Protected, Rare and Medicinal Plant Species of the Buiratau State National Natural Park (Republic of Kazakhstan)

Almagul Kali , Kulpash Dakenovna Kenzhina , Gulzhazira Turlybekova , Symbat Erzhankyzy Tulegenova , Assiya Dukenbayeva , Assel Rustemova , Raikhan Beisenova *

Posted Date: 6 September 2023

doi: 10.20944/preprints202309.0226.v1

Keywords: Flora; Endemic; Rare; Biomorphology; Ereymentausky; Belodymovsky; Reserve; Small Hills

Article

Protected, Rare and Medicinal Plant Species of the Buiratau State National Natural Park (Republic of Kazakhstan)

Almagul Kali [1], Kulpash Dakenovna Kenzhina [1], Gulzhazira Turlybekova [2], Symbat Erzhankyzy Tulegenova [1,3], Assiya Dukenbayeva [4], Assel Rustemova [3] and Raikhan Beisenova [3,5,6,*]

[1] Department of Botany, E.A. Buketov Karaganda University, Karaganda, Kazakhstan; a-auelbekova@mail.ru (A.K.); k29k29d13@mail.ru (K.D.K.); symbat.udeshova@mail.ru (S.E.T.)
[2] Department of Zoology, Buketov Karaganda University, Karaganda, Republic of Kazakhstan; gulzhazira_t@mail.ru
[3] Environmental Management and Engineering Department, Faculty of natural sciences, L.N.Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan; asel.esengalyeva.97@mail.ru
[4] Department of Biology and Genomics, Faculty of natural sciences, L.N.Gumilyov Eurasian National Univesity, Nur-Sultan, Kazakhstan; asiya_b@mail.ru
[5] Insitute of Environmental Engineering, Peoples' Friendship University of Russia named after Patrice Lumumba, Moscow, Russia
[6] High Scool of Ecology, Yugra State University, Khanty Mansysk, Russia
* Correspondence: raihan_b_r@mail.ru

Abstract: The biodiversity of the State National Natural Park (SNNP) "Buiratau" has not been studied, as it is young in Kazakhstan. The purpose of our study was an independent botanical and geographical study of the vegetation cover of the SNNP "Buiratau". This study have been carried out using the method route-reconnaissance and identifying plants, according to plant guide "Flora of Kazakhstan" (1999), "Key to Plants of Central Asia" (1974). The results showed that depending on the geographical location (Kazakh highland, steppe zone) of the SNNP "Buiratau" territory this natural complex has a very diverse botanical feature. In these types of vegetation of this territory, there are both Red Data Book and rare and endemic plants, such as black alder and birch forests, the peculiarity of which is that some species (Alnus glutinosa (L) Gaertn, Betula Kirghisorum Sav. - Rysz.) are listed in the Red book and very few. Medicinal, plant species and their resource potential are an important component of the flora. The analysis showed that the SNNP "Buiratau" is a unique natural environment, which is characterized by 10 species of plants listed in the Red Book, and 26 species of rare and endangered species.

Keywords: flora; endemic; rare; biomorphology; ereymentausky; belodymovsky; reserve; small hills

1. Introduction

Kazakhstan has a significant part of all the natural Pontic steppes preserved on Earth, and since ancient times the steppe has played an important economic and environmental role for the local population. However, today the steppes are the least protected type of ecosystems in Kazakhstan.

Currently, out of the 25 existing republican specially protected natural areas of Kazakhstan with a strict protection regime, steppe ecosystems, except for the SNNP Buiratau, are protected only in the Irgiz-Turgai State Nature Reserve, partly in the Naurzum and Korgalzhyn State Nature Reserves (subzone of moderately arid steppes), in Bayanaulsky (subzone of dry fescue-feather grass steppes) and Karkaralinsky (forest-steppe zone) state national natural parks.

The territory of the national natural park belongs to the second category of specially protected natural areas with the status of a nature protection and scientific institution of Republican significance, is intended for the conservation of biological and landscape diversity, the use of unique

natural complexes and objects of the State Natural - reserve fund, which have a special ecological, scientific, historical, cultural and recreational value.

The objects of the protected area fund are: forest, geological, hydrogeological, geomorphological, zoological and botanical objects.

The rarity and uniqueness of the ecosystems of the park is characterized by the following features:

- the presence of relic forms;
- average degree of endemism;
- a combination of species representing different ecosystems of fauna and flora, their diversity.

The territory of the national natural park "Buiratau" is located at the junction of two regions - the southeast of Akmola and the northeast of Karaganda. It includes areas - GU SNP "Buiratau", Belodymovsky and Ereymentausky state zoological reserves, zoological reserve of local importance "Falcon Mountains" and the territory previously reserved for the Ereymentau State Reserve. In addition, add a site to the east of the village of Belodymovka within the Karaganda region. In administrative terms, this is the territory of the Yereymentau district of the Akmola region and the Osakarov district of the Karaganda region [1].

Currently, 12 national natural parks are organized in Kazakhstan. The Buiratau State National Natural Park (SNNP) is the youngest. It was established in 2011 and includes three previously existing protected areas - the Natural Park “Buiratau”, the zoological reserves “Belodymovsky” and “Yereymentau”, and the territory originally reserved for the Yereymentau State Reserve. At present, the total area of SNNP “Buiratau” is 88,968 hectares. [2]

The territory of the Buiratau SNNP is located within the steppe zone in the transition zone between the subzones of mildly arid and drought steppes. According to the physical-geographical zoning of Kazakhstan, the territory of the national park is located within the Central Kazakhstan hills [3]. The main ecosystems are represented by semi-arid and drought steppes with an altitudinal belt in the province of the Karaganda-Chingiztau dry-steppe low-hill terrain and in the area of the Yereymentau-Karkaraly mountainous hillocky territory (Karamysheva, Rachkovskaya, 1973) [4-6].

According to the vegetation map of the Buiratau SNNP [7], on the territory of the national park are presented: arid steppes on mountain black humus soils, because most of the territory is within the Kazakh hillocky area; dry steppes on dark chestnut soils; petrophytic steppes on rocks, stony and gravelly soils; meadow, forest and shrub vegetation - (*the last types of vegetation are not separated on the map*). Forest vegetation is represented by birch, pine, aspen and black alder forests. The shrub type of vegetation is diverse, these are: willows, mesophytic shrub communities of honeysuckle, wild rose, hawthorn, cotoneaster; xerophytic communities of caragana and spirea; petrophytic shrub communities composed of Cossack juniper.

Floristic research on the territory of the national natural park "Buiratau" was carried out in 2012-2016. When compiling the abstract, numerous collections were used, stored in the Herbarium of JSC MNPKh "Phytochemistry". The order of families is given in accordance with the system of A.L. Takhtadzhan (1987) and Synopsis of Siberian Flora (2005) [8].

In 2012, several expedition trips were organized to collect herbarium material under the guidance of Doctor of Biological Sciences, Professor Kupriyanov A.N. from the Kuzbass Botanical Garden of the Institute of Human Ecology, Siberian Branch, Russian Academy of Sciences [9].

Great gratuitous methodological and practical assistance in the study of the flora of "SNNP "Buiratau" was provided by an expeditionary group led by Doctor of Biological Sciences, Professor Kupriyanov A.N. (Institute of Human Ecology SORAN), who conducted research in the park during 05.05.2012. to 09.05.2012 and from 02.07.2012 to 07.07.2012

In the course of a study in 2012, rare and endangered species of plants located on the territory of the national natural park "Buiratau" were identified, as well as the habitats of the Red Book plant species.

Based on the results of botanical expeditions in 2012, 128 plant species were collected and identified from the following departments: Gymnosperms department -3 species; department

 doi:10.20944/preprints202309.0226.v1

Angiosperms - 120 species, department Ferns - 5 species. Of the rare species listed in the Red Book of Plants of Kazakhstan, the habitats of sticky alder (black) and Kyrgyz birch have been identified.

In the course of the research, the following issues were studied and resolved: laying of 8 phenological sites in all areas of the park. The main method of recording floristic information was the collection of herbarium materials at monitoring sites.

On August 2-4, 2012, the expedition group of the Institute of the Steppe of the Russian Academy of Sciences, within the framework of the project of the geographical society "Steppe World of Eurasia", conducted reconnaissance studies on the territory of the SNNP "Buiratau", the expedition group led by Chibilev A.A. Director of the Steppe Institute of the Ural Branch of the Russian Academy of Sciences (IS Ural Branch of the Russian Academy of Sciences).

According to A.A. Chibilev, on August 2-4, 2012, the expedition group of the Institute of the Steppe of the Russian Academy of Sciences, within the framework of the project of the Russian Geographical Society "Steppe World of Eurasia", conducted reconnaissance studies on the territory of the state national park "Buiratau", located on the territory of Akmola and Karaganda regions . SNNP "Buiratau" is located in the central part of the Central Kazakhstan low-hill country, covering most of the island low-mountain massif Ermentau. In terms of landscape, the territory of the park is a combination of ridge and hilly hills with slightly undulating and sloping plains.

The chain of low mountains of the Ermentau massif in the form of a horst block is composed of Proterozoic quartzites and has a submeridional strike. On the smoothed peaks of the mountains, traces of ancient peneplain have been preserved. The slopes are mostly soft, convex-concave with a steepness of 19 to 25°. In many places, the slopes and peaks are complicated by protrusions of quartzite rocks, which gave rise to the name of the mountain range, which was part of the Buyratau park - Curly Mountains. The mountain range is dissected by a network of dens and small river valleys.

A characteristic feature of the territory of the park is the development of wide flat-sloping plains, stretched along mountain ranges or occupying foothill steps.

Forming a significant orographic boundary, the Ermentau Mountains serve as a barrier to the western transport of air masses. This contributes to an increase in the amount of atmospheric precipitation, better moistening of the foothill plains and a decrease in summer temperatures compared to the surrounding landscapes of Central Kazakhstan.

In terms of moisture, the landscapes of the park approach those of a typical and northern steppe, which contributes to the formation of a chernozem-steppe low-mountain belt. Characteristic elements of the low-mountain-steppe landscape of Ermentau are birch, aspen-birch forests and gallery black alder forests. However, the main type of landscape is the steppes, which are represented by many varieties, including fescue-feather grass, petrophyte-forb-oats steppes, steppe and forb-grass meadows with high productivity, the formation of felt and dry herbage. Compared to the vegetation of the Bayanaul State National Natural Park, the predominant type of vegetation in the territory of the Bayanaul State National Nature Park is steppe, as it is located in the subzone of dry fescue-feather grass steppes, characterized by the predominance of xerophytic turf grasses with the participation of steppe forbs. The low-hill character of the relief of the territory with a wide variety of physical and geographical conditions, strong rubble, thin and underdeveloped soils was also reflected in the species composition of the steppes. In contrast to the plain steppes, shrubs almost always participate in them, for example, meadowsweet (Spyrea), St. Shrub steppes cover both the slopes of hills and low mountains, as well as valleys between hills, and wide intermountain plains. They are quite diverse in composition and structure. The most typical are shrub-feather grass, shrub-fescue, shrub-oats, shrub-tyrs steppes. A certain regularity is observed in their distribution [10–15].

Until the 90s of the last century, steppe and meadow-steppe lands were widely used as pastures and hayfields, as well as for arable land. Plots of former arable land are fallows at various stages of restoration of steppe vegetation.

In the conditions of the national natural park, the protection of grassy ecosystems of the mountain-flat landscapes of Ermentau is a big problem. In the absence of grazing by hoofed mammals and systematic haymaking, the accumulation of steppe felt and old herbage will inevitably

 doi:10.20944/preprints202309.0226.v1

occur, which not only lead to degradation of the optimal structure of steppe communities, but also pose a great fire hazard. The load of the existing and prospective stock of wild ungulates of the national park (roe deer, deer, argali, elk) will not solve the problem of effective management of steppe ecosystems.

Under these conditions, it is necessary to carry out a special landscape land management on the territory of the national park with the allocation of an economic zone, including:

(a) agro-tourism infrastructure along the periphery of the park and in its buffer zone;
(b) grasslands that provide for the park's own needs;
(c) pasture areas with a minimum and moderate load of livestock (primarily horses).

Horse grazing can be carried out in the peripheral part of the park, and in winter (tebenevka) everywhere, without creating permanent bases and summer camps for livestock inside the park.

Thus, in order to develop agro-tourism infrastructure, it is expedient to create cattle-breeding steppe complexes in the peripheral part of the park and its buffer zone, which will allow museumification of the main attributes of the pasture-nomadic culture of the steppe peoples.

The ruins of the former pasture cattle breeding infrastructure of the 20th century have been preserved on the territory of the park. On the one hand, these territories should be reclaimed with the removal of technical and building elements from the park, on the other hand, the remains of buildings of the 20th century can be museumified as objects of historical and cultural heritage along with monuments of the ancient world and the Middle Ages (mounds, sanctuaries, mazars, kulpytas, etc.).

In general, the steppe landscapes of the SNNP "Buiratau" are an important link in a single and continuous network of key landscape areas of the steppe zone of Eurasia and represent the standards of the ecosystems of the Central Kazakhstan lowland country. The Institute of the Steppe of the Russian Academy of Sciences plans to continue landscape-geobotanical and zoogeographic research on the territory of the national park within the framework of the project of the Russian Geographical Society "The Steppe World of Eurasia".

The property of the Buiratau park are relic black alder forests and birch groves that grow near the southern border of the park [16–22].

The botanical originality of the Buiratau SNNP determines the need for constant monitoring of the vegetation cover state. On the basis of monitoring, it is necessary to rationally plan the recreational impact and other types of nature management that are possible on the territory of the national park. This will preserve unique ecosystems and ensure the sustainable development of adjacent territories.

The purpose of our work is making an independent botanical and geographical survey of the vegetation of the Buiratau SNNP and a summary of the work of botanists of Kazakhstan and Russia, who worked at different times in the protected area.

Main research objectives:

1. Study of the species composition and bioecological indicators of plants of the SNNP "Buiratau" listed in the Red Book of Kazakhstan.
2. Identification of rare and endangered plant species SNNP "Buiratau";
3. Determination of bioecological indicators of endemic plant species "SNNP "Buiratau";
4. Identification of the ratio of medicinal plants of the State Scientific and Production Enterprise "Buiratau", branches: Ereymentau and Belodymovsky;
5. Determination of life forms and ecological groups of medicinal plants of SNNP "Buiratau".
6. The article presents a part of the results obtained, devoted to the biological characteristics of protected, rare and medicinal plant species of the national natural park [18–21].

2. Results

2.1. Early studies of the Central Kazakhstan's flora species

In recent years, the flora of SNNP has been actively studied. Thus, according to F.M. Ismailova (2013), A.N. Kupriyanov, the floristic composition was estimated at 498 species belonging to 73 families and 277 species of plants. Of these, the division Horsetails - 4 species; division Ferns - 5 species; division Gymnosperms - 3 species; division Angiosperms – 486 species [15].

When comparing the assessment of the floristic richness of the national park, we compare it with the flora of the entire territory of the Central Kazakhstan hillocky area, within which the main part of the Buiratau Park is located. The flora of the small hills includes 1453 plant species. And on the territory of the Buiratau park one fifth of the flora of this peculiar region is represented in terms of botanical and geographical terms (Kupriyanov et al., 2014). The representatives of cereals (Poaceae), compositae (Asteraceae) and legumes (Fabaceae) are characterized by the greatest number of species. The most multi-species genus includes wormwood (Artemisia), feather grass (Stipa), astragalus (Astragalus), onions (Allium). The typical steppe representatives of families and genera form the basis of cenofloras (Ishmuratova, Ismailova, 2014) [16].

In the work of G.F. Pryadko (2021) to the abstract flora of the Buiratau National Natural Park to the list of 498 species (publications of Kupriyanov, 2014), another 100 plant species were added, previously identified by the author for this territory. In 1981-1985 the author conducted field research in the hillocky area of Yereymentau (Yereymentau district of Akmola region and Osakarov district of Karaganda region) to substantiate the Yereymentau State Reserve. It is proposed to include in the new edition of the Red Book of Kazakhstan very rare species found in the BuiratauNational Park: *Allium shaerocephalon, Caragana leucophloea, Rhinactinidia eremophila, Trinia muricata.* These species are rare not only in the Central Kazakhstan hillocky areas, but also throughout Kazakhstan, and *Allium shaerocephalon* known only within the BuiratauNational Park.

In addition, we note that according to the report "Flora of vascular plants" of the Buiratau SNNP for the period 2012-2016 (2017), carried out under the supervision of M.Yu. Ishmuratova and thereport on the topic: "Assessment of the species composition and current state of the populations of medicinal plants of the Buiratau SNNP for 2018" (2019), carried out under the guidance of Molodejnyi village the flora of the SNNP already has 610 species, of which 288 species and 75 families' plants, including Horsetails - 4 species; Ferns - 5 species; Gymnosperms - 3 species and Angiosperms - 598 species. We adhere to this number of species in our work [17–19].

2.2. Species composition of Buiratau State National Natural Park's flora

Our materials of identifying showed a number of endemics, valuable medicinal and state-protected plant species. The last category combines rare and endangered plant species listed in the Red Book of Kazakhstan [10]. Tables 1 and 2 shows the species composition of the plants of the SNNP "Buiratau", listed in the Red Book of Kazakhstan. According to these lists there are 10 species (*Alnus glutinosa, Betula Kirghisorum, Adonis wolgensis, Adonis villosa, Adonis vernalis, Pulsatilla patens, Pulsatilla flavescens, Tulipa patens, Paris guadrifolia, Stipa pennata*), belonging to 7 genera and 4 families.

Table 1. Species composition of plants of Buiratau SNNP, listed in the Red Book of Kazakhstan.

Family	Genus	Species
Betulaceae	Alnus	*Alnus glutinosa (L) Gaertn*
	Betula	*Betula Kirghisorum Sav. – Rysz*
Ranunculaceae	*Adōnis*	*Adonis wolgensis*
		Adonis villosa Lebed.
		Adonis vernalis
	Pulsatilla	*Pulsatilla patens Mill.*
		Pulsatilla flavescens (Zucc.) Juz.
Liliaceae , Melanthiaceae	Tulipa	*Tulipa patens ex Schult. et Schult. fil.*

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 September 2023 doi:10.20944/preprints202309.0226.v1

	Paris	*Paris guadrifolia L.*
Poaceae	Stipa	*Stipa pennata L.*

Table 2. Bioecological indicators of protected plant species of Buiratau SNNP, listed in the Red Book of Kazakhstan.

Species name Abundance according to Drude	**Life form, applying**	**Humidity Habitat**	**Light life form**
*Alnus glutinosa (L) Gaertn** Cop 2	*Tree, rare. Agash, Sirek tur*; Medicinal, in the production of leather, lacquer, woodworking. etc.	*Moisture-loving, hygrophyte;* in a very humid environment, swampy forests, *floodplain*, lowland swamps, etc.	*Photophilous, shade-tolerant;* Forest growing character of the forest-steppe, steppe zones
Betula Kirghisorum Sav. – Rysz Sp.	*Tree, endemic,* Medicinal, in folk medicine, food, essential oils	*Mesophyte*; island pine forests, steppe lowlands.	*Photophilous, microthermal, mesotrophic*
Adonis wolgensis Sol	*Perennial herbs*, medication. Decorative	*Mesophyte*; Mezhosopochnye gorges, lowlands, different feather grass steppes	Forest edge, dry meadows
Adonis villosa Lebed. Sp	*Multigelt. herbal*, folk med., honey plant	*Mesophyte*	Rocky hillsides
*Adonis vernalis** Sp	*Perennial herbal*, medicinal	*Mesophyte*	Edge of the forest, dry meadow
Pulsatilla patens Mill. Sp	*Perennial herbal,* in folk medicine, poisonous	*Mesoxerophyte*	*Photophilous*, coniferous forests and dry slopes
Pulsatilla flavescens (Zucc.) Juz. Sp	*Perennial herbal*, decorative, in folk medicine, poisonous	*Mesoxerophyte*	*Photophilous*, rocky, dry slopes
*Tulipa patens ex Schult. et Schult. fil.**** Sp	*Perennial herbal*, decorative	*Xerophyte*	*Photophilous*, rocky steppes, on bare rocks along river banks
Paris guadrifolia L. Sp	*Perennial herbal*, in folk medicine, poisonous	*Mesophyte;* Moist soil forests, shrubs and river banks	In partial shade
*Stipa pennata L.*** Sp	*Perennial herbal*, decorative, fodder.	*Mesophyte;* Indicator of meadow-steppe conditions, does not tolerate excessive humidity	*Photophilous*, dry rocky areas

* Exists up to 80-100 years. ** Exists up to 75 years *** Often found on saline soil.

Figure 1 illustrates the distribution of plants according to the humidity of the Buiratau SNNP, included in the Red Book of Kazakhstan. Of the above identified 10 species listed in the Red Book of Kazakhstan, most can be attributed to perennial herbaceous plants, and mesophytes and mesoxerophytes predominate in ecological morphologies.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 September 2023 doi:10.20944/preprints202309.0226.v1

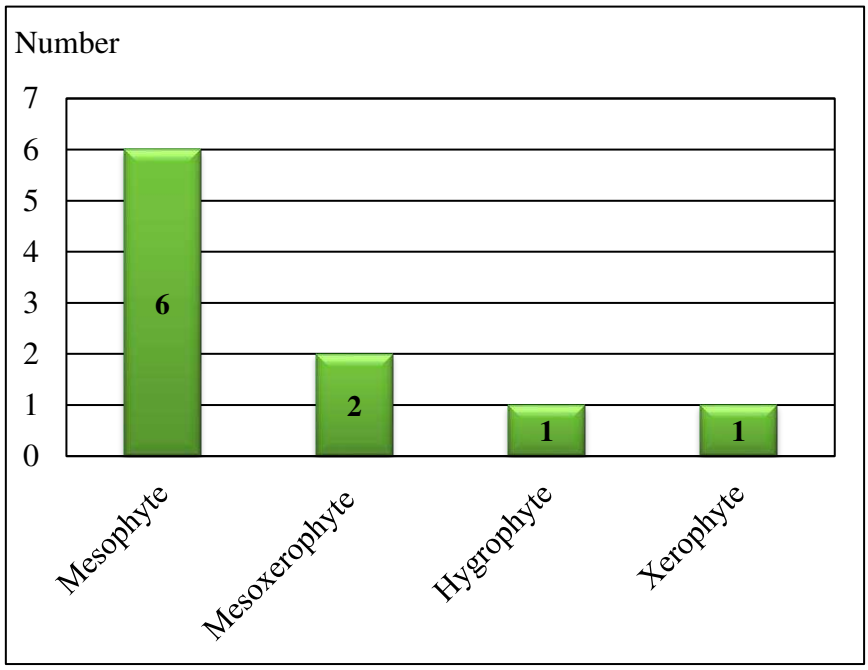

Figure 1. The distribution of plants according to the humidity of the Buiratau SNNP, included in the Red Book of Kazakhstan.

On the territory of the SNNP "Buiratau" from the general list of species of rare and endangered plants of this region grow 26 (Alnus glutinosa, Betula Kirghisorum, Pulsatilla patents, Stipa pennata, Tulipa patents, Amygdalus nana, Artemisia glauca, Artemisialatifolia, Barbareaarcuate, Barbarea stricta,Cáltha palustris, Cardamine impatiens, Crepis sibirica, Dianthus acicularis, Glechoma hederacea, Gypsophilarupestris, Lychnischalcedonica, Paris guadrifolia, Poa remota, Prunella vulgaris, Pteridium pinetorum, Scrophularia alata, Silene incurvifolia, Sphaerophysa salsula, *Adonis wolgensis, Pulsatilla flavescens*), which is 4.26%.

According to life forms, the studied objects were divided as follows: herbaceous biennials – 2 species, herbaceous perennials – 21 species, shrubs – 1 species, trees – 2 species. The results of observations showed that the dominant position among the life forms of rare and protected species is occupied by herbaceous perennials, trees and herbaceous biennials are in second place, and shrubs are in third place.

According to the presented Table 3 the analysis of ecological fitness of rare and protected plant species of the SNNP "Buiratau" showed that out of 26 plant species: mesophytes - 13, mesoxerophytes - 1, xerophytes - 7, xeropetrophytes - 1, mesohygrophytes - 2, hygrophytes - 2. How it can be seen from the results obtained, the main proportion of rare and protected species is represented by mesophytes, which indicates a sufficient degree of moisture in the SNNP "Buiratau" and the formation of a significant degree of meso - and microrelief, which allows the formation of more humid environmental conditions.

Table 3. Bioecological indicators of rare and protected plant species of the Buiratau SNNP.

Species name Abundance according to Drude	Life form	Life form according to the humidity	Life form according to the light
Alnus glutinosa In the alder association - Cop 2 In the forb-birch association - sol	Tree	+ (hygrophilous, hygrophyte) Mesophyte predominates	+ (photophilous)
Betula Kirghisorum In the birch association - Cop 2	Tree	+ (hygrophilous)	+-(shade-tolerant)

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 September 2023 doi:10.20944/preprints202309.0226.v1

Pulsatilla patents Sp	Perennial, herbaceous plant, geophyte (poisonous)	+ (hygrophilous)	+- (shade-tolerant)
Stipa pennata Cop 3	Perennial, herbaceous plant	- (xeromorphic graminoid)	+ photophilous
Tulipa patents* Sp	Perennial, herbaceous plant	+ (hygrophilous) Xerophyte, xeropetrophyte	Shade-tolerant
Amygdalus nana Sp	Bush	- xerophyte (drought-resistant)	+ photophilous
Artemisia glauca Cop 1	Perennial, herbaceous plant	- xerophyte (drought-resistant)	Withstands heat, frost
Artemisia latifolia Cop 1	Perennial, herbaceous plant	- xerophyte (drought-resistant)	+ photophilous
Barbarea arcuate Sp	Perennial, herbaceous plant	Mesophyte, mesotroph	Can grow in semi-shaded place
Barbarea stricta Sp	Biennial, herbaceous plant	Mesophyte (hygrophilous , weedy)	Photophilous
Cáltha palustris Sp	Perennial herbaceous plant (poisonous)	Hydrophyte	Light-loving, shade-tolerant
Cardamine impatiens Sp	Biennial, herbaceous plant	Mesophyte (hygrophilous)	Shade-loving
Crepis sibirica Sp	Perennial, herbaceous plant	Mesophyte	Photophilous
Dianthus acicularis Cop 1	Perennial shrub	Xerophyte	Drought resistant
Glechoma hederacea Cop 2	Perennial herbaceous plant (poisonous)	Mesophyte (hygrophilous)	Shade-tolerant
Gypsophila rupestris Cop1	Perennial, herbaceous plant	Xerophyte	Photophilous
Lychnis chalcedonica Sp	Perennial, herbaceous plant	Mesophyte (moisture-loving, drought-resistant)	Photophilous
Paris guadrifolia Sp	Perennial herbaceous plant (poisonous)	Mesophyte	Shade-loving
Poa remota Sp	Perennial, herbaceous plant	Mesophyte (hygrophyte) (hygrophilous)	Thermophilic
Prunella vulgaris Sp	Perennial herbaceous plant (poisonous)	Mesophyte (hygrophilous)	Light-loving, shade-tolerant
Pteridium pinetorum Sp	Perennial, grassy, fern	Mesophyte (hygrophilous)	Photophilous
Scrophularia alata Sp	Perennial, herbaceous plant	Mesophyte (hygrophilous)	Photophilous
Silene incurvifolia Sp	Perennial, herbaceous plant	Mesophyte	Photophilous
Sphaerophysa salsula** Sp	Perennial herbaceous plant (poisonous)	Mesophyte (moisture-loving, weedy)	Photophilous
Adonis wolgensis Sp	Perennial, herbaceous	Xerophyte	Photophilous
Pulsatilla flavescens Sp	Perennial, herbaceous (poisonous)	Mesoxerophyte	Photophilous

Inhabitants of the salty environment: *Often found in weedy areas, **Grows in weedy soil.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 September 2023 doi:10.20944/preprints202309.0226.v1

It can be assumed that new finds can be expected on the territory of this natural-geographical object, which may be unique for the vegetation cover of the northeastern rocky hills.

According to the survey results presented in Table 4, we identified endemic plant species for the Buiratau SNNP, including representatives of 7 species from 6 genera and 5 families.

Table 4. Species composition of Buiratau SNNP endemic plant species.

Family	Genus	Species
Betulaceae	*Betula*	*Betula kirghisorum*
Euphorbiaceae	*Euphorbia*	*Euphórbia microcárpa*
Apiaceae	*Trinia*	*Trinia muricata*
Lamiaceae	*Thymus*	*Thymus rasitatus*
Asteraceae	*Seratula*	*Serratula kirghisorum*
		Serratula dissecta
	Phalacrachena	*Phalacrachena calva*

As can be seen from Table 5 in terms of ecological confinement, most endemic species belong to mesophytes, mesoxerophytes and xeromesophytes; in relation to light, many are photophilous and shade-tolerant. The dominant position among life forms is herbaceous perennials.

Table 5. Bioecological indicators of Buiratau SNNP endemic plant species.

Species name Abundance according to Drude	Life form	Life form according to the humidity	Life form according to the light
Betulakirghisorum In the birch association - Cop 2 In the forb-birch association - Sol	Tree	Mesophyte, moisture-loving	Photophilous
Euphorbia microcarpa Cop 1	Perennial herbaceous	Xeromesophyte	Photophilous
Trinia muricata Sol	Biennial herbaceous	Mesophyte	Shade-tolerant
Thymusrasitatus Sol	Semi-shrub	Xerophyte	Petrofit
*Serratula Kirghisorum** Sp	Perennial	Mesoxerophyte	Photophilous
Serratula dissecta Sp	Perennial	Mesophyte, ephemeroid	Shade-tolerant
Phalacrachena calva Sol	perennial	Mesoxerophyte	Photophilous

* Grows on weedy, swamp-stony steppe.

2.3. Medicinal plants of the Buiratau State National Natural Park

An important source of practically useful substances are medicinal and essential oil plants, the components of which are used in the food, perfumery and cosmetic industries, and also have antimicrobial, anti-inflammatory, fungicidal, wound healing, antiviral and other types of biological activity [17].

Biologically active compounds isolated from medicinal and aromatic plants, as well as their individual components, have been used by humans since ancient times as medicinal, antiseptic, perfumery and protective agents (repellents, attractants, and others) [3-4]. At present, the production

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 September 2023 doi:10.20944/preprints202309.0226.v1

of components based on medicinal and essential oil plants is widely developed in many countries of the world. World production of essential oil exceeds 150 thousand tons, medicinal raw materials - 450 thousand tons.

The flora of any region contains in its composition economically valuable components that are of practical importance for human activity. Specially protected territories are also carriers of economically valuable, including medicinal plants. This potential of the flora allows the use of these species for breeding research and biodiversity conservation.

Diverse in terms of species and landscape, the flora of the Buiratau SNNP makes it possible to identify many valuable sources of plant materials that are used or were previously used in the national economy. For many plant species in Kazakhstan, only fragmentary information is still available.

As a result of field research on the branches of the Buiratau SNNP, a taxonomic list of all types of medicinal plants was determined and compiled [12]. According to them, the medicinal plants of the Yereymentau branch are 231 species, and in the "Belodymovsky" branch, the list includes 274 taxa of these plant species.

Table 6, Figure 2 indicates the results of studying the species composition of the flora of vascular plants showed that 231 species of medicinal plants belonging to 152 genera and 51 families grow on the territory of the Buiratau SNNP in the Yereymentau branch, and 274 species of medicinal plants grow in the Belodymovsky branch assigned to 165 genes and 55 families.

Table 6. Taxonomic composition of medicinal plants in the study area.

Family	**Number of species, pcs.**		**% of total number of species**	
	Yereymentau	Belodymovsky	Yereymentau	Belodymovsky
Apiaceae	7	9	3.03	3.28
Asparagaceae	1	1	0.43	0.36
Aspleniaceae	1	1	0.43	0.36
Asteraceae	48	53	20.77	18.24
Betulaceae	2	3	0.87	1.09
Boraginaceae	4	4	1.73	1.45
Brassicaceae	14	18	6.06	6.56
Campanulaceae	2	2	0.87	0.72
cannabaceae	2	2	0.87	0.72
Caprifoliaceae	1	1	0.43	0.36
Caryophyllaceae	6	7	2.59	2.55
Chenopodiaceae	7	8	3.03	2.91
Convolvulaceae	2	2	0.87	0.72
Crassulaceae	3	3	3.03	1.09
Cupressaceae	1	1	0.43	0.36
Cyperaceae	-	1		0.36
Dipsacaceae	2	2	0.87	0.72
Dryopteridaceae	1	1	0.43	0.36
Eleagnaceae	1	1	0.43	0.36
Ephedraceae	1	1	0.43	0.36
Equisetaceae	2	4	0.87	1.45
Fabaceae	16	17	6.93	6.20
Fumariaceae	1	1	0.43	0.36
Frankeniaceae	1	1	0.43	0.36
Gentianaceae	1	1	0.43	0.36
Geraniaceae	3	3	3.03	1.09
Glosulariaceae	-	2		0.72

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 September 2023 doi:10.20944/preprints202309.0226.v1

Hypolepidaceae	-	1		0.36
Iridaceae	1	1	0.43	0.36
Lamiaceae	12	17	5.19	6.20
Lemnaceae	1	1	0.43	0.36
Liliaceae	1	1	0.43	0.72
Limoniaceae	1	1	0.43	0.36
Linaceae	1	1	0.43	0.36
Lythraceae	1	1	0.43	0.36
Malvaceae	1	1	0.43	0.36
Nymphaceae	1	-	0.43	-
Onagraceae	3	3	3.03	1.09
Parnassiaceae	-	1		0.36
Pinaceae	1	1	0.43	0.36
Plantaginaceae	3	6	3.03	2.189
Poaceae	1	1	0.43	0.36
Polygalaceae	1	1	0.43	0.36
Polygonaceae	9	9	3.89	3.28
Primulaceae	3	3	1.29	1.09
Ranunculaceae	10	12	4.33	4.379
Rhamnaceae	1	1	0.43	0.36
Rosaceae	22	28	9.52	10.21
rubiaceae	4	4	1.73	1.45
Salicaceae	7	8	3.03	2.91
Scrophulriaceae	10	13	4.33	4.74
Solanaceae	1	1	0.43	0.36
Typhaceae	2	2	0.86	0.72
Urticaceae	1	1	0.43	0.36
Valerianaceae	2	2	0.86	0.72
Viburnaceae	-	1	-	0.36
Total	**231**	**274**	**100.00**	**100.00**

The largest number of species was noted in the Asteraceae family – 48 in the Ereymentau branch and 53 species in the Belodymovsky branch, the second position is occupied by the Rosaceae family - 22 and 28 species, respectively, the third position is occupied by the Fabaceae family - 16 and 17, respectively. The most abundant species in terms of the number of medicinal plants are wormwood, willow, cinquefoil, plantain and others.

As can be seen from the Table 7 the analysis of plant life forms showed that the largest group is perennial herbaceous plants – 175 and 205 species.

Table 7. The ratio of life forms of Buiratau SNNP medicinal plants, branches: Yereymentauand Belodymovsky.

Life form	Number of types, pcs.		% of total number of species	
	Yereymentau	Belodymovsky	Yereymentau	Belodymovsky
Tree	6	8	2.59	2.91
Bush	20	27	8.65	9.85
Shrub	4	1	1.73	0.36
Semi-shrub	2	1	0.86	0.36
Perennial herbaceous	175	205	75.76	74.81
Biennial herbaceous	8	9	3.46	3.28
Annual herbaceous	16	24	6.93	8.75

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 September 2023 doi:10.20944/preprints202309.0226.v1

Total	231	274	100.0	100

The second position is occupied by bushes – 20 species, the third – by annual herbaceous plants (16 species). The number of other life forms is very small.

According to the Table 8 among the ecological groups, mesophytes predominate - 110 and 141 species, the second position is occupied by xerophytes - 70 and 73 species, and the third by hygrophytes - 35 and 38 species, respectively.

Table 8. Ecological groups of Buiratau SNNP medicinal plants, branches Yereymentauand Belodymovsky.

Ecological group in relation to humidification conditions	Number of types, pcs.		% of total number of species	
	Yereymentau	Belodymovsky	Yereymentau	Belodymovsky
Hydatophyte	1	1	0.43	0.36
Hydrophyte	4	5	1.73	1.82
Hygrophyte	35	38	15.15	13.86
Mesophyte	110	141	47.62	51.45
Mesoxerophyte	5	6	2.16	2.18
Xeromesophyte	6	10	2.59	3.64
Xerophyte	70	73	30.30	26.64
Total	231	274	100.00	100.00

According to the previous analyzes, the ecological structure of vascular plants in the territory of the Buiratau SNNP was also dominated by mesophytic plant species. Their indicator was 45.5%, there were also numerous xerophytics and mesoxerophytic plants, which accounted for 25.9% and 15.06%, respectively. The smallest were plants - succulents, the indicator of which is only 0.4% [17]

Among the 231 Yereymentau and 274 Belodymovsky species of medicinal plants, 56 species are used in official medicine. These are great burnet, hill-growing saltwort, wreath-bearing saw wort, elecampane, felon herb, spatterdock, great nettle, Marshall's thyme, Ural licorice, and other [18].

Most of the species belong to plants used in folk medicine - 175 (Yereymentau branch) and 218 (Belodymovsky branch) species [19].

3. Discussion

According to our studies, the flora of the SNNP Buiratau includes 610 species [17–19]. In general, according to official data, the flora of Kazakhstan includes 68 species of tree species, 266 species of shrubs, 433 species of semi-shrubs and semi-herbs, 2598 species of perennial grasses and 849 species of annual grasses. About 500 species are endemic. (Flora and fauna of Kazakhstan - Welcome.kz tours to Kazakhstan).

Nevertheless, the biodiversity of flora in the protected areas has been studied in detail only in the reserves and some national parks, such as Burabay and Bayanaul. For example, on the territory of Aksu-Zhabagly, about one and a half thousand species of vegetation can be found. The Almaty Reserve has biodiversity of deciduous to coniferous forests, alpine meadows; the Naurzum Reserve – biodiversity of pine forest; the Karatau Reserve – biodiversity of 53 species of endemic plants, 43 of which are listed in the Red Book. In total, different types of vegetation in this reserve, according to various sources, are from 400 to 700 [20].

The distribution of SNNP "Buiratau" plants, listed in the Red Book, according to humidity, shows that most of them can be attributed to perennial herbaceous plants, with mesophytes and mesoxerophytes predominating in ecological morphology. In the Aksu-Zhabagly Reserve (1927), more than 1350 species of flora were registered, of which more than 200 are rare, 177 endemic, 30 relict, 39 plants are listed in the Red Book of Kazakhstan. Naurzum Nature Reserve includes 687 species of higher plants, including 20 rare ones 5 of which is included in the Red Book. In the Almaty

 doi:10.20944/preprints202309.0226.v1

Reserve more than 1100 species of flora was registered, including 50 rare and endemic and 26 plants included in the Red Book. Korgalzhinsky Reserve has 511 species from 70 families. Markakolsky reserve – more than 1000 species of flora, 15 of them rare. Ustyurtsky reserve has 250 species of higher plants from 163 genera and 43 families [1] and 40 species of algae. West Altai Reserve – 800 species of flora. Alakol Reserve – more than 300 species of higher plants. Karatau Reserve – 400 species of flora, 25% of which are endemic. In the 11 national parks of the Bayanaul SNNP, 500 species of higher plants are registered, including 59 rare species and 40 boreal relics. The flora of the Burabai SNNP is also well studied, with more than 800 plant species being described. The flora of the Borovsky massif includes 757 species, 109 of which need protection and 12 are listed in the Red Book [21].

Most of the plant species of the SNNP Buiratau belong to the plants used in folk medicine – 175 (Ereymentau branch) and 218 (Belodymovskaya branch) species [19]. If we consider all medicinal plants in Kazakhstan, we can find data that medicinal plants are divided into wild and cultivated in the territory of Kazakhstan. In the republic, more than 500 species of medicinal plants are harvested as raw materials. Of particular value is horsetail ephedra, the source of ephedrine, cultivated in the mountainous regions of Kazakhstan. The preparations of the root of elecampane and St. John's wort are of industrial importance. The pharmacy network of the republic prepares about 30 types of medicinal plants [22].

The use of the plants for pharmaceutical needs is carried out in strictly established terms and in ways that do not harm the flora.

The Republic of Kazakhstan has an Approved List of Medicinal Plants, which includes 278 plant species [23].

From the results of the research, it can concluded that almost 80% of medicinal plants from the approved list grow in the SNNP Buyratau.

4. Materials and Methods

The material for the analysis of protected, rare and economically valuable species of flora was the reports of expeditions, collected herbarium materials and herbariums stored in the fund of the Buiratau SNNP and in the fund of the Karaganda Buketov University, geobotanical descriptions. The main research method was route-reconnaissance. Office processing was carried out according to generally accepted botanical methods. When identifying plants, such books as “Flora of Kazakhstan” (1999) [24–32], “Illustrated guide to plants of Kazakhstan” (1972) [33] was used. All species names are given according to the summary “List of vascular plants of Kazakhstan” (1998) [34]. Protected species (rare and endangered) species are identified using the Red Book of the Kazakh SSR (1981) [35], the Red Book of Kazakhstan (2014) [36]. Attribution to medicinal plants occurred in accordance with, medicinal plants themselves were studied in the course of field research at the branches of the Buiratau SNNP.

The collection of herbarium material and the study of phytocenoses in the natural complex in the national natural park "Buiratau" were carried out during scientific expeditions; Herbarium material is collected from April 2019 until the end of October. At the same time, phenological studies are carried out for woody, shrubby and herbaceous plants [36]. To prepare materials for creating an electronic herbarium, photographs will be taken using video cameras and cameras.

The study of the floristic composition was carried out by the method of route-reconnaissance and semi-stationary survey of the territory. At the same time, traditional methods were used - compiling lists of known species for specific routes, points and ecosystems, as well as collecting herbarium and subsequent identification according to various floristic reports (Flora of Kazakhstan, 1956-1966; Flora of the USSR, 1969-1993; Tsvelev, 1977;) [24–34].

One of the most important types of work in the implementation of research methods is the herbarization of plants. The following stages are distinguished: collection of plants, drying, identification, mounting, storage. The collection of plants was carried out in dry weather. Herbaceous plants for the herbarium were collected with all their parts - aboveground and underground shoots, roots, flowers or fruits, branches up to 30 cm long were taken from trees and shrubs. The plant was

 doi:10.20944/preprints202309.0226.v1

laid out on a herbarium sheet in such a way that it evenly filled the sheet and at the same time freely placed on it [37].

Drying of plants began with the fact that the plant is taken out of wet excursion herbarium sheets and transferred to dry ones. All plants on a sheet of paper were placed so that not a single part sticks out of it. After checking the presence of labels, the herbarium folders were closed and stacked on one metal frame of the drying press, each leaf with a plant was separated by moisture-absorbing paper pads. From above, the material to be dried was covered with a second frame, and the entire press with the plant was tightly tied so that it was impossible to move the frames relative to each other. The presses were placed outdoors or in a well-ventilated area. Plants dry better if there are no more than 15-20 herbarium sheets in the press at the same time and do not turn black when dried, if damp pads are regularly replaced with dry ones. The herbarium was considered dried up if, when the plant was touched by the sensitive part of the hand, no cold was felt. Dried plants were processed, labeled, recorded in a workbook or diary, and then sent for patching on thick light paper, the paper for mounting plants should be thick enough and have a standard size of 42x28 cm. A label is glued in the lower right corner according to this pattern:

In the lower right corner, a label is glued according to the following pattern:

Herbarium of the RSU SNNP "Buiratau";

Family (in Latin and Russian);

Genus and species (Latin name and Russian name);

Location;

Habitat;

Date Gathered Defined

In parallel with the drying of plants, work is carried out to study them, i.e. their belonging to a certain family, genus, species is precisely established according to the generally accepted botanical and biological methods.

To date, the list of higher vascular plants in the national park "Buiratau" has 128 species. The species diversity of the vegetation cover is known in various places located on the territory of the park and adjacent territories. The study of the species composition of plants continues. The main task in this direction is to identify the entire species diversity of plants.

The flora of Kazakhstan is rich in useful plants. Diverse, though not so rich in terms of species, the plant world of the SNNP "Buiratau", highly saturated contrasting flora of the park, makes it possible to identify many valuable sources of plant materials that are used or were used earlier in the national economy. On the basis of the Buyratau State Natural Park, we conducted a number of scientific expeditions. Herbarium material was collected and identified according to the generally accepted botanical method [38–42].

Table 9 contains information about botanical expeditions in 2019 on the territory of the SNNP "Buiratau". To collect herbarium material, a total of 18 expedition trips to the park and adjacent territories were carried out.

Table 9. Information about botanical expeditions in 2019 on the territory of the SNNP "Buiratau".

№	Date	Route of the expedition	Purpose of the expedition
1	15.04.19.-17.04.19.	Branch "Belodymovsky" Karaagash tract	Carrying out phenological observations of trees and shrubs
2	22.04.19.-24.04.19.	Yereymentausky Branch Falcon Mountains	Collection of herbarium material
3	03.05.19.-10.05.19.	Branch "Belodymovsky" mountain "Akdym".	Compiling a list of Mount Akdym, studying spring flora
4	20.05.19.-25.05.19.	Branch "Belodymovsky" Zhambasbulak	Collection of herbarium
5	10.06.19.-15.06.19.	Northwestern slope of Mount Berkut	Carrying out phenological observations of plants
6	24.06.19-30.06.19.	Branch "Belodymovsky"	Collection of herbarium

 doi:10.20944/preprints202309.0226.v1

7	03.07.19.-07.07.19.	Branch "Belodymovsky" mountain "Akdym", branch "Ereymentausky"	Collection of herbariums, study of the flora of SNNP "Buiratau", preliminary study on monitoring sites.
8	15.07.19.-20.07.19.	Branch "Ereymentausky"	Carrying out phenological observations of plants and collecting herbarium material
9	05.08.19-12.08.19.	Branch "Yereimentau" falcon mountains	Collection of herbarium material
10	19.08.19.	Branch "Belodymovsky"	Collection of herbarium material
11	26.08.19.	Branch "Ereymentausky"	Collection of herbarium material
12	28.08.19.	Branch "Belodymovsky"	Collection of herbarium material
13	02.09.19-05.09.19.	Branch "Belodymovsky"	Carrying out phenological observations of plants and collecting herbarium material
14	16.09.19.	Branch "Belodymovsky"	Collection of herbarium material
15	17.09.19.	Branch "Ereymentausky"	Collection of herbarium
16	19.09.19. 20.09.19	Belodymovsky branch and Yereymentausky branch	Collection of herbarium material.
17	23.09.19. 28.09.19.	Yereymentausky branch Belodymovsky branch	Collection of herbarium
18	04.10.19.	SNNP "Buiratau" territory of the park	Phenological observation of trees and shrubs in the park

In 2020, we have the main necessary material and technical resources to carry out research work on the topic “Flora of vascular plants of the Buiratau SNNP”. In the future, we will purchase a stereoscopic microscope MBS-10, for carrying out work on the study of plants. To accurately establish belonging, they are to the definition of a family, genus, species according to generally accepted botanical and biological methods.

Abundance is a visual estimate of the number of individuals of each species in a community. It is determined according to the Drude scale [43]:

- soc (socialis) - “abundantly”, the plants close together with their above-ground parts, forming a pure thicket, other species are found in this case very rarely, in separate specimens;
- cop3 (copiosus) - "a lot", plants are very abundant, they are background;
- cop2 - "a lot", plants come across often, there are many of them, they are scattered;
- cop1 - "quite a lot", plants are found occasionally, scattered;
- sp (sparsus) - "few", plants are very rare;
- sol (solitarius) - "single", there are very few plants, only a few specimens per sample plot.
- un (unicus) - "single", plants are found on the territory in a single specimen.

The belonging of a species to an ecological group was determined in relation to the moistening conditions [44]:

- hydrophytes (aquatic plants),
- hygrophytes (coastal aquatic plants),
- mesohygrophytes (plants of waterlogged soils),
- mesophytes (hygrophilous plants),
- xeromesophytes (plants adapted to conditions with slightly lower than average moisture content in the soil),
- mesoxerphites (plants of dry places),
- xerophytes (plants growing in conditions of constant moisture deficiency).

5. Conclusions

Summing up, it is great to be noted that: depending on the geographical location (Kazakh hillocky area, steppe zone) of the territory of the Buiratau SNNP, this natural complex has a very diverse botanical peculiarity. In these types of vegetation of this territory, there are both Red Book Data and rare and endemic plants. The real treasure of the park are black alder and birch forests, the peculiarity of which is that some species (*Alnus glutinosa (L)* Gaertn, *Betula Kirghisorum Sav. - Rysz.)* are in the Red Book and very few in number. A particularly important role in this natural complex is played by economically valuable, especially medicinal, plant species and their resource potential.

On the territory of the park, many research works are carried out annually in various directions and goals. But despite this, the territory is located within the Kazakh hillocky area, and the main ecosystems are represented by mildly dry and dry steppes with an altitudinal belt, dry steppe low mountains of the mountainous hillocky territory. Also, the peculiarities of climatic conditions cause changes in the life forms of plant communities, in connection with these data; further research of this object is of interest for geobotanical work.

After analyzing the above, it should be noted that the Buiratau SNNP is a unique natural environment, which has characteristic endemic and rare plant species. The territory also has 10 plant species listed in the Red Book and 26 species of rare and endangered species. It also has the peculiarity in economic relations due to large resources of economically valuable plant species are concentrated in this territory.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, X.X. and Y.Y.; methodology, X.X.; software, X.X.; validation, X.X., Y.Y. and Z.Z.; formal analysis, X.X.; investigation, X.X.; resources, X.X.; data curation, X.X.; writing—original draft preparation, X.X.; writing—review and editing, X.X.; visualization, X.X.; supervision, X.X.; project administration, X.X.; funding acquisition, Y.Y. All authors have read and agreed to the published version of the manuscript." Please turn to the CRediT taxonomy for the term explanation. Authorship must be limited to those who have contributed substantially to the work reported.

Funding: Please add: "This research received no external funding" or "This research was funded by NAME OF FUNDER, grant number XXX" and "The APC was funded by XXX". Check carefully that the details given are accurate and use the standard spelling of funding agency names at https://search.crossref.org/funding. Any errors may affect your future funding.

Institutional Review Board Statement: In this section, you should add the Institutional Review Board Statement and approval number, if relevant to your study. You might choose to exclude this statement if the study did not require ethical approval. Please note that the Editorial Office might ask you for further information. Please add "The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of NAME OF INSTITUTE (protocol code XXX and date of approval)." for studies involving humans. OR "The animal study protocol was approved by the Institutional Review Board (or Ethics Committee) of NAME OF INSTITUTE (protocol code XXX and date of approval)." for studies involving animals. OR "Ethical review and approval were waived for this study due to REASON (please provide a detailed justification)." OR "Not applicable" for studies not involving humans or animals.

Informed Consent Statement: Any research article describing a study involving humans should contain this statement. Please add "Informed consent was obtained from all subjects involved in the study." OR "Patient consent was waived due to REASON (please provide a detailed justification)." OR "Not applicable." for studies not involving humans. You might also choose to exclude this statement if the study did not involve humans. **W**ritten informed consent for publication must be obtained from participating patients who can be identified (including by the patients themselves). Please state "Written informed consent has been obtained from the patient(s) to publish this paper" if applicable.

Data Availability Statement: We encourage all authors of articles published in MDPI journals to share their research data. In this section, please provide details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. Where no new data were created, or where data is unavailable due to privacy or ethical restrictions, a statement is still required. Suggested Data Availability Statements are available in section "MDPI Research Data Policies" at https://www.mdpi.com/ethics.

Acknowledgments: The work was supported by the staff of the Buyratau SNNP (according to the "Report Flora of Vascular Plants" of the "Buiratau GNNP" for the period 2012-2016" (2017), carried out under the supervision

of scientific supervisor M.Yu. Ishmuratova and researcher Ismailova F.M. report on the topic: "Assessment of the species composition and current state of the populations of medicinal plants of the SNNP "Buiratau" for 2018" (2019), Mukasheva M.A., Ishmuratova M.Yu. Report on the topic: "Assessment of the species composition and current state of the medicinal plant population plants of SNNP "Buiratau" for 2018. Molodyozhny settlement, 2019).

Conflicts of Interest: Declare conflicts of interest or state “The authors declare no conflict of interest.” Authors must identify and declare any personal circumstances or interest that may be perceived as inappropriately influencing the representation or interpretation of reported research results. Any role of the funders in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript; or in the decision to publish the results must be declared in this section. If there is no role, please state “The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results”.

References

1. Ishmuratova M.Yu., Ismailova F.M., Minakov A.I. Geographic novelties in the flora of the State National Natural Park "Buiratau". International scientific journal Actual problems of our time №3 (9) Karaganda. Bolashak - Baspa 2015.
2. Rubtsova T.A., Fetisov D.M., Gelunov A.N. New geobotanical zoning of the Jewish Autonomous Region. Vestnik FEB RAS. 2016. 1. S.26-37.
3. Vegetation map of SNNP "Buiratau". TsDZ and GIS "Terra". Almaty, 2014.
4. Karamysheva Z.V., Rachkovskaya E.I. Vegetation map of the steppe part of the Central-Kazakhstan «melkosopochnik» (peneplane) as the basis for botanico-geographical regionalization // Geobotanical mapping 1973. Leningrad. P. 30–49. https://doi.org/10.31111/geobotmap/1973.30
5. Isachenko T.I. and Rachkovskaya E.I. The main zonal types of Northern Kazakhstan. Geobotany, issue 13 / edited by E.M. Lavrenko. M., Publishing House of the Academy of Sciences of the USSR, 1961. P.138
6. Nikolaev V.A. Landscapes of the Asian steppes. Moscow Publishing House, 1999. P.13-33. URL: https://www.rfbr.ru/rffi/ru/books/o_65617.
7. Soil map of the Kazakh SSR, M.: Main Directorate of Geodesy and Cartography under the Council of Ministers of the USSR, 1976. - 2 sheets.
8. Soil map of the KazSSR, M.: Main Department of Geodesy and Cartography under the Council of Ministers of the USSR, 1976. - 2 sheets.
9. Ismailova F.M. “Addition to the list of plant species in the Red Data Book of the SNNP “Buiratau”.
10. Kupriyanov A.N., Khrustaleva I.A., Gabdullin E.M., Ismailova F.M. Synopsis of the flora of the state national park "Buiratau" (mountains Ermentau, Central Kazakhstan) // Botanical research of Siberia and Kazakhstan. – 2014.- Issue 20.-p.30-57.
11. Prozorova T.A., Chernykh I.B. Biodiversity of vegetation in the Bayanaul National Park. - Pavlodar: Eco, 2001. - 187 p.
12. Kamkin V.A., Kadenova A.B., Kamkina E.V. Plants of the Bayanaul State National Natural Park. - Pavlodar: Kereku, 2009. - 477 p.
13. Kadenova A.B., Kamkin V.A., Erzhanov N.T., Kamkina E.V. Flora and vegetation of the Bayanaul State National Natural Park. - Pavlodar: Kereku, 2008. - 383 p.
14. Kupriyanov A.N., Khrustaleva I.A., Manakov Yu.A. New species for the Bayanaul National Park // Botan. iss. Sib. and Kazakhstan. - 2008. - Issue. 14. - S. 20-23.
15. Kupriyanov A.N., Khrustaleva I.A., Akmullaeva A.S. List of plants of the Bayanaul National Park (Central Kazakhstan) // Botan. iss. Sib. and Kazakhstan. - 2011. - Issue. 17. - S. 95-114.
16. Ishmuratova M.Yu., Ivlev V.I. Useful plants of the Bayanaul mountain forest // MaterialyVIIMiedzyn. nauk. -prakt. konferenceDynamikanaukowychbadan - 2011. - Przemysl-Poland, 2011. - S. 44-47.
17. Landscape map of the Kazakh SSR. M.: Main Directorate of Geodesy and Cartography under the Council of Ministers of the USSR. 1979
18. Belousova L.S., Denisova L.V. Rare plants of the world -M.: Timber industry, 1983.-344p.
19. Vegetation map of SNNP " Buiratau ". Almaty: Center for remote sensing and GIS Terra. 2005
20. Biological sciences / 1. Systematics and geography of higher plants. d.b.n. Ogar N.P. Ph.D. Imankulova S. K. Kazakh National Pedagogical University named after Abai, Kazakhstan SPECIALLY PROTECTED NATURAL TERRITORIES OF KAZAKHSTAN AS CENTERS OF LANDSCAPE AND BIOLOGICAL DIVERSITY CONSERVATION. Reserves and national parks of Kazakhstan. Almaty Kitap, 2006, 282p.
21. Medicinal plants // Kazakhstan. National Encyclopedia. - Almaty: Kazakh encyclopedias, 2005. - T. III. — ISBN 9965-9746-4-0. (CC BY-SA 3.0), Medicinal plants of Kazakhstan / otv. ed. L. K. KLYSHEV. - Alma-Ata: Science of the KazSSR, 1966.
22. Order of the Ministry of Ecology and natural resources of the Republic of Kazakhstan dated March 7, 2023 No. 77 approved the list of medicinal plants.

23. Karamysheva Z.V. Primary successions on stony habitats in the Central Kazakhstan uplands. Geobotany. Issue 13. L.: Publishing House of the Academy of Sciences of the USSR, 1961. P. 468-477
24. Karamysheva Z.V., Rachkovskaya E.I. Vegetation map of the steppe part of the Kazakh uplands. M 1: 1,500,000, M.-L., 1975
25. Central Kazakhstan small hills. Kazakhstan. General physical and geographical characteristics. Publishing House of the Academy of Sciences of the USSR. 1950, pp.101-106
26. Storozhenko D.M. Soils of the Karaganda region. - Alma-Ata: Science, 1967. - 268 p.
27. Flora of Kazakhstan. T.1.-Alma-Ata: Publishing House of the Academy of Sciences of the Kazakh SSR, 1956.-354p.
28. Flora of Kazakhstan. T.2.-Alma-Ata: Publishing House of the Academy of Sciences of the Kazakh SSR, 1958.-290s.
29. Flora of Kazakhstan. T. 3.-Alma-Ata: Publishing House of the Academy of Sciences of the KazSSR, 1960.-458s.
30. Flora of Kazakhstan. T. 4.-Alma-Ata: Publishing House of the Academy of Sciences of the KazSSR, 1961.-545p.
31. Flora of Kazakhstan. T. 5.-Alma-Ata: Publishing House of the Academy of Sciences of the Kazakh SSR, 1961.-515p.
32. Flora of Kazakhstan. T. 6.-Alma-Ata: Publishing House of the Academy of Sciences of the KazSSR, 1963.-465p.
33. Flora of Kazakhstan. T. 7.-Alma-Ata: Publishing House of the Academy of Sciences of the KazSSR, 1964.-498s.
34. Flora of Kazakhstan. T. 8.-Alma-Ata: Science, 1965.-448s.
35. Flora of Kazakhstan. T. 9.-Alma-Ata: Science, 1966.-425s.
36. Illustrated guide to plants of Kazakhstan. TT. 1.2. Alma-Ata, "Science", 1972.
37. Abdulina S.A. List of vascular plants of Kazakhstan. / Ed. R.V. Kamelina / Almaty. 1998. 187 p.
38. Red Book of the Kazakh SSR: Rare and endangered species of animals and plants in 2 parts. Part 2: Plants / Bykov B.A. - Alma-Ata: Kainar, 1981. - 605s.
39. Red Book of Kazakhstan. V.2, Part 2. Plants / Ed. E.O. Baitulin. - 2nd Ed., revised and enlarged - Astana: LTD “Art - Print XXI”, - 2014. - 452 p.
40. Serebryakov I.G. Ecological morphology of plants. Life forms of angiosperms and conifers. - M .: Higher school, 1982 - 380s.
41. Skvortsov A.K. Herbarium. A guide to methodology and technology. -Moscow: Nauka, 1977.-199p.
42. Serebryakov I.G. Morphology of the vegetative organs of higher plants. - Soviet Science, 1952.-392p.
43. Yurtsev B.A., Kamelin R.V. Basic concepts and terms of floristry. - Perm. Perm University, 1991. 80s.
44. Poniatovskaya V.M. Accounting for the abundance and distribution of species in natural plant communities // Field geobotany, T.3.-M.-L.: Nauka, 1964.-p.209-299.
45. Atlas of habitats and resources of medicinal plants in Kazakhstan. - Almaty: Gylym, 1994. - 168 p.
46. Abysheva L.N., Belenovskaya L.M., Bobyleva N.S. Wild useful plants of Russia. - St. Petersburg: SPKhFA Publishing House, 2001. - 663 p.
47. Bykov B.A. Introduction to phytocenology. - Alma-Ata: Publishing House of the Academy of Sciences of the Kazakh SSR, 1970. - 226 p.
48. Field geobotany: 3 volume - Establishment of ecological profiles and sample plots / E.M. Lavrenko, A.A. Korchagin -. M.: Book on Demand, 2013. - 554 p.
49. Kupriyanov A.N. New species of wormwood Artemisia (subgen. Artemisia, Asteraceae) from Central Kazakhstan // Botanical journal. - 1995. - T. 80. - No. 2. - S. 83-84.
50. Five-year report on the topic: "Flora of vascular plants" of " Buiratau SNNP " for the period 2012-2016. Scientific adviser, candidate of biological sciences, associate professor Ishmuratova M.Yu. Performer ns.and Smailova F.M. P.Molodezhny, 2017. P.55
51. Report on the topic: "Assessment of the species composition and current state of populations of medicinal plants of the SNNP " Buiratau " for 2018". P.Molodezhny, 2019. P.15
52. Minakov A.I., Ismailova F.M., Sagaliev N.A., Ishmuratova M.Yu., Turlybekova G.K. Fauna and flora of the state national natural park " Buiratau ". Monograph. Karaganda, 2019. P.195-372
53. Sinitsyn G.S. New medicinal plants of Kazakhstan. - Alma-Ata: Publishing House of the Academy of Sciences of the Kazakh SSR, 1982. - 128 p.
54. Aidarkhanova G.S., Koblanova S.A. Ecological structure of the flora of the Central Kazakhstan uplands within the Buyratau State National Natural Park. // Problems of Botany of Southern Siberia and Mongolia: Sat. scientific Art. based on the materials of the XVII int. scientific-practical. conf. (Barnaul, May 24-27, 2018) / AltGU, Yuzh. -Sib. nerd. garden, Altai department Rus. nerd. islands. - Barnaul: AltGU Publishing House, 2018. - P. 5–7.

 doi:10.20944/preprints202309.0226.v1

55. Mukasheva M.A., Ishmuratova M.Yu. Report on the topic: "Assessment of the species composition and current state of the population of medicinal plants of the SNNP “Buiratau" for 2018. Molodyozhny settlement, 2019.