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CURRENT DISTRIBUTION OF THE SPECIES *EREMURUS ROBUSTUS* AND *E. TIANSCHANICUS*

The article presents the results of the study of the genus *Eremurus* of the family *Asphodelaceae*, which includes more than 70 species of perennial herbaceous plants with thickened roots and root leaves. According to «Flora of Kazakhstan», 13 species of the genus are registered in Kazakhstan, but according to M.S. Baitenov, their number reaches 15 species. Areal of the genus covers Western Asia and Iran-Turan region, with the greatest species diversity in the south of Central Asia. The aim of the study was to identify the current distribution of species of *Eremurus robustus* and *E. tianschanicus*, which will help further research work will facilitate further field research. Literature sources were screened and more than 130 herbarium specimens from major collections (AA, TASH, LE, MW) from 1988 to 2024 were reviewed. Based on the collected data, a distribution map of species of the genus *Eremurus robustus* and *E. tianschanicus* was compiled. We have determined the ranges of the studied species according to the Botanical-geographical zoning of Kazakhstan and Central Asia: *Eremurus robustus* has the following range: Region – Saharo-Gobian, Subregion – Irano-Turanian, Province – Mountain-middle – Asian – Dzungarian – Dzungaro-North Tianshan; *Eremurus tianschanicus* has the following range: Region – Saharo-Gobian, Subregion – Irano-Turanian, Province – Mountain-middle – Asian – Dzungaro-North Tianshan.

Keywords: *Asphodelaceae*, *Eremurus*, range, floristic regions, ecology.

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Eremurus robustus және *E. tianschanicus* түрлерінің қазіргі таралуы

Мақалада *Asphodelaceae* тұқымдасына жататын *Eremurus* туысына жүргізілген зерттеу нәтижелері ұсынылған. Бұл туысқа жуандаған тамырлары мен түп жапырақтары бар 70-тен астам көпжылдық шөптесін өсімдіктер жатады. «Қазақстан флорасы» деректеріне сәйкес, Қазақстанда бұл туыстың 13 түрі тіркелген, алайда М.С. Байтеновтің мәліметтері бойынша олардың саны 15 түрге жетеді. Бұл туыстың таралу аймағы Батыс Азия мен Иран-Тұран облысын қамтиды, ал түрлік алуантүрлілігі ең жоғары аймақ – Орталық Азияның оңтүстігі. Зерттеудің мақсаты – *Eremurus robustus* және *E. tianschanicus* түрлерінің қазіргі кездегі таралуын анықтау. Бұл мәліметтер аталған түрлерге қатысты болашақ далалық зерттеу жұмыстарына негіз болады. Жұмыс барысында 1988 жылдан 2024 жылға дейінгі кезеңдегі әдеби деректерге шолу жасалып, ірі гербарий қорларындағы (AA, TASH, LE, MW) 130-дан астам үлгілер қарастырылды. Жиналған деректер негізінде *Eremurus robustus* және *E. tianschanicus* түрлерінің таралу картасы жасалды. Зерттелген түрлердің таралу аймақтары Қазақстан мен Орталық Азияның ботаникалық-географиялық аудандастырылуына сәйкес анықталды: *Eremurus robustus* түрінің таралу аймағы: Аймақ – Сахара – Гоби, Ішінара аймақ – Иран-Тұран, Провинция – Таулы Орталық Азия (Жетісу-Солтүстік Тянь – Шань); *Eremurus tianschanicus* түрінің таралу аймағы: Аймақ – Сахара – Гоби, Ішінара аймақ – Иран – Тұран, Провинция – Таулы Орталық Азия (Жетісу-Солтүстік Тянь-Шань).

Түйін сөздер: *Asphodelaceae*, *Eremurus*, ареал, флористикалық аудандар, экология.

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Современное распространение видов *Eremurus robustus* и *E. tianschanicus*

В статье представлены результаты исследования рода *Eremurus* семейства *Asphodelaceae*, включающего более 70 видов многолетних трав с утолщенными корнями и прикорневыми листьями. Согласно «Флоре Казахстана», в Казахстане зарегистрировано 13 видов рода, однако по данным М.С. Байтенова, их количество достигает 15 видов. Ареал рода охватывает Западную Азию и Ирано-Туранскую область, с наибольшим видовым разнообразием на юге Средней Азии. Целью исследования являлось выявление современного распространения видов *Eremurus robustus* и *E. tianschanicus*, что позволит проводить последующие полевые исследования. В ходе работы был осуществлен скрининг литературных источников и просмотр более 130 гербарных образцов из крупных фондов (AA, TASH, LE, MW) за период с 1988 по 2024 гг. На основе собранных данных составлена карта распространения видов рода *Eremurus robustus* и *E. tianschanicus*. Нами определены ареалы изучаемых видов в соответствии с ботанико-географическим районированием Казахстана и Средней Азии: *Eremurus robustus* обладает следующим ареалом: Область – Сахаро-гобийская, Подобласть – Ирано-туранская, Провинция – Горносредная – Азиатская – Джунгарская – Джунгаро-Северотяньшанская; *Eremurus tianschanicus* обладает следующим ареалом: Область – Сахаро-гобийская, Подобласть – Ирано-туранская, Провинция – Горносредная – Азиатская – Джунгаро-Северотяньшанская.

Ключевые слова: *Asphodelaceae*, *Eremurus*, ареал, флористические районы, экология.

Introduction

Genus *Eremurus* M. Bieb. – is a perennial herbaceous plant of the family *Asphodelaceae*, includes about 70 species. Its main range is the mountain steppes of Central and Eastern Asia; it is also found in the Crimea, Caucasus, and Western Siberia. The first description was given by P. Pallas in 1733. Since the 1860s, *Eremurus* has been cultivated in botanical gardens in Russia and Europe [1,3].

In 1819, M. Biberstein isolated *Eremurus* (*E. spectabilis*). In 1842, Karelin and Kirillov isolated *Ammolirion* and *Henningia*. Regel (1868) included 4 species of *Henningia*, but Fedchenko (1906) refuted *H. aucheriana*. In the late 19th century Baker described new species from Persia and Afghanistan, some of them synonyms. In 1921 Fedchenko described *E. baissunensis*, in 1932 Popov mentioned *E. copetdaghensis*, in 1923 with Vvedensky – *E. hilariae*, in 1928 Vvedensky isolated *E. regelii*, in 1935 Fedchenko – *E. korovinii* and *E. saprjagajevii* [4,6].

In Kazakhstan, according to «Flora of Kazakhstan», the genus includes 13 species, according to M.S. Baitenov – 15, among which endemics *E. hilariae* and *E. anisopterus* [7,11]. *Eremurus* are valued as ornamental plants with large inflorescences, used for bio-oils, glue and have medical potential [12]. Foreign scientists conducted studies on mor-

phology, phylogeny and phytochemistry of Central Asian representatives of the genus [13,17].

In Russia, acetyl groups in the roots of *Eremurus zangezuristicus* were studied [18]. Chinese scientists conducted studies on pollination of *E. anisopterus*, characteristics of a new galactomannan from its roots, chemical composition, gynomonoecey and population structure in different territories [19,23]. The phytochemistry of *E. altaicus* within its Chinese range was also studied [24].

Iranian specialists performed a review of *Eremurus* species, including phytochemistry, pharmacology and traditional uses, and also conducted specialized studies of *E. luteus* roots [25,27]. In Kazakhstan, the study of species of the genus *Eremurus* of the natural flora has not been studied so far. Separate works on this group concerned the issues of introduction [28]. The more so, multidirectional analysis of species of this genus has not been carried out.

In the conditions of the Zailiysky Alatau, species of *Eremurus robustus* and *E. tianschanicus* have been studied insufficiently. The lack of data on their ecology, structure and distribution complicates the understanding of their role in the ecosystems of the region. The aim of the research is to identify the current distribution of the species *Eremurus robustus* and *E. tianschanicus*, which will help further research work for in the field. These two species

were chosen due to their ecological importance for the region and insufficient study, which makes them promising subjects for research aimed at solving practical problems, such as landscaping and improving the urban environment.

Materials and methods

The objects of the study were the species *Eremurus robustus* and *E. tianschanicus*. *Eremurus*

robustus Regel is a 100-200 cm tall perennial with a bluish smooth stem (up to 2 cm), spindle-shaped roots and linear leaves (3-8 cm). The inflorescence is dense, 40-100 cm long. Flowers are pink or white with a yellow spot, 15-17 mm. Blooms in June-July. *Eremurus tianschanicus* is a perennial plant 50-150 cm tall. Roots are spindle-shaped, leaves are keeled, 0.5-1.2 cm. Inflorescence is narrow, dense. Flowers are pale pink with a yellow spot, 10-12 mm. Flowering period: June-July (Fig. 1).



Figure 1 – Studied species of the genus *Eremurus*

Herbarium specimens from collections of the Institute of Botany and Phytointroduction (AA, Almaty, Kazakhstan), Lomonosov Moscow State University (MW, Moscow, Russia), Komarov Botanical Institute (LE, St. Petersburg, Russia), Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan (TASH, Tashkent, Uzbekistan) were analyzed during the study. The main reference books were used for species identification: «Flora of Kazakhstan», «Determinant of Plants of Central Asia and Kazakhstan» and others [7,29,30]. Latin and Russian names of plants are given according to the databases International Plant Names Index (IPNI, URL: <https://www.ipni.org/>) and Plants of the World Online (POWO, URL: <https://powo.science.kew.org/>). The map was prepared using the QGIS 3.28 program.

Results and discussion

According to «Flora of Kazakhstan», *Eremurus robustus* is found in the foothills and on meadow slopes of mountains up to the subalpine belt. This species can be found in the Zailiysky Alatau, Chuliykiy Mountains, Kyrgyz Alatau and Western Tien Shan. The range covers Central Asia. *Eremurus tianschanicus* grows on wooded foothills and rocky southern slopes of the lower mountain zone. This species is found in the Zailiysky Alatau, Chuliykiy Mountains, Kyrgyz Alatau, Karatau and Western Tien Shan. The general distribution is Central Asia (Table 1). According to the «Central Asia Plant Identifier», *Eremurus robustus* is found in Tien Shan and Pamir-Alai, except Pamir. And *Eremurus tianschanicus* is widespread in the Tien Shan and in

the north-eastern part of Pamir-Alai. On the basis of data on herbarium specimens, a distribution map of species of the genus *Eremurus* (*E. robustus*, *E.*

tianschanicus) was made (Fig. 2,3). Data presented in herbarium collections AA, LE, MW, GBIF, Plantarium (Table 2).

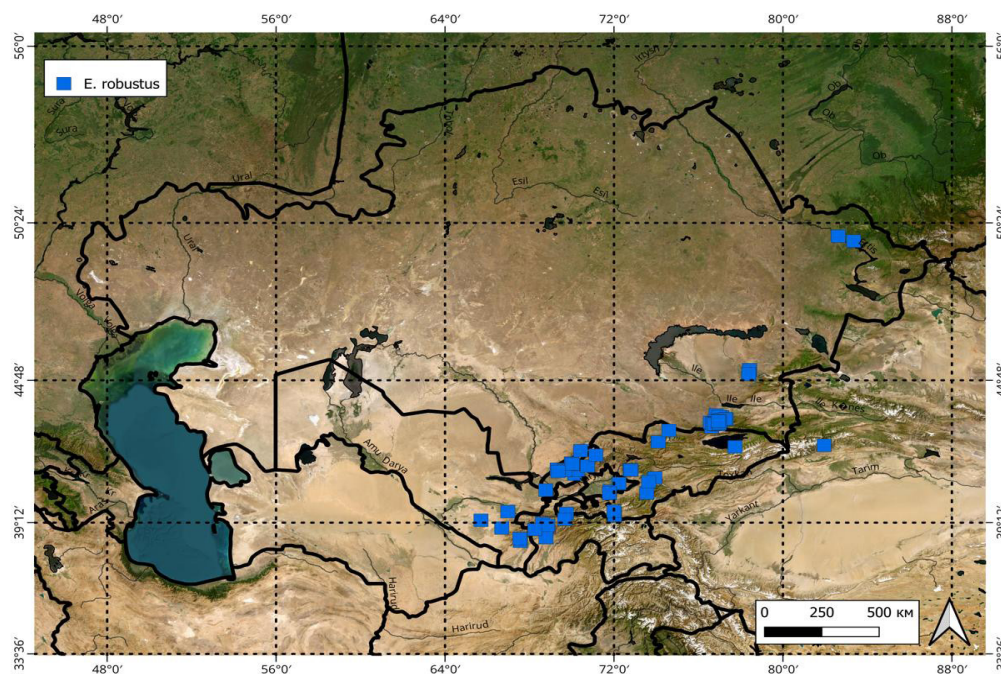


Figure 2 – Distribution map of the species *Eremurus robustus* Regel

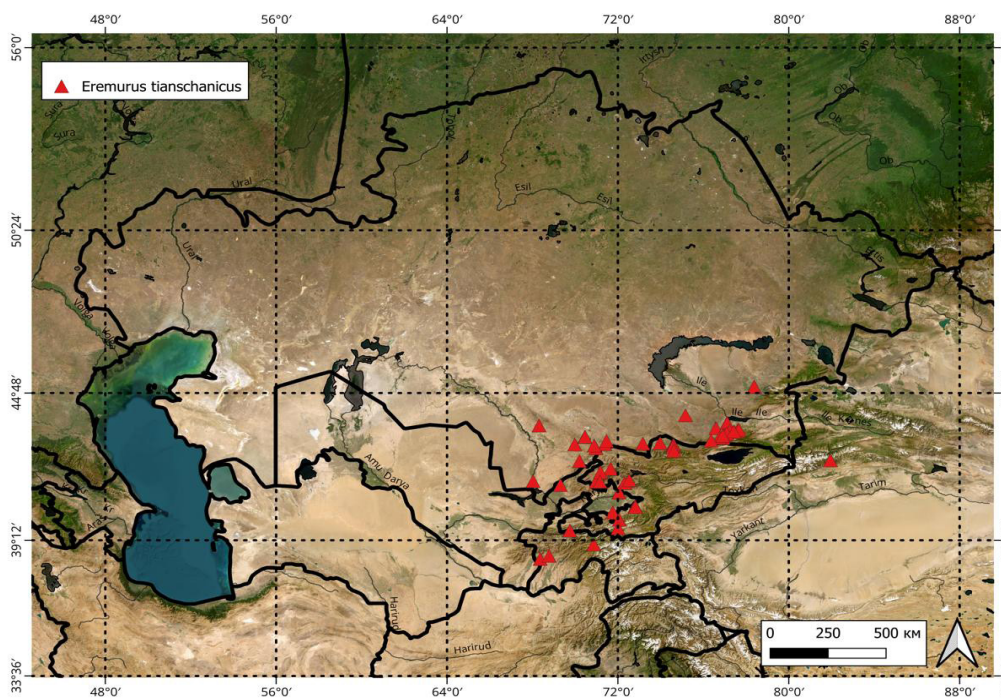


Figure 3 – Distribution map of *Eremurus tianschanicus* Pazij et Vved ex Golos

Table 1 – Representation of herbarium specimens by floristic districts

Species	Floristic district										
	WTSH	DA	ZA	Alt	Lug	Uzb	Tad	Kyr	ChI	KA	Kar
<i>E. r</i>	4	1	46	2	12	32	7	11	-	-	-
<i>E. t</i>	11	-	17	-	-	3	4	21	6	5	5

Note: Data provided in herbarium collections AA, LE, MW, GBIF, Plantarium [8,30]

Table 2 – Representation of two *Eremurus* species in different herbarium collections

GC/Eb	Floristic district										
	WTSH	DA	ZA	Alt	Lug	Uzb	Tad	Kyr	ChI	KA	Kar
<i>E. robustus</i>											
AA	1	1	2	-	-	-	-	-	-	-	2
LE	-	-	8	-	-	10	4	7	-	-	-
MW	2	-	-	-	-	6	4	1	-	-	-
GBIF	-	-	30	-	-	-	-	-	-	-	-
Pl	1	-	6	2	12	16	1	3	-	-	3
<i>E. tianschanicus</i>											
AA	1	-	9	-	-	-	-	-	-	5	-
LE	-	-	-	-	-	-	1	6	-	-	-
MW	2	-	1	-	-	2	1	7	2	-	-
GBIF	6	-	6	-	-	-	-	-	-	-	-
Pl	2	-	1	-	-	1	2	8	4	-	-

Note: Data presented in herbarium collections AA, LE, MW, GBIF, Plantarium [8,30] Designations of floristic areas: WTSH – Western Tien Shan; DA – Dzungarian Alatau; ZA – Zailiysky Alatau; Alt – Altai; Lug – Lugansk; Uzb – Uzbekistan; Tad – Tajikistan; Kyr – Kyrgyzstan; ChI – Chu-Ili Mountains; KA – Kyrgyz Alatau; Kar – Karatau.

Analysis of *Eremurus robustus* distribution based on herbarium data. *Eremurus robustus* occurs in various geographical regions of Central Asia, including the Western Tien Shan, Dzungarian Alatau, Zailiysky Alatau, Altai, Uzbekistan, Tajikistan and Lugansk (cultural plantations). The bulk of the finds are from Kazakhstan, Kyrgyzstan and Uzbekistan, with the greatest concentration of data in the Zailiysky Alatau and adjacent areas.

Geographic distribution. Western Tien Shan: occurs in mountainous areas including the Ugam Range and Chankalo Range. The altitudinal range varies from 1800 m (Pavlov, 1954) to low foothill areas. Dzungarian Alatau: noted in southwestern spurs, mainly in canyons and among shrub thickets (Goloskokov, 1955). Zailiysky Alatau: the most extensive representation of herbarium data from the XIX century (Fedtschenko, 1888-1909) up to modern finds (GBIF, 2024). Occurs at different altitudes, in gorges, slopes, river valleys, and in an-

thropogenic landscapes. Altai: found in culture in Ust-Kamenogorsk, indicating possible introduction of the species. Lugansk: data on cultivation of the species in private farmsteads (Plantarium, 2013-2021). Uzbekistan: recorded in the Fergana Valley, Samarkand region, Chatkal and Gissar ridges, at altitudes of 1500-2860 meters. Predominantly occurs on mountain slopes, among shrub thickets and junipers. Tajikistan: Data from the Gissar Range, including western and south-western spurs, indicate stable presence of the species. Distribution dynamics: herbarium data indicate a significant increase in the number of observations in recent decades, especially due to digital platforms (Plantarium, GBIF). This may indicate both improved monitoring of the species and possible changes in its distribution. Ecological preferences: *Eremurus robustus* prefers mountain slopes, stony and loess soils, and is found among shrub thickets, in foothills and river valleys. The altitudinal range varies from 1000m to 2860m

above sea level. *Eremurus robustus* demonstrates a wide ecological plasticity, occurring in different conditions – from dry foothills to high-mountain meadows. The range of the species covers Central Asia, mainly mountain systems of Tien Shan and Pamir-Alai, with the highest concentration of finds in Zailiysky Alatau. Further research should be aimed at studying the influence of climatic changes on the range and population dynamics of the species. This analysis allows us to better understand the current status of *Eremurus robustus* populations and predict possible changes in its distribution.

Analysis of *Eremurus tianschanicus* distribution on the basis of herbarium data shows that the species is distributed in mountainous areas of Central Asia – Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. The study of herbarium collections from the late XIX century reveals the peculiarities of geography, preferred ecological conditions and dynamics of species occurrence.

Geographical distribution. Western Tien-Shan: In this region *Eremurus tianschanicus* is found on rubbly slopes, canyons and mountain slopes of Karatau. Herbarium specimens have been recorded since 1932, with most finds occurring in the mid-twentieth century (1936, 1948, 1954, 1957, 1958, 1959). Occurrence has been noted at elevations of 1000-1200 m altitude. Modern data confirm its presence in the region, including finds in 2009 (Plantarium). Zailiysky-Kungei Alatau: This region includes foothill and mountainous areas of Almaty Region. Herbarium collections started in 1930, covering loess foothills, Mai-Bulak, Kara-Kastek gorges, Kok-Tyube mountain and Medeo sports complex. The plant is found in the forest belt of mountains, steppes and foothills at altitudes from 1000 to 1930 meters. Recent findings confirm its distribution in the region (2020, 2024). Chu-Ili Mountains: Finds are concentrated in the area of Kuyuk Pass and the vicinity of Zhambyl region. Herbarium collections have been recorded since 1948, in the last decades (2011-2020) the presence of *Eremurus tianschanicus* has been repeatedly confirmed. Kyrgyz Alatau: Collections were made in Merken district, Taldy-Bulak and Merke river valleys. The species was recorded in steppe slopes, foothills and mid-mountains. The data cover the period from 1933 to 1983. Karatau: Findings of the plant belong to the Koksau and Bayaldyr gorges and the Kuyuk Pass. Herbarium data cover the years 1958-2015, confirming the species' stable presence in the region. Kyrgyzstan: A significant data set for Kyrgyzstan covers the northern slopes of the Altai Range, Fergana Range, Ak-Bura, Chu, Yassy, Kara-Suu, Naryn, Aflatun river val-

leys. The altitudes vary from 850 to 2500 m. Findings cover the period from 1947 to 2024, indicating a stable distribution of the species. Tajikistan: The species occurs on the slopes of the Gissar, Darvaz and Turkestan ranges, as well as in the basin of the Obikhingou and Almasy rivers. Herbarium specimens are dated 1962-2017. Uzbekistan: The main finds are on the northern slopes of the Zeravshan Range and in the vicinity of Urgut. Cultivation of the species in the Tashkent Botanical Garden has also been noted (2018). Wide geographical range: *Eremurus tianschanicus* is widespread in mountain systems of Central Asia, preferring rubbly, stony and steppe slopes at altitudes from 850 to 2500 m. Despite its stable presence in the region, the influence of climatic changes and anthropogenic factors requires further study and monitoring of population status. *Eremurus tianschanicus* continues to be an important element of the flora of Central Asia, and its study provides a deeper understanding of the processes of adaptation and spread of plants in mountainous conditions.

In the course of the work 128 herbarium specimens covering materials for the period from 1988 to 2024 were considered. As a result of the analysis, *Eremurus robustus* was found to grow in the following floristic areas: Zailiysky Alatau, Western Tien Shan, Dzungarian Alatau, as well as in the countries of Uzbekistan, Tajikistan and Kyrgyzstan. Gerbar specimens were collected in May and June. The largest number of specimens was collected by the following scientists: A.I. Geld, O. Dubynin, O. Fedchenko and M.G. Popov.

The species *Eremurus tianschanicus* is found in the following areas: Western Tien Shan, Zailiysky and Kungei Alatau, Chu-Iliyskiy Mountains, Kyrgyz Alatau, Karatau, as well as in the countries of Kyrgyzstan, Tajikistan and Uzbekistan. Herbarium specimens were collected during the periods of June-July. Among the scientists who collected the largest number of herbarium specimens of this species are: I.A. Gubanov, M.G. Pimenov, E.V. Kluikov, N.V. Pavlov and L. Chilikina. Distribution points of the species *Eremurus robustus* were found in the Altai and Dzungarian Alatau. Since these regions are not listed in the «Flora of Kazakhstan», this finding is considered a geographical discovery that expands the range of distribution of the studied species.

Conclusion

As a result of detailed analysis of literature sources and study of more than 130 herbarium specimens stored in large herbarium collections (AA,

TASH, LE, MW), the following data were obtained. The studied specimens cover a wide time range from 1888 to 2024, which allowed us to identify changes in the distribution of *Eremurus robustus* and *Eremurus tianschanicus* species in space and time. On the basis of herbarium data, we compiled a detailed distribution map of these species. According to the information presented in the «Flora of Kazakhstan», earlier the ranges of these species were limited to the floristic areas of Zailiysky and Kungei Alatau, Kyrgyz Alatau, Chu-Iliyskiy mountains and Western Tien-Shan. However, the results of our study demonstrate a wider distribution of *Eremurus robustus*, which also occurs in the Altai and Dzungarian Alatau regions, which extends the boundaries of the known range of the species and requires clarification of the existing floristic maps. Taking into account botanical-geographical zoning of Kazakhstan and

Central Asia, we have determined the ranges of these species: *Eremurus robustus*: Region – Saharo-Gobian, Subregion – Irano-Turanian, Province – Mountain Middle Asian – Dzungarian – Dzungaro-North Tianshan; *Eremurus tianschanicus*: Region – Saharo-Gobian, Subregion – Irano-Turanian, Province – Mountain Middle Asian Dzungaro-North Tianshan. The obtained data allow not only to clarify the boundaries of distribution of these species, but also to reveal new localities of their occurrence. This is especially important for further floristic and geobotanical studies, as well as for assessing the state of populations under conditions of changing climate and anthropogenic impact. Monitoring of the population structure of *Eremurus robustus* and *Eremurus tianschanicus* in extended ranges will be a promising area for future research.

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