және салыстырмалы зерттеу әдістері қолданылды, бұл зерттелетін түрлердің таралу шекараларын нақтылауға мүмкіндік берді. Зерттеу нәтижелерінің жоғары практикалық маңызы бар: оларды қоршаған ортаны қорғаудың аймақтық стратегияларын әзірлеуде, ерекше қорғалатын табиғи аумақтарды аймақтарға бөлуде, сондай-ақ білім беру іс-шараларында пайдалануға болады. Интерактивті деректер базасы аймақтық деңгейде биологиялық әртүрлілікті бақылау және табиғатты қорғау саласына негізделген шешімдер қабылдау құралы болып табылады.

Түйін сөздер: сирек кездесетін және жойылып бара жатқан түрлер, Солтүстік Қазақстан облысы, мәліметтер базасы, интернет-ресурс, биоәртүрлілік, аққұйрықты субүркіт, орман сусары, бұйра лалагүл, карта-схема.