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Checklist of rare plants of the flora Ulytau Region

In the article a list and a brief analysis of rare plants of the flora of Ulytau region, listed in the Red Book of Kazakhstan was presented. According to the conducted researches 20 species of rare plants included in the Red Book of Kazakhstan are registered in Ulytau region: *Adonis volgensis, Anabasis turgaica, Astragalus krascheninnikovii, Crambe tataria, Craniospermum subvillosum, Dactylorhiza fuchsii, Ledebouriella seseloides, Oxytropis subverticillaris, Pulsatilla patens, Silene betpakdalensis, Spiraeanthus schrenkianus, Stipa pennata, Tanacetum ulutavicum, Tulipa albertii, Tulipa biebersteiniana, Tulipa biflora, Tulipa borszczowii, Tulipa patens, Tulipa suaveolens, Valeriana chionophila*. We propose to exclude 5 species (*Crambe tataria, Pulsatilla patens, Stipa pennata, Tulipa biebersteiniana* and *Tulipa patens*) from the Red Data Book of Kazakhstan, as they do not need protection. We consider it is necessary to include in the next edition of the Red Data Book of Kazakhstan 8 species of narrow-local endemics growing only in Ulytau region: *Astragalus krascheninnikovii, Clausia kasakhorum, Gagea sarysuensis, Hedysarum ulutavicum, Seseli betpakdalense, Seseli mironovii, Silene anisoloba, Thymus crebrifolius*.

Keywords: Kazakhstan, Asia, biodiversity, endemism, rare plants, Red Book.

Introduction

Red Data Books have become a “tool” for inventorying rare and endangered species, scientific and legal foundation for their protection, environmental awareness and education of the population. The problem of studying and preserving rare plant species is urgent, timely both at the national and regional levels [1].

There are about 5,658 higher vascular plants in the flora of Kazakhstan [2], of which 370 species are listed in the Red Book of Kazakhstan [3]. One of the interesting places of floral diversity is the Kazakh Uplands, where 2,100 species of higher vascular plants from 557 genera belonging to 126 families grow [4]. The Kazakh Uplands is located on the vast Kazakh shield and is represented by low, strongly dissected mountain ranges rising above the smoothed surface of the Mesozoic peneplain [5]. In the north, the uplands passes into the West Siberian lowland, in the northeast into the wide Irtysh valley, and in the west and southwest it is bordered by the young Neogene plateaus of Turgai and the southern part of Betpakdala, in the south it is bordered by the lake basin. Balkhash, in the southeast and east, rests on the Altai and Tarbagatai mountains. It is part of the Ural-Mongolian geosynclinal belt [4].

One of the unique geographical points in the Kazakh Uplands are the Ulytau mountains (Ulytau district, Ulytau region), which, on the one hand, are a little-studied floral area, on the other hand, have prospects for active development as a tourist and recreational territory. The Ulytau State National Natural Park has been created on the territory of the Ulytau Mountains, occupying 54.46 thousand hectares, or 28.2 % of the territory surveyed by us. The Ulytau Mountains are the geographical center of the Republic of Kazakhstan, they are distinguished by unique geomorphological structures, including both forest and steppe, meadow [6].

More than 819 species of higher vascular plants from 89 families and 366 genera grow in the flora of the Ulytau Mountains. On the territory of Bolshoy Ulytau, there are 5 narrow–localized endemes (*Anabasis turgaica, Clausia kasakhorum, Lepidium eremophilum, Tanacetum ulutavicum, Thymus crebrifolius*), 6 endemic species of Kazakh smallmouth (*Astragalus kasachstanicus, Atraphaxis decipiens, Erysimum kazachstanicum, Gagea sarysuensis, Lappula rupestris, Thymus eremita*), 7 species — endemic and subendemic to Kazakhstan: *Artemisia albicerata, Gypsophila rupestris, Serratula dissecta, Silene anisoloba, S. balchaschensis, Thymus kirgisorum*, *Th. rasitatus*. The 8 species are included in the “Red Book of Kazakhstan”: *Adonis wolgensis, Anabasis turgaica, Craniospermum echioides, Stipa pennata, Tanacetum ulutavicum, Tulipa biebersteiniana, Tulipa patens, Tulipa schrenkii* [7].

The main objective of this study was to conduct an inventory of rare plants in the Ulytau Region and to compile a modern list of rare species of this region.

Experimental

Ulytau region is located in the central part of Kazakhstan, with its administrative center in the city of Zhezkazgan. The oblast was formed relatively recently — on June 8, 2022. Ulytau region borders with Kostanay region in the north, Karaganda region in the northeast and east, Zhambyl region in the southeast, Turkestan and Kyzylorda regions in the south, and Aktobe region in the west. This study makes an inventory of rare plants listed in the Red Book of Kazakhstan [3].

The research is based on the results of field studies and literature data, as well as materials from herbarium collections LE, MW, AA and NUR.

Life form, rarity category, ecological habitat and occurrence are given for each species. Rarity categories are given according to the Red Data Book of Kazakhstan [3]. The frequency of occurrence of the species was assessed according to four gradations: "usually" — species grows ubiquitously in most suitable habitats; "occasionally" — the plant occurs sporadically not throughout the territory, but is regularly identified in certain ecotopes; "rarely" — species noted sporadically in some floristic areas; "very rarely" — one to three locations are known throughout the Ulytau region [8]. Genera and species are listed in alphabetical order. Latin names of species were checked against international plant databases [9, 10].

Results and Discussion

According to the results of the research, it was found that in Ulytau region there are 20 species of rare plants listed in the Red Book of Kazakhstan [3]. Of these, 9 species are classified as III category of rarity, 8 species as II category, 2 species as I category, and 1 species as IV category. Analysis of life forms showed that of all rare species of Ulytau region, only one shrub (*Spiraeanthus schrenkianus* Maxim.) and one semi-shrub (*Silene betpakdalensis* Bajt.) were noted, all other species are herbaceous perennials (Table).

T a b l e

List of rare plants of Ulytau Region included in the Red Book of Kazakhstan

No	Plant name	Rarity category	Life form
1	*Adonis volgensis* Steven ex DC.	III	Perennial
2	*Anabasis turgaica* Iljin & Krasch.	III	Perennial
3	*Astragalus krascheninnikovii* Kamelin (=*Astragalus kokaschiki* Gamajun.)	I	Perennial
4	*Crambe tataria* Sebeok	II	Perennial
5	*Craniospermum subvillosum* Lehm. (=*Craniospermum echioides* (Schrenk) Bunge).	II	Perennial
6	*Dactylorhiza fuchsii* (Druce) Soo	II	Perennial
7	*Ledebouriella seseloides* (Hoff m.) H. Wolff	II	Perennial
8	*Oxytropis subverticillaris* C.A. Mey.	III	Perennial
9	*Pulsatilla patens* (L.) Mill.	II	Perennial
10	*Silene betpakdalensis* Bajt.	II	Semi-shrub
11	*Spiraeanthus schrenkianus* Maxim.	III	Shrub
12	*Stipa pennata* L.	III	Perennial
13	*Tanacetum ulutavicum* Tzvelev	III	Perennial
14	*Tulipa albertii* Regel	II	Perennial
15	*Tulipa biebersteiniana* Schult. et Schult. f.	III	Perennial
16	*Tulipa biflora* Pall.	I	Perennial
17	*Tulipa borszczowii* Regel	II	Perennial
18	*Tulipa patens* Agardh. ex Schult. et Schult. f.	III	Perennial
19	*Tulipa suaveolens* Roth	III	Perennial
20	*Valeriana chionophila* Popov & Kult.	IV	Perennial

Below is an outline of rare plants of Ulytau region included in the Red Book of Kazakhstan:

1. *Adonis volgensis* Steven ex DC. Perennial. Declining species (III category) [3]. Grows in grassy-typchak and grassy steppes. Occurs rarely.

Note. *Adonis volgensis* has a relatively wide distribution in Kazakhstan, the species is found in Central, Northern and Eastern Kazakhstan. The state of *A. volgensis* populations in Northern Kazakhstan is stable, which is ensured by good seed reproduction [11].

2. *Anabasis turgaica* Iljin & Krasch. Perennial. A rare species numbers of which are decreasing catastrophically fast, which may put it at risk of extinction (Category III) [3]. Occurs rarely.

Note. *Anabasis turgaica* is a narrowly localized endemic of the Ulytau Mountains [12], practically the only herbaceous species among the genus Anabasis. This species is characterized by a thickened caudex, from which branching herbaceous shoots depart [7].

3. *Astragalus krascheninnikovii* Kamelin (=*Astragalus kokaschiki* Gamajun.). Perennial. Rare species (category I) [3]. Grows along the edges of dry watercourses in clay desert. Occurs rarely.

Note. This species is a narrow local endemic of Betpakdala [12], known from Kokashi tract, Zhanaarka district, Ulytau region (classical location of the name *Astragalus kokaschiki*) and 40-50 km from Lake Tailykol, in the valley of the Sarysu River (classical location of the name *Astragalus krascheninnikovii*).

4. *Crambe tataria* Sebeok. Perennial. Rare species (II category) [3]. Grows along roadsides. Occurs occasionally.

Note. Prior to the 90s of the XX century, the plant was not found on the territory of the Kazakh Shallow Soil. All modern herbarium collections were made along the Karaganda-Zhezkazgan highway. Most likely, the species "escaped" from the culture. For a long time, *C. tataria* was cultivated in the Karaganda Botanical Garden and recommended as an ornamental plant [4].

5. *Craniospermum subvillosum* Lehm. (=*Craniospermum echioides* (Schrenk) Bunge). A very rare species (category II) [3]. Grows on rocky and rubbly slopes of hills. It occurs rarely.

Note. *Craniospermum echioides* was considered endemic to Kazakhstan. However, later information appeared about its distribution in Dzungaria, in Southwestern Mongolia and Northwestern China [13]. According to the latest international classification [10], *Craniospermum echioides* is recognized as a synonym of *Craniospermum subvillosum*.

6. *Dactylorhiza fuchsii* (Druce) Soo. Perennial. A rare species, occurring in small numbers in a small area (category II) [3]. It grows in forest meadows, forest edges and shrubs, on the banks of rivers and streams. It occurs rarely.

Note. *Dactylorhiza fuchsii* is morphologically similar to *Dactylorhiza maculata*. When they co-occur, they form populations that include plants with intermediate morphology, indicating possible hybridization. We consider that *Dactylorhiza maculata* is generally a European species, with only isolated occurrences in Asia, particularly in the western part of Siberia and in Kazakhstan. Determining the exact eastern distribution limit of this species is challenging due to its similarity with *D. fuchsii* in this region, where their ranges overlap [14].

7. *Ledebouriella seseloides* (Hoff m.) H. Wolff. Perennial. Rare species (II category) [3]. Grows on rubbly slopes of hills. Occurs very rarely.

Note. In Ulytau region was found in Aktau mountains: "Kazakhstan, Dzhezkazgan region, east of Atasu, Aktau mountains, 26.06.1991, M.G. Pimenov, E.V. Kluikov (MW0861099)". The species was described from East Kazakhstan. Type species: "Altai in campis et collibus siccis lapidosis ad montam Tschingistau, 08.1826, Ledebour 226" (LE). According to the international classification, this species is considered a synonym of *Saposhnikovia divaricata* (Turcz. ex Ledeb.) Schischk. [10]. Additional studies are needed to establish the taxonomic position of this species using modern molecular genetic methods.

8. *Oxytropis subverticillaris* C.A. Mey. Perennial. Species with rapidly decreasing range (III category) [3]. Occurs rarely.

Note. *Oxytropis subverticillaris* is morphologically close to *Oxytropis rhynchophysa* [15]. Z.V. Karamysheva and E.I. Rachkovskaya (1973) give priority to the name *Oxytropis subverticillaris* for the Kazakh Uplands, because *Oxytropis subverticillaris* was described from a single specimen in the phase of secondary flowering. J.U. Baimukhambetova (1989), who studied the type material of these species, concluded that they are identical and, taking into account the priority, the name *Oxytropis subverticillaris* should be left [4].

9. *Pulsatilla patens* (L.) Mill. Perennial. Rare species (II category) [3]. Grows in steppes and on slopes of hills. Occurs commonly.

Note. The intraspecific structure of *P. patens* is extremely complex and confusing. In Central and Northern Kazakhstan, *P. patens* with purple and yellow coloration of perianth petals, which were previously attributed to different species, are observed. Plants with purple flowers were referred to *P. patens* and with yellow flowers to *Pulsatilla uralensis* (Zămels) Tzvel. (=*Pulsatilla flavescens* (Zuccar.) Juz.) [4]. Currently, it is necessary to conduct systematic studies of the *P. patens* complex of Northern and Central Kazakhstan using molecular genetic methods. It should be noted that in Central Kazakhstan plants with purple flowers

predominate, and in Northern Kazakhstan plants with yellow flowers predominate [16]. In this area, the ranges of the two species overlap, and transitional populations with common taxonomic characters are formed.

10. *Silene betpakdalensis* Bajt. Semishrubby shrub. Very rare species (II category) [3]. Grows on rubbly-melkozem slopes of hills and foothill plains. Occurs very rarely.

Note. In Ulytau region one locality of this species is known 100 km south of Zhezkazgan city (KUZ) [4]. The plant is described from the Chu-Ili Mountains: "Prov. Almatansis, montes Tschu-Iliensis, fl. Anda-Ssaj in decliviis saxosis, 26 VI 1954, fl. et fr. Immat., lg. M. Bajtenov" (AA).

11. *Spiraeanthus schrenkianus* Maxim. Shrub. Rare species with a decreasing range (III category) [3]. Grows on clay slopes of hills. Occurs very rarely.

Note. In Ulytau region one locality of *Spiraeanthus schrenkianus* is known in Northern Betpakdala: Zhanaarkinsky district, Northern Betpakdala, vicinity of Zhuantobe Mountain, 46°26'N, 70°28'E, 17 VII 2011, A. Kupriyanov, O. Kupriyanov. Kupriyanov, O. Kupriyanov (KUZ, KAZ 01474). Single plants, small groups of bushes are found in the territory of the Kazakh Uplands, the main part of the Betpakdala population is located to the south in Central Betpakdala [4]. *Spiraeanthus schrenkianus* is a rare and endemic species that deserves special attention [12]. It is one of the oldest plants of our planet. It probably grew here in the Eocene, about 40 million years ago, during climate aridization, forming the oldest shrub-steppe communities [17].

12. *Stipa pennata* L. Perennial. Species with decreasing abundance (III category) [3]. Grows on slopes of hills mainly from the northern side, on steppe hollows, in bushes. Occurs usually.

Note. At present, this species does not need State protection, as the species occupies vast areas in Kazakhstan. The species was included in the Red Data Book of Kazakhstan due to extensive plowing of virgin lands in Northern and Central Kazakhstan, as well as other anthropogenic impacts.

13. *Tanacetum ulutavicum* Tzvelev. Perennial. Reducing in number species (III category) [3]. Grows in cracks in granite rocks. Occurs rarely.

Note. *Tanacetum ulutavicum* is a narrow-local endemic of the Ulytau Mountains [12]. The species was described from the Ulutau Mountains: "Karaganda region, middle part of Karsakpai district, slope of Kazan-Tau mountain, 12 km south of Ulutavicum, 12 VII 1929, n 298, N. Shipchinsky" (LE). This species is morphologically close to *Tanacetum achilleifolium* and *T. millefolium*, in relation to which it is a narrowly endemic race confined to rocky and stony habitats [4].

14. *Tulipa albertii* Regel. Perennial. Rare species (II category) [3]. Grows on rubbly and fine-grained slopes, screes and low mountains. Occurs occasionally.

Note. *Tulipa albertii* is endemic to Kazakhstan [12]. In Ulytau oblast there is the northernmost border of the range of this species.

15. *Tulipa biebersteiniana* Schult. et Schult. f. Perennial. Reducing in number species (III category) [3]. Grows in steppe, on forest edges, among shrubs, along river valleys. Occurs rarely.

Note. *Tulipa biebersteiniana* was described in 1829 from specimens from the North Caucasus (between Mozdok and Kizlyar). The species was named in honor of the Russian botanist F.K. Bieberstein-Marshall. Some systematists refer *T. biebersteiniana* and *T. patens* to synonyms of the widespread in Europe *T. sylvestris* subsp. *Australis* [18, 19]. However, according to Zonneveld (2009), the difference in DNA content between *T. biebersteiniana* and *T. sylvestris* may be a basis for recognizing *T. biebersteiniana*.

16. *Tulipa biflora* Pall. Perennial. Endangered species (category I) [3]. Grows on stony and rubbly slopes of hills. Occurs occasionally.

Note. The species was described in 1776 by P.S. Pallas based on specimens from the Caspian deserts. Location of type specimens is unknown. According to the latest system of the genus Tulipa [18], many species from sect. Biflores A.D. Hall ex Veldkamp & Zonn. are considered synonyms of the *T. biflora* s.l. complex, including *T. buhseana* and *T. sogdiana*. Currently, systematic studies of *T. biflora* s.l. group should be carried out using modern molecular research methods.

17. *Tulipa borszczowii* Regel. Perennial. Rare species (II category) [3]. Grows in sandy massifs, along loess plumes of desert hills and chinks. Occurs rarely.

Note. The main areal of this species is located in the Aral deserts and in the northern part of the Kyzylkum desert [20]. The northernmost limit of the range of this species is located in the Ulytau region.

18. *Tulipa patens* Agardh. ex Schult. et Schult. f. Perennial. Rare, decreasing in number, species (III category) [3]. Grows in dry sagebrush steppes, in steppe meadows, on rubbly slopes, solonetz meadows and solonets, in interfold gulleys. Occurs usually.

Note. The taxonomic position of *Tulipa patens* is relatively controversial, some authors [18, 19] refer it synonymously to *T. sylvestris* subsp. *australis*. Other authors [21, 22, 23] consider this species as an independent taxon. We also believe that *Tulipa patens* deserves recognition on the basis of a complex of morphological characters and ecology.

19. *Tulipa suaveolens* Roth (=*Tulipa schrenkii* Regel.). Perennial. Decreasing in number species. III category. Grows in steppes, deserts and semi-deserts, on plains and foothills. Occurs rarely.

Note. The species is usually known as *Tulipa schrenkii*, which was described from the Esil River valley in 1873. However, the older name *Tulipa suaveolens* takes precedence [18]. The main range of the species within the Kazakh Shallow Soil is in the extreme west, and in the east, it reaches the Aktau-Shunak Mountain junction [4].

20. *Valeriana chionophila* Popov & Kult. Perennial. Insufficiently studied species (IV category) [3]. Grows in the semi-desert plain on loamy soils. Occurs rarely.

Note. *Valeriana chionophila* is given for the first time for Ulytau region. The species was found in Ulytau region, near Surguti, Kubentaev S.A., Alibekov D.T., 04.04. 2024 (NUR). The new location is the northernmost limit of the range of this species. Earlier this species was first found in Karaganda region, in Targyl mountains, near Gulshat, Kubentaev S.A., Alibekov D.T., 15.04. 2021 (NUR).

According to our long-term field research and literature analysis, we propose to exclude the following species from the Red Data Book of Kazakhstan: C*rambe tataria, Pulsatilla patens, Stipa pennata, Tulipa biebersteiniana* and *Tulipa patens*. According to our data, these species do not need protection, because they are often found in different regions of Kazakhstan, sometimes in large areas and with high abundance. In addition, *Crambe tataria* in Ulytau region is an adventive species that occupies disturbed communities, which is also a reason for its exclusion from the Red Data Book of Kazakhstan.

The territory of Ulytau region served as a corridor of species migration from north to south and from east to west for a long historical period. Therefore, endemism in this territory is weakly expressed. However, the isolation of the Ulytau Mountains both in the Paleozoic and Quaternary periods led to the preservation of some paleo and neo-endemics [4]. On the territory of Ulytau region there are 6 species of narrow-local endemics growing exclusively only in this region, such as: *Anabasis turgaica* Iljin & Krasch., *Astragalus kraschenninnikovii* Kamelin, *Clausia kasakhorum* Pavlov, *Gagea sarysuensis* Murz., *Hedysarum ulutavicum* Knjaz, *Seseli betpakdalense* Bajtenov, *Seseli mironovii* (Korovin) Pimenov & Sdobnina, *Silene anisoloba* Schrenk, *Tanacetum ulutavicum*, *Thymus crebrifolius* Klokov. Of these plants, 5 species (*Clausia kasakhorum*Pavlov, *Anabasis turgaica*Iljin & Krasch*, Hedysarum ulutavicum* Knjaz*., Tanacetum ulutavicum* Tzvelev, *Thymus crebrifolius* Klokov) are found only in the Ulytau Mountains. Three species (*Astragalus kraschenninnikovii* Kamelin*, Seseli betpakdalense* Bajt*., Seseli mironovii* (Korovin) Pimenov & Sdobnina) occur only in Betpakdal. Of all narrow local endemics growing exclusively in Ulytau region, only *Anabasis turgaica* and *Tanacetum ulutavicum* are protected at the State level. At present, it is necessary to study the state of populations, abundance and distribution of other narrow-local endemics of Ulytau region. We consider it necessary to include the following endemic species in the next edition of the Red Data Book of Kazakhstan: *Astragalus kraschenninnikovii, Clausia kasakhorum, Gagea sarysuensis, Hedysarum ulutavicum, Seseli betpakdalense, Seseli mironovii, Silene anisoloba, Thymus crebrifolius*.

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Ұлытау облысы флорасының сирек өсімдіктерінің тізімі

Мақалада Қазақстанның Қызыл кітабына енген Ұлытау өңірінің сирек кездесетін өсімдіктерінің тізімі мен қысқаша талдауы берілген. Жүргізілген зерттеулерге сәйкес, Ұлытау өңірінде Қазақстанның Қызыл кітабына енген сирек кездесетін өсімдіктердің 20 түрі тіркелген, атап айтсақ: *Adonis volgensis, Anabasis turgaica, Astragalus krascheninnikovii, Crambe tataria, Craniospermum subvillosum, Dactylorhiza fuchsii, Ledebouriella seseloides, Oxytropis subverticillaris, Pulsatilla patens, Silene betpakdalensis, Spiraeanthus schrenkianus, Stipa pennata, Tanacetum ulutavicum, Tulipa albertii, Tulipa biebersteiniana, Tulipa biflora, Tulipa borszczowii, Tulipa patens, Tulipa suaveolens, Valeriana chionophila*. Оның ішінде 5 түр (*Crambe tataria, Pulsatilla patens, Stipa pennata, Tulipa biebersteiniana* және *Tulipa patens*) қорғауды қажет етпейтіндіктен Қазақстанның Қызыл кітабынан шығаруды ұсынамыз. Қазақстанның Қызыл кітабының келесі басылымына Ұлытау өңірінде ғана өсетін *Astragalus krascheninnikovii, Clausia kasakhorum, Gagea sarysuensis, Hedysarum ulutavicum, Seseli betpakdalense, Seseli mironovii, Silene anisoloba, Thymus crebrifolius* сияқты жіңішке жапырақты эндемиктердің 8 түрін енгізуді қажет деп санаймыз.

Кілт сөздер: Қазақстан, Азия, биоәртүрлілік, эндемизм, сирек өсімдіктер, Қызыл кітап.

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Чек-лист редких растений флоры Улытауской области

В статье представлены список и краткий анализ редких растений флоры Улытауской области, занесенных в Красную книгу Казахстана. Согласно проведенным исследованиям, в Улытауской области зарегистрировано 20 видов редких растений, занесенных в Красную книгу Казахстана: *Adonis volgensis, Anabasis turgaica, Astragalus kraschenninnikovii, Crambe tataria, Craniospermum subvillosum, Dactylorhiza fuchsii, Ledebouriella seseloides, Oxytropis subverticillaris, Pulsatilla patens, Silene betpakdalensis, Spiraeanthus schrenkianus, Stipa pennata, Tanacetum ulutavicum, Tulipa albertii, Tulipa biebersteiniana, Tulipa biflora, Tulipa borszczowii, Tulipa patens, Tulipa suaveolens, Valeriana chionophila*. Из них 5 видов (*Crambe tataria, Pulsatilla patens, Stipapennata, Tulipa biebersteiniana* и *Tulipa patens*) предлагаем исключить из Красной книги Казахстана, поскольку они не нуждаются в охране. Считаем необходимым включить в следующее издание Красной книги Казахстана 8 видов узколокальных эндемиков, произрастающих только в Улытауской области: *Astragalus kraschenninnikovii, Clausia kasakhorum, Gagea sarysuensis, Hedysarum ulutavicum, Seseli betpakdalense, Seseli mironovii, Silene anisoloba u Thymus crebrifolius*.

Ключевые слова: Казахстан, Азия, биоразнообразие, эндемизм, редкие растения.

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