

Data Paper

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Ecological and geographical characteristics of the subgenus *Cercidotrix* Bunge in Betpak-Dala

In the present study, data on the species composition and geographic distribution of representatives of the subgenus *Cercidotrix* Bunge in the Betpak-Dala region have been systematized and clarified for the first time based on an analysis of herbarium collections (AA, MW, LE, TASH) and recent field observations. The scientific novelty of the study lies in the integration of literature sources and herbarium data to refine the ecological and geographic characteristics of *Cercidotrix* Bunge representatives in the desert ecosystem of Betpak-Dala, thereby enabling a more comprehensive assessment of their biodiversity and ecological traits. The analysis of ecological and geographic data for the genus *Astragalus* L. demonstrates that the collection and systematization of this information have been carried out for the first time both in Betpak-Dala and in Kazakhstan as a whole.

Keywords: *Astragalus*, *Cercidotrix*, Betpak-Dala, ecology, geography, herbarium, life form, ecological group.

Introduction

The Fabaceae family consists of valuable forage plants. It includes such major genera as *Astragalus*, *Lathyrus*, *Medicago* (alfalfa), *Melilotus* (sweet clover), *Oxytropis*, *Trifolium* (clover), *Vicia* (vetch), and others. After grasses, legumes are the most important group of flowering plants for humans in terms of practical significance. In legume seeds, the main storage substances are protein, as well as starch and fatty oil, which determine their high nutritional and fodder value. The legume family includes about 550 genera and 13,000 species distributed throughout the world, making it one of the largest families in the global flora. In Kazakhstan, 42 genera and about 650 species are found [1]. *Astragalus* L., is one of the largest genres of flowering plants in the Leguminosae family [2].

The genus *Astragalus* L. is a very large Holarctic genus, comprising more than 2,000 species, of which about 900 occur in the former USSR and 308 in Kazakhstan. Most species of *Astragalus* remain poorly studied in terms of their chemical composition, forage value, and other properties. Some of them serve as good forage plants, while others contain alkaloids, glycosides, or saponins and are poisonous [3, 4]. Active ingredients from *Astragalus* sp. They are used in nutrition, and their use in the treatment of neurological diseases is attracting increasing attention [3]. Many *Astragalus* species have extremely limited ranges and are endemic to Kazakhstan; there are 75 such endemic species, which is more than 25 % of the total [5, 6].

Species of the genus *Astragalus* L. are annual or perennial herbaceous plants, subshrubs, and less commonly shrubs, with well-developed or strongly shortened stems. They are usually covered with simple or bifurcate hairs, and more rarely glabrous (hairless) [6].

Betpak-Dala is one of the largest clay deserts in the world. This vast natural region stretches 170 kilometers from north to south and about 500 kilometers from west to east, covering an area of 75,000 square kilometers on the Kazakh plains—two and a half times the size of modern-day Belgium. Almost entirely uninhabited, Betpak-Dala captivates with its diverse landscape. Its proximity to the Kazakh Uplands is reflected in the region's rocky areas, low hills, and small depressions.

Among the CIS countries, about 900 species of the genus *Astragalus* L. are recorded. At present, a new representative of the genus *Astragalus* L., namely *Astragalus mollis*, has been identified in Azerbaijan [7]. In Kazakhstan, 309 species occur, 11 of which are listed in the Red Book. In the Betpak-Dala Desert, 17 species

are found, belonging to 11 sections of the subgenus *Cercidotrix* Bunge (*Astragalus* L.). According to the Flora of Kazakhstan, two species—*Astragalus sumnevicii* and *Astragalus karatjubeki*—are endemic [8, 9].

The objective of the present study is to investigate the ecological and geographical characteristics of the subgenus *Cercidotrix* Bunge (*Astragalus* L.) in the desert ecosystem of Betpak-Dala, including the determination of species composition, geographic distribution (Fig. 1), predominant life forms, ecological niches, and patterns of distribution across different habitat types.

Scientific novelty:

1. For the first time, data on the species composition and geographic distribution of representatives of the subgenus *Cercidotrix* Bunge in the Betpak-Dala region have been systematized and clarified.

2. An integrated analysis of herbarium material and literature sources has been conducted, allowing a more precise determination of the ecological and geographical characteristics of the subgenus in the desert ecosystem.

3. Based on the analysis of ecological and geographical features of the genus *Astragalus* L., it is important to note that this study and data collection have been carried out for the first time both for the genus *Astragalus* L. in Betpak-Dala and for the territory of Kazakhstan as a whole.

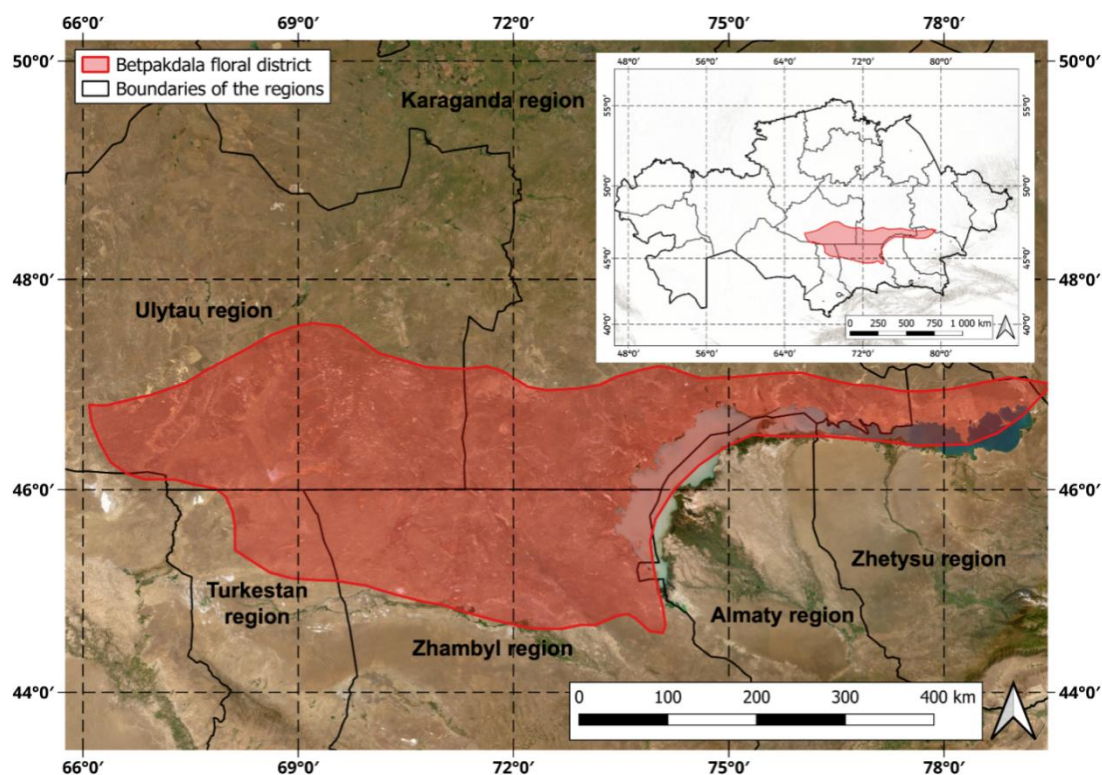


Figure 1. Map of the location of the Betpak-Dala floristic region within the territory of Kazakhstan

Experimental

The research work used classical botanical (ecologo-systematic; ecologo-geographical) methods. In the course of the work, herbarium materials collected on the territory of Betpak-Dala were studied through the internet resources of the collection fund of the Institute of Botany and phytointroduction (AA), herbarium of Moscow University (MW), herbarium of St. Petersburg State University (LE), the Central herbarium fund of Uzbekistan (TASH) and iNaturalist and GBIF (Global Biodiversity Information Facility). Herbarium collection is carried out according to the method of Skvortsov A. K. (1977) [7; 10–25]. To identify the collected materials, fundamental reports were used: “Flora of Kazakhstan” (1961) [5], “Illustrated determinant of Kazakhstan” (1969), “Determinant of Middle Asia and Kazakhstan” (1972) and “Flora of the USSR”. The ecological conditions of the species were studied based on the works of Raunkiaer C. (1934), Serebryakov I.G. (1964), Shennikov (1950), and Poplavskaya (1950) [26–30]. To assess the statistical significance of differences in species distribution across ecological groups, the basic formula for calculating percentages in statis-

tics was used. A total of 17 species were distributed among three groups: 7 species (41.2 %) as hemicryptophytes, 7 species (41.2 %) as phanerophytes, and 3 species (17.6 %) as chamaephytes.

Results and Discussion

The CIS of *Astragalus* includes about 900 species among countries [10]. *Astragalus* L. there are 309 species of the genus, of which 11 species are listed in the Red Book [9]. Representatives of the genus *Astragalus* L. in the genus *Cercidotrix* Bunge found in the territory of Betpak-Dala are classified into 11 sections [10, 31]. Studies of the species of the subgenus *Cercidotrix* Bunge (*Astragalus* L.) occurring in Betpak-Dala, along with the examination of herbarium material, showed that the studied subgenus has a wide ecological amplitude and is fairly well distributed in this area. The total number of species in the studied territory is 17, which can be seen in Table 1:

Table 1

Taxonomic composition of species of genus *Astragalus* L. (compiled from Flora of Kazakhstan)

№	Section	Subsection	Species
1	Xiphidium Bge.	Xiphidium	<i>Astragalus arbuscula</i>
			<i>A. polyceras</i>
			<i>A. scleroxylon</i>
			<i>A. virgatus</i>
		Macrotropida R. Kam	<i>A. compressus</i>
2	Ammodendron		<i>A. brachypus</i>
3	Corethrum Bge		<i>A. karatjubeki</i>
4	Ammodytes (Stev.) Bge		<i>A. Kronenburgii</i>
5	Erioceras Bge.		<i>A. ammodytes</i>
6	Tamias Bge		<i>A. arcuatus</i>
7	Paracystium Gontsch.		<i>A. Turczaninovii</i>
8	Scabriseta R. Kam.		<i>A. Sumnevicii</i>
9	Pseudohelmia R. Kam.		<i>A. lasiophyllus</i>
10	Bucharica B. Fedtsh.		<i>A. scabrisetus</i>
11	Bulimioides Bge.		<i>A. Krascheninikovii</i>
			<i>A. macropetalus</i>
			<i>A. unijugus</i>

Abstract

Astragalus kronenburgii B. Fedtsch. ex Kneuck.

Perennial herbaceous plant. It grows on gravelly, woody, and rocky slopes in the foothills and low mountains.

It blooms in May and bears fruit until June and July.

It occurs in the floristic regions of Betpak-Dala, Dzungarian Alatau, Zailiysky Kungey Alatau, Chu-Ili Mountains, Karatau, and Western Tien Shan.

General distribution worldwide: Kyrgyzstan, Uzbekistan [8, 9].

A. ammodytes Pall.

Perennial herbaceous plant. Grows on sandy soils.

Flowering occurs from May to June; fruiting from May to July.

It is found in the floristic regions of Irtysh, Semipalatinsk, Aktobe, Western and Eastern Low Hills, Zaysan, Aral Sea region, Kyzylorda, Betpak-Dala, and Turkestan.

General distribution worldwide: Altai, China, Mongolia, Tuva, Uzbekistan, and Xinjiang [8, 9].

A. arcuatus Kar. et Kir.

Perennial herbaceous plant. Grows on rocky slopes of hills.

Flowering occurs from June to July.

It is found in the floristic regions of Irtysh, Kokshetau, Aktobe, Mugodzhaz, Emba, Turgay, Western and Eastern Low Hills, Ulytau, Karkaraly, Zaysan, Betpak-Dala, Altai, Dzungarian Alatau, and Karatau.

General distribution worldwide: Eastern European part of Russia, Mongolia [8, 9].

A. Turczaninowii Kar. et Kir.

Perennial herbaceous plant. Grows in desert zones on stabilized hummocky sands, in river valleys, saxaul thickets, and on sandy loams along mountain foothills.

Flowering occurs from April to June; fruiting from May to June.

It is found in the floristic regions of Aktobe, Turgay, Western Low Hills, Aral Sea region, Kyzylorda, Betpak-Dala, Muyunkum, Balkhash-Alakol, Kyzylkum, Turkestan, Tarbagatai, Dzungarian Alatau, Chu-Ili Mountains, and Karatau.

General distribution worldwide: Afghanistan, Turkmenistan, Uzbekistan [8, 9].

A. Sumneviczii Pavlov.

Perennial herbaceous plant. Grows on compacted sands and sandy-clay hills.

Flowering occurs from May to June; fruiting from June to July.

It is found in the floristic region of Betpak-Dala.

General distribution worldwide: Endemic [8, 9].

A. lasiophyllus Ledeb.

Perennial herbaceous plant. Grows in sagebrush and saltwort-sagebrush deserts, on outcrops of chalk and tertiary clays.

Flowering occurs in (April) May; fruiting from May to June.

It is found in the floristic regions of Aktobe, Emba, Western Low Hills, Northern Ust-Urt, Buzachi, Mangyshlak, Aral Sea region, Betpak-Dala, Balkhash-Alakol, Dzungarian Alatau, Zailiysky Kungey Alatau, Chu-Ili Mountains, and Karatau.

General distribution worldwide: Eastern European part of Russia, Mongolia, Northern European part of Russia, Uzbekistan, and Xinjiang [8, 9].

A. scabrisetus Bonge.

Perennial herbaceous plant. Grows on sands, sandy-stony slopes, and clayey areas.

Flowering occurs from April to May; fruiting in June.

It is found in the floristic regions of Aktobe, Turgay, Western and Eastern Low Hills, Karkaraly, Zaysan, Northern Ust-Urt, Mangyshlak, Aral Sea region, Betpak-Dala, Balkhash-Alakol, Kyzylkum, Dzungarian Alatau, Zailiysky Alatau, Chu-Ili Mountains, and Karatau.

General distribution worldwide: Mongolia, Uzbekistan, Xinjiang [8, 9].

A. arbuscula Pall.

Bushy shrub. Grows in steppes and sagebrush deserts, occasionally on sands, more often on rocky and pebble soils, in forested foothills and dry slopes of low mountains.

Flowers in May; fruits in June.

It is found in the floristic regions of Irtysh, Turgay, Western and Eastern Low Hills, Karkaraly, Zaysan, Betpak-Dala, Balkhash-Alakol, Altai, Tarbagatai, Dzungarian Alatau, Zailiysky Alatau, and Chu-Ili Mountains.

General distribution worldwide: Altai, Mongolia, Xinjiang [8, 9].

A. polyceras Kar. et Kir.

Bush. Grows on gravelly and clayey solonchak soils, at the edges of sands, and in desert steppes among sagebrush.

Flowering occurs from April to May; fruiting in May.

It is found in the floristic regions of the Caspian Lowland, Western Low Hills, Betpak-Dala, Balkhash-Alakol, and Dzungarian Alatau.

General distribution worldwide: Xinjiang [8, 9].

A. scleroxylon Bunge

Subshrub. Grows on solonchak red clays, gravelly soils of buttes and dry stream beds, less commonly on sandy soils of desert low mountains.

Flowering occurs from May to June.

It is found in the floristic regions of Betpak-Dala, Muyunkum, Kyzylkum, Turkestan, and Karatau.

General distribution worldwide: Uzbekistan [8, 9].

A. compressus Ledeb.

Subshrub. Grows on gravelly and sandy steppe areas in intermontane depressions and valleys.

Flowers in May; fruits in July.

General distribution worldwide: Altai, North-Central China, Mongolia, Xinjiang [8, 9].

A. virgatus Pall.

Perennial herbaceous plant. Grows in sandy and desert steppes, feather grass and feather grass-fescue steppes, in meadow depressions among sandy ridges, on clayey cliffs, and fallow lands.

Flowering occurs from May to June; fruiting from June to August.

It is found in the floristic regions of the Spur of the General Syrt, Tobol-Ishim, Irtysh, Caspian Lowland, Aktobe, Mugodzhar, Emba, and Betpak-Dala.

General distribution worldwide: Bulgaria, Central European part of Russia, Eastern European part of Russia, Hungary, Crimea, North Caucasus, Romania, Southern European part of Russia, Ukraine, and Western Siberia [8, 9].

A. krascheninnikovii Kamelin

Bush. Grows along the edges of dry spring streams in clayey deserts.

Flowering occurs from May to June.

It is found in the floristic region of Betpak-Dala.

General distribution worldwide: Endemic [8, 9].

A. macropetalus Schrenk

Perennial herbaceous plant. Grows on gravelly mountain foothills and slopes, in clayey ephemeral deserts and dry steppes.

Flowering occurs from April to July; fruiting from May to June.

It is found in the floristic regions of Kyzyl-Orda, Betpak-Dala, Balkhash-Alakol, Chu-Ili Mountains, Karatau, and Western Tien Shan.

General distribution worldwide: Uzbekistan [8, 9].

A. brachypus Schrenk ex Fisch. & C.A. Mey.

Perennial herbaceous plant. Grows on sands, weathered sandstones, sandy solonchaks, and in desert shrub thickets.

Flowering occurs from April to June; fruiting from June to July.

It is found in the floristic regions of the Caspian Lowland, Western Low Hills, Aral Sea region, Kyzyl-Orda, Betpak-Dala, Muyunkum, Balkhash-Alakol, and Zailiysky Alatau.

General distribution worldwide: Kyrgyzstan, Xinjiang [8, 9].

A. karatjubeki Golosk.

Subshrub. Grows on coastal sands.

Flowering occurs from May to June; fruiting from June to July.

It is found in the floristic regions of Betpak-Dala and Balkhash-Alakol.

General distribution worldwide: Endemic [8, 9].

A. unijugus Bunge.

A small shrub. Grows in clayey and sandy deserts on takyr, edges of solonchaks, calcareous loams, and sandy loams. Flowering occurs from May to June; fruiting in June. It is found in the floristic regions of Western Low Hills, Kyzyl-Orda, Betpak-Dala, and Balkhash-Alakol. General distribution worldwide: Xinjiang [8, 9].

Cercidotrix Bunge (*Astragalus* L.) description of herbarium specimens of representatives of the genus can be seen in Table 2.

Table 2

**Comparative data on the presence of species of the genus *Cercidotrix* Bunge in herbarium collections
(AA, MW, LE, TASH, GBIF and iNaturalist)**

№	Name of the species by FK	AA	MW, GBIF, iNaturalist	LE
1	<i>Astragalus arbuscula</i> Pall.	3	4	3
2	<i>A. polyceras</i> Kar. & Kir.	4	2	-
3	<i>A. scleroxylon</i> Bunge	1	1	3
4	<i>A. virgatus</i> Pall.	-	-	-
5	<i>A. compressus</i> Ledeb.	-	-	-
6	<i>A. brachypus</i> Schrenk ex Fisch. & C.A. Mey.	-	-	-
7	<i>A. karatjubeki</i> Golosk.	1	-	-
8	<i>A. Kronenburgii</i> B.Fedtsch. ex Kneuck.	2	-	-
9	<i>A. ammodytes</i> Pall.	4	-	-
10	<i>A. arcuatus</i> Kar. & Kir.	5	-	-
11	<i>A. Turczaninovii</i> Kar. et Kir.	6	-	5
12	<i>A. Sumneviczii</i> Pavlov	-	2	1
13	<i>A. lasiophyllus</i> Ledeb.	8	-	1
14	<i>A. scabrisetus</i> Bong.	2	1	2
15	<i>Astragalus kokaschikii</i> Gamajun	1	-	-
16	<i>A. macropetalus</i> Schrenk	3	1	18
17	<i>A. unijugus</i> Bunge	10	3	2
	Species in total	50	14	35

Note. FK — Flora of Kazakhstan; AA — on the Herbarium of the Institute of Botany and Phytointroduction; MW — on the Herbarium of Moscow University; III — on the Herbarium of Saint Petersburg State University.

In the herbarium of the Institute of Botany and Phytointroduction (AA), a total of 50 specimens related to this subgenus were collected. The most frequently encountered and mostly collected between 1934–1941 were *Astragalus unijugus* (20.8 %) and *Astragalus lasiophyllus* (14.6 %). In the digital herbarium “Noevkovcheg” at Moscow State University (MW), 14 specimens were collected. Most of these were gathered in 1951, with the most common species being *Astragalus arbuscula* (33.3 %), *A. polyceras* (16.7 %), and *A. unijugus* (16.7 %). In the herbarium of Saint Petersburg State University (LE), the majority of the specimens were collected between 1958–1960. The predominant species were *Astragalus macropetalus* (48.5 %) and *A. turczaninovii* (18.2 %). In the National Herbarium of Uzbekistan (TASH), 6 specimens were recorded, including 4 specimens of *Astragalus arbuscula* (66.7 %) and 2 specimens of *A. ammodytes* (33.3 %). Figure 2 shows several species of herbarium specimens of the subgenus *Cercidotrix* Bunge collected from the Betpak-Dala Desert. Analysis of herbarium collections showed that *A. unijugus* Bunge, *A. lasiophyllus*, and *A. turczaninovii* are widespread and exhibit a high degree of distribution.

Based on herbarium specimens, a distribution map of species of the subgenus *Cercidotrix* Bunge within the floristic regions of Kazakhstan was compiled (Fig. 3). According to the obtained data, the species *A. kokaschikii* Gamajun and *Astragalus sumneviczii* Pavl. are recorded only from a single locality, which confirms their status as rare and narrowly endemic species.

In this study, among the species belonging to the subgenus *Cercidotrix* Bunge (*Astragalus* L.), two species are included in the Red Book. Considering these species individually:

Astragalus kokaschikii Gamajun is a rare local endemic species with a limited distribution range. It flowers in June. The species is known from only one locality—the clay desert of Betpak-Dala, where it grows along the banks of the dried-up Kokashyk riverbeds. Its extremely low abundance is a consequence of economic and anthropogenic activities. As a conservation measure, the establishment of the Betpak-Dala Nature Reserve has been proposed. It is necessary to determine the current state of the populations and develop appropriate conservation measures [9].

Astragalus sumneviczii Pavl. is a rare local endemic species. It is a perennial plant 4–15 cm in height. The species flowers from May to July and bears fruit from June to July. It grows on compacted sandy soils of the Betpak-Dala region (Fig. 4). Due to anthropogenic activities, the probability of extinction of the species is high. As a preventive conservation measure, the organization of the Betpak-Dala Nature Reserve is recommended. It is necessary to assess the current condition of the species in nature and establish protection measures [9].

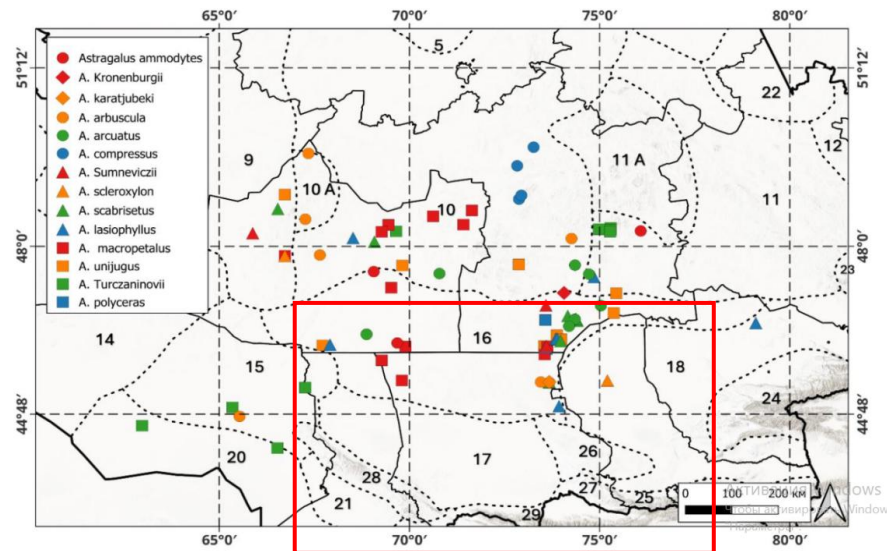


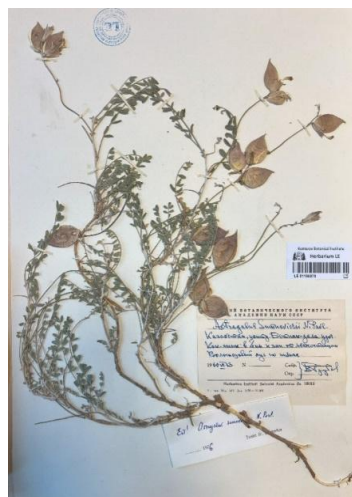
Figure 3. Map of the distribution of species of the subgenus *Cercidotrix* Bunge in the floristic regions of Kazakhstan



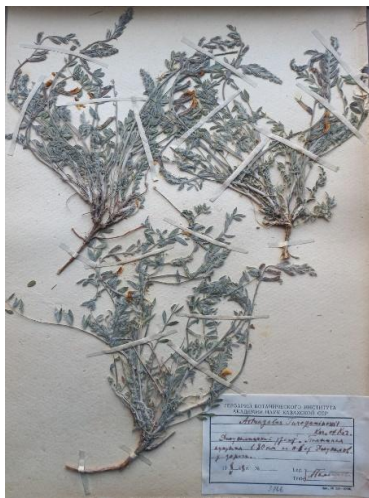
Astragalus virgatus Pall
Herbarium MW



Astragalus compressus Ledeb.
Herbarium MW



Astragalus Sumneviczii Pavlov.
Herbarium LE



Astragalus Turczaninowii Kar.&Kir
Herbarium AA



Astragalus ammodytes Pall
Herbarium LE



Astragalus polyceras Kar. et Kir.
Herbarium AA

Figure 4. Herbarium specimens of species of the subgenus *Cercidotrix* Bunge. in the Betpak-Dala

Species of the subgenus *Cercidotrix* Bunge, found in the territory of Betpak-Dala, grow in various ecological groups due to the adaptation of representatives of a related branch to the soil. In our research work, we can identify 3 different groups. These are: sandy, rocky-gravel, clay-salt marshes. The species adapted to these groups can be divided as shown in Figure 5. Regarding soil conditions, these plants are frequently found on sandy soils; therefore, they are classified as psammophytes. Psammophytes are plants that grow on sandy soils. They possess a xeromorphic structure and a well-developed root system. In psammophytes, adventitious buds are formed on the roots depending on the accumulation of sand, while adventitious roots develop on the stems when they become covered with sand [3].

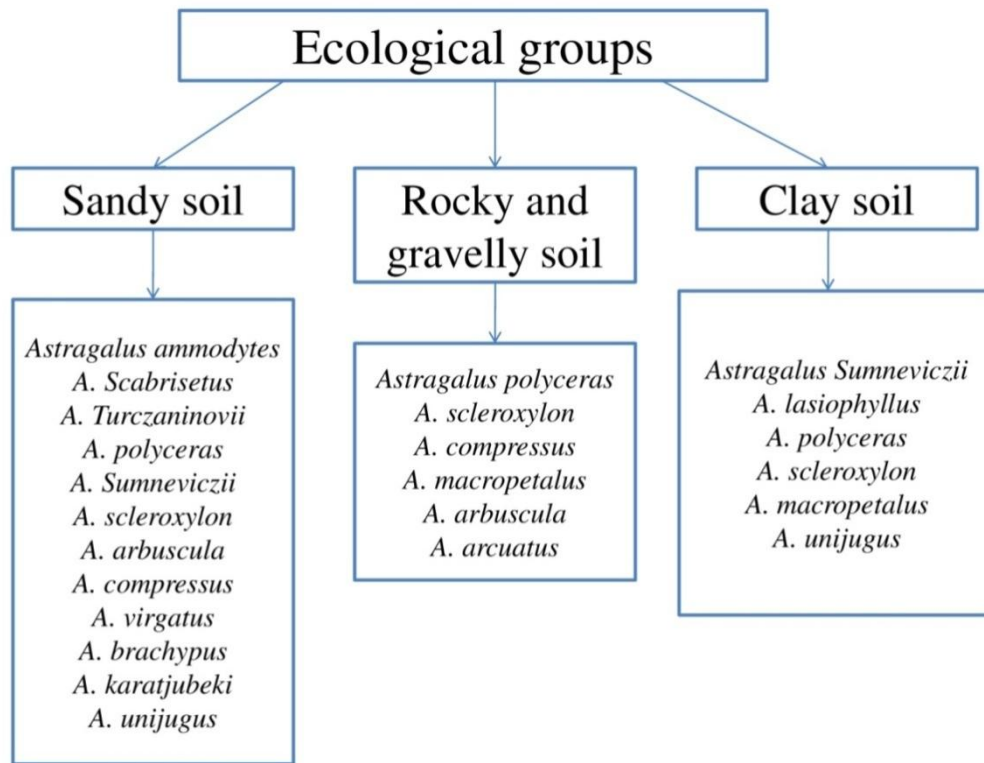


Figure 5. Ecological groups of species of the subgenus *Cercidotrix* Bunge (*Astragalus* L.)

Astragalus is a polymorphic genus that includes a variety of life forms: annual ephemeral herbs, as well as perennial herbaceous, shrubby, subshrub, and branched forms. Currently, there are 2,455 species of these plants worldwide [26, 27].

Analysis of life forms according to I.G. Serebryakov showed that the identified species belong only to certain groups. The predominant life forms are perennial plants (9 species), shrubs (2 species), subshrubs (2 species), sub-shrubs (3 species), and dwarf semi-shrubs (1 species) which can be seen in Table 3.

Ecological analysis of the subgenus indicates a wide distribution of xerophytes and mesophytes in desert and gravelly habitats [26, 27].

Table 3

Life forms according to I.G. Serebryakov

№	Species	Types life form
1	<i>Astragalus ammodytes</i>	Perennial grasses
2	<i>Astragalus arbuscula</i>	Bush
3	<i>Astragalus arcuatus</i>	Perennial grasses
4	<i>Astragalus brachypus</i>	Subshrub
5	<i>Astragalus compressus</i>	Subshrub
6	<i>Astragalus karatjubeki</i>	Subshrub
7	<i>Astragalus kokaschikii</i>	Bush
8	<i>Astragalus Kronenburgii</i>	Perennial grasses
9	<i>Astragalus lasiophyllus</i>	Perennial grasses

Continuation of Table 3

№	Species	Types life form
10	<i>Astragalus macropetalus</i>	Perennial grasses
11	<i>Astragalus polyceras</i>	Subshrub
12	<i>Astragalus scabrisetus</i>	Perennial grasses
13	<i>Astragalus scleroxylon</i>	Subshrub
14	<i>Astragalus Sumneviczii</i>	Perennial grasses
15	<i>Astragalus Turczaninovii</i>	Perennial grasses
16	<i>Astragalus unijugus</i>	Shrub
17	<i>Astragalus virgatus</i>	Perennial grasses

In the course of a study by C. Raunkier, the life forms of *Cercidotrix* Bunge species were identified. Of these, 41.2 % are hemicryptophytes (7 species), phanerophytes — 41.2 % (7 species) and hametophytes — 17.6 % (3 species) in Figure 2 [30].

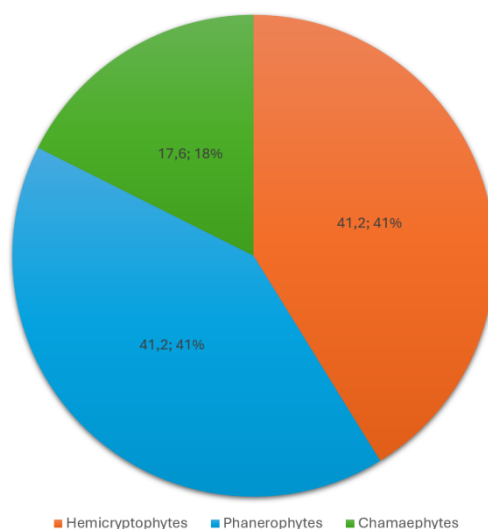


Figure 5. Life forms of representatives of the related branch of *Cercidotrix* Bunge according to C. Raunkier

Conclusion

Thus, on the basis of field studies, collection of information on scientific publications and analysis of the herbarium fund, it was found that 17 species of representatives of the genus *Astragalus* L grow on the territory of Betpak-Dala. Ranking by ecological groups and life forms was carried out. Depending on moistening conditions xerophyte species prevail, perennial herbaceous, bushes plants dominate by life form. Species with fodder value were identified.

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Conflict of interest

The authors declare no conflict of interest.

Author contribution

The manuscript was written through contributions of all authors. All authors have given approval to the final version of the manuscript. CRediT: **Turarova Ye.M.** — conceptualization, project administration; investigation, writing, review and editing; **Osmonali B.B.** — methodology, validation, data curation; **Mamurova A.T.** — project administration, supervision.

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Бетпакдала аумағындағы *Cercidotrix* Bunge туыстармағы өкілдерінің экологиялық-географиялық ерекшеліктері

Мақалада алғаш рет Бетпакдала аумағындағы *Cercidotrix* Bunge тармағының түр құрамы мен географиялық таралуы туралы деректер жүйелендіріліп, нақтыланды. Бұл зерттеу гербарий коллекция қорларының (AA, MW, LE, TASH) талдауы мен қазіргі өрістік бақылауларға негізделген. Зерттеудің ғылыми жаңалығы әдеби деректер мен гербарий материалдарын интеграциялау арқылы Бетпакдала шөл экожүйесіндегі *Cercidotrix* Bunge өкілдерінің экологиялық-географиялық ерекшеліктерін нақтылау, бұл олардың биоалуантүрлілігін және экологиялық сипаттарын тереңірек бағалауға мүмкіндік береді. Жүргізілген экологиялық-географиялық талдау көрсеткендей, *Astragalus* L. туысына қатысты деректерді жинау және жүйелеу алғаш рет Бетпакдалада және жалпы Қазақстан аумағында жүзеге асырылды.

Кілт сөздер: *Astragalus*, *Cercidotrix*, Бетпакдала, экология, география, гербарий, тіршілік формасы, экологиялық топ.

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Эколого-географические особенности представителей рода *Cercidotrix* Bunge, встречающихся на территории Бетпакдалы

В настоящей работе впервые систематизированы и уточнены данные о видовом составе и географическом распространении представителей подрода *Cercidotrix* Bunge на территории Бетпакдалы на основе анализа гербарных коллекций (AA, MW, LE, TASH) и современных полевых наблюдений. Научная новизна исследования заключается в интеграции литературных источников и гербарных данных для уточнения эколого-географических характеристик представителей *Cercidotrix* Bunge в пустынной экосистеме Бетпакдалы, что позволяет глубже оценить их биоразнообразие и экологические особенности. Проведенный анализ эколого-географических данных рода *Astragalus* L. показывает, что сбор и систематизация информации выполнены впервые как для Бетпакдалы, так и для территории Казахстана в целом.

Ключевые слова: *Astragalus*, *Cercidotrix*, Бетпакдала, экология, география, гербарий, жизненная форма, экологическая группа.

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