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NEW LOCALITIES OF RARE FLORA SPECIES IN THE KAZAKH PART OF THE KYRGYZ ALATAU RANGE

The Kyrgyz Alatau, located at the junction of the Northern and Western Tien Shan ranges, forms an ecotonal zone between the Chuy Valley to the north and the Kochkor, Susamyr, and Talas valleys to the south. Its border position between different orographic and climatic regions determines the mosaic nature of landscapes and, consequently, the high diversity of various geo-elements within the flora. According to recent studies, the flora of the Kyrgyz Alatau (within Kazakhstan) includes 1,473 species of vascular plants, belonging to 504 genera and 94 families, which represents almost 50% of the species of the Northern Tien Shan flora as a whole. To date, between 41 and 46 rare species included in the national Red Book have been recorded in the Kazakh (western) part of the range by various authors, five of which are endemic to the Kyrgyz Alatau. Field research conducted in 2022–2025 led to the identification of 15 new localities of rare species in the Kazakh part of the Kyrgyz Alatau. Most species are threatened; however, some taxa, such as *Allium suworowii*, *Celtis caucasica*, *Pyrus regelii*, and *Zabelia corymbosa*, form stable local populations.

The obtained results supplement the information on the distribution and status of populations of rare species in the flora of the western part of the Kyrgyz Alatau and emphasize the need to continue monitoring in this biogeographically significant ecotonal region.

Keywords: Kyrgyz Alatau Range, rare species, flora.

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Қазақстан бөлігіндегі Қырғыз Алатауы жотасының сирек кездесетін флора түрлерінің жаңа таралу нүктелері

Қырғыз Алатауы Солтүстік және Батыс Тянь-Шань жоталарының түйіскен тұсында орналасқан және солтүстігінде Шу алқабы мен оңтүстігінде Қоқор, Сұсамыр және Талас алқаптары арасындағы экотондық аймақ болып табылады. Оның әртүрлі орографиялық және климаттық аймақтар шекарасында орналасуы ландшафттардың мозаикалық құрылымын және нәтижесінде флора құрамындағы әртүрлі геоэлементтердің жоғары әртүрлілігін анықтайды. Қазіргі зерттеулерге сәйкес, Қырғыз Алатауының (Қазақстан аумағында) флорасы 504 тұқымдасқа жататын 1 473 жоғары сатылы өсімдік түрін қамтиды, бұл Солтүстік Тянь-Шань флорасының жалпы түрлерінің шамамен 50%-ын құрайды. Қазіргі таңда жотаның Қазақстандағы (батыс) бөлігінде әртүрлі авторлар республикалық Қызыл кітапқа енген 41–46 сирек кездесетін түрді анықтаған, олардың 5-еуі Қырғыз Алатауына эндемик болып табылады. 2022–2025 жылдары жүргізілген дала зерттеулері Қазақстан бөлігінде сирек кездесетін түрлердің 15 жаңа өсіп шығу нүктесін анықтауға мүмкіндік берді. Көптеген түрлер қауіп-қатер астында болса да, *Allium suworowii*, *Celtis caucasica*, *Pyrus regelii* және *Zabelia corymbosa* сияқты кейбір таксондар тұрақты жергілікті популяцияларды қалыптастырады. Алынған нәтижелер Қырғыз Алатауының батыс бөлігінің флорасындағы сирек кездесетін түрлердің таралуы мен популяция жағдайы туралы мәліметтерді толықтырып, биогеографиялық маңызы бар экотондық өңірде мониторингті жалғастыру қажеттігін атап көрсетеді.

Түйін сөздер: Қырғыз Алатауы жотасы, сирек кездесетін түр, флора.

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Новые местонахождения редких видов флоры казахстанской части хребта Киргизского Алатау

Киргизский Алатау, расположенный на стыке хребтов Северного и Западного Тянь-Шаня, представляет собой экотонную зону между Чуйской долиной на севере и Кочкорской, Сусамырской и Таласской долинами на юге. Его пограничное положение между различными орографическими и климатическими регионами обуславливает мозаичность ландшафтов и как следствие высокое разнообразие различных геоэлементов в составе флоры. Согласно современным исследованиям, флора Киргизского Алатау (в пределах Казахстана) насчитывает 1 473 вида сосудистых растений, относящихся к 504 родам и 94 семействам или почти 50 % от видов флоры Северного Тянь-Шаня в целом. На настоящий момент в казахстанской (западной) части хребта разными авторами отмечено от 41 до 46 редких видов, включённых в республиканскую Красную книгу, 5 из которых являются эндемичными для Киргизского Алатау. Полевые исследования, проведённые в 2022–2025 гг., позволили выявить 15 новых местонахождений редких видов в казахстанской части Киргизского Алатау. Большинство видов находятся под угрозой, однако отдельные таксоны, такие как *Allium suworowii*, *Celtis caucasica*, *Pyrus regelii* и *Zabelia corymbosa* формируют стабильные локальные популяции. Полученные результаты дополняют сведения о распространении и состоянии популяций редких видов флоры западной части Киргизского Алатау и подчёркивают необходимость продолжения мониторинга в этом биогеографически значимом экотонном регионе.

Ключевые слова: хребет Киргизский Алатау, редкий вид, флора.

Introduction

According to the botanical and geographical zoning of Kazakhstan, the Kyrgyz Alatau belongs to the Kyrgyz Mountain subprovince of the Jungar–North Tien Shan province, within the Iran–Turan subregion of the Saharo-Gobi Desert region (Rachkovskaya, 2003). It forms an ecotonal belt that separates the Chuy Valley to the north from the Kochkor, Susamyr, and Talas valleys to the south, situated between the ranges of the Northern and Western Tien Shan.

This border position of the Kyrgyz Alatau between different orographic and climatic regions determines the high mosaic structure of landscapes and the significant diversity of its natural complexes. In turn, this promotes the coexistence in the flora of both distinct geo-elements (desert, steppe, and mountain) and entire floristic complexes, resulting in a high level of botanical diversity and ecotonal character. Therefore, the Kyrgyz Alatau range holds important biogeographical significance, particularly in the context of botanical and geographical zoning.

According to recent data, the flora of the Kyrgyz Alatau comprises at least 1,473 species of vascular plants, belonging to 504 genera and 94 families (Zhaylybayeva, 2024). Of the total number of higher vascular plant species of the Northern Tien Shan

(Baitenov, 1985), 49.9% are represented in the flora of the Kyrgyz Alatau.

Turning to the discussion of the rare species of the Kyrgyz Alatau flora, it should be noted that, according to Mukhtubayeva S.K. (Mukhtubayeva et al., 2017), 41 rare species listed in the Red Book of the Republic of Kazakhstan (Red Data Book of Kazakhstan, 2014) are found in the flora of its Kazakh part. In the dissertation study by T.M. Muratova, “Analysis of the Flora of the Western Part of the Kyrgyz Alatau” (Zhaylybayeva, 2024), information is provided for this territory on 46 rare Red Book species. In addition, the Kyrgyz Alatau hosts five endemic plant species (Kubentayev et al., 2024).

The aim of the present study was to identify new localities of rare plant species in the Kyrgyz Alatau and to clarify information on their status. One of the key motivations for this research was the establishment in 2025 of the regional state nature park (hereinafter RSNP) “Merke” within the study area, which was granted the status of a specially protected natural area. The park covers an area of over 86,000 hectares. Its creation opens new opportunities for the development of ecotourism and sustainable nature management based on enhancing the level of environmental education among the population, including the conservation of rare plant species.

Materials and methods

The objects of the study were rare plant species identified during field research conducted in 2024–

2025 within the kazakh part of the Kyrgyz Alatau range. In addition, the list of new rare species includes previously unpublished points discovered during expedition trips in 2022.

Figure 1

Rare species of the Kyrgyz Alatau

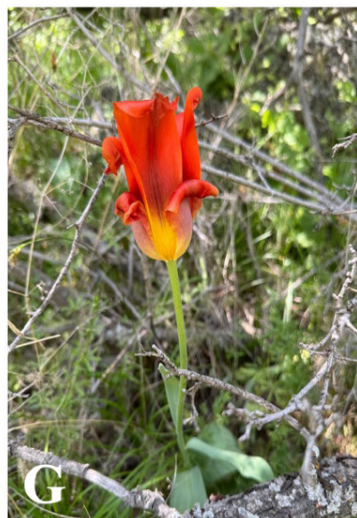
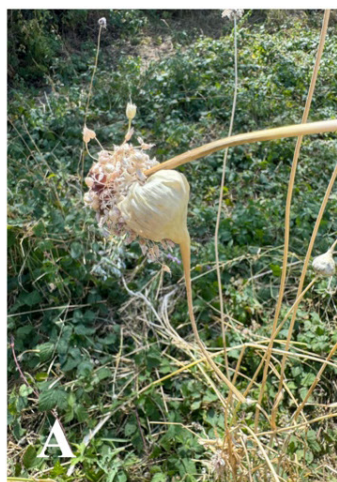
(A – *Armeniaca vulgaris* Lam., B – *Pistacia vera* L., C – *Pyrus regelii* Rehder, D – *Sorbus persica* Hedl)



Figure 2

Rare species of the Kyrgyz Alatau

(A – *Allium longicuspis* Regel, B – *Allium margaritae* B. Fedtsch., C – *Allium renardii* Regel,
D – *Allium suworowii* Regel, E – *Arum korolkowii* Regel,
F – *Juno coerulea* (B. Fedtsch.) Poljakov, G – *Tulipa greigii* Regel)



Standard floristic and cartographic research methods were employed during the fieldwork. The collection and processing of herbarium material followed the methodology of I.I. Guryeva (Guryeva, 2013). Plant species identification was carried out based on the 9-volume edition Flora of Kazakhstan (Pavlov, 1956–1966) and the Illustrated Identification Guide (Goloskokov, 1969–1972). Species names were aligned with current botanical nomenclature data using online resources: Plantarium.ru and Plants of the World Online (POWO) (Plantarium, 2007–2026; POWO, 2026).

For mapping the localities of rare plant species in the kazakh (western) part of the Kyrgyz Alatau range, QGIS 3.40 software was used (accessed on January 16, 2026; <https://qgis.org>).

Results and discussion

In the course of field research conducted in the fall of 2024 and spring of 2025 as part of the

implementation of grant AR23484591 “Comprehensive research (floristic, molecular genetic and resource) on the *Allium* L. genus of the Kyrgyz Alatau cross-border range – a scientific foundation for the management of the region’s natural resources”, as well as on the basis of our own observations in 2022, new localities of 15 rare species of flora of the Kyrgyz Alatau were identified. Of these, 11 species are included in the Red Book of the Republic of Kazakhstan (Red Data Book of Kazakhstan, 2014) and 13 are included in the Regional Red Book of the Zhambyl region (Red Data Book of Zhambyl region, 2007), which indicates the high local value of these taxa. In addition, the list below includes 2 rare species for the flora of the Kyrgyz Alatau.

Here is a list of new localities of rare (within Kazakhstan) species of the Kyrgyz Alatau with an indication of administrative districts, gorges and altitude. In accordance with the recorded coordinates, maps of their habitats were formed (Figure 3).

Table 1

Rare species of the Kyrgyz Alatau

№	Species	Habitats	Is there a threat to the Kyrgyz Alatau?	Note
<i>Species included in the Red Book of the Republic of Kazakhstan (2014)</i>				
1	<i>Armeniaca vulgaris</i> Lam.	29.09.2022 Aktiken Gorge, within the territory of the Merken RSNP, height 1361 m a.s.l.	+	Places of natural growth are limited
		Aktiken Gorge, within the territory of the Merken RSNP, height 1390 m a.s.l.		
		Aktiken gorge, within the territory of the Merken RSNP, height 1462 m a.s.l.		
		T. Ryskulovsky district, Makpal gorge, 1100 m a.s.l.		
2	<i>Allium suworowii</i> Regel	Turar, Ryskulov district, Makpal gorge. 03.05.2025.	–	It has an anthropophilic character
		Altitude 1182 m a.s.l.		
		Turar Ryskulov district, Syugaty gorge. 03.05.2025. Altitude 1270 m a.s.l.		
3	<i>Arum korolkowii</i> Regel	T. Ryskulov district, Makpal gorge (1260 m, 1100m) (2 locations)	+	Narrow stenotopic appearance
4	<i>Celtis caucasica</i> Willd.	01.10.2022	–	It is not uncommon, including on the territory of RSNP
		Aktiken gorge, within the territory of the Merke RSNP high. 1260 m Zhambyl district, Makpal gorge		

Continuation of the table

№	Species	Habitats	Is there a threat to the Kyrgyz Alatau?	Note
5	<i>Juno coerulea</i> (B. Fedtsch.) Poljakov	04.05.2025 Turar, Ryskulov district, Syugaty gorge (2 locations) (1028 m, 1000 m)	+	Places of natural growth are limited
6	<i>Pistacia vera</i> L.	6.05.2025 Zhambyl district, Uzynbulak gorge (height 1100 m), Syugaty (1021 m)	+	It is found only in the western part of the range
7	<i>Paeonia intermedia</i> C.A.Mey.	29.09.2022 Merke Gorge, within the territory of the Merke RSNP, height 1382 m a.s.l.	+	Gathering by the local population for bouquets
8	<i>Tulipa greigii</i> Regel	06.05.2025 Zhambyl district, Tastambek gorge (1113 m), Karasai gorge (1300 m.)	+	Collection of bulbs by the local population and for bouquets (numerous diggings were found in the Almaly-Sai gorge)
9	<i>Sorbus persica</i> Hedl.	06.05.2025 Zhambyl district, Tastambek gorge (1100 m)	+	Places of natural growth are very limited
10	<i>Malus sieversii</i> (Ledeb.) M. Roem.	29.09.2022 r. Aktiken Gorge, within the territory of the Merke RSNP, height 1375 m a.s.l. Aktiken Gorge, within the territory of the Merke RSNP, height 1390 m a.s.l. Aktiken gorge, within the territory of the Merke RSNP, height 1480 m a.s.l.	+	Places of natural growth are very limited
11	<i>Zabelia corymbosa</i> (Regel & Schmalh.) Makino	21.09.2022 r. Aktiken Gorge, within the territory of the Merken RSNP, height 1390 m a.s.l. Aktiken gorge, within the territory of the Merken RSNP, height 1480 m a.s.l.	–	It is not uncommon, including on the territory of the RSNP
Species also included in the Red Book of Zhambyl region (2014)				
12	<i>Allium longicuspis</i> Regel	Turar Ryskulovsky district, Syugaty gorge. 27.08.2024, altitude 1170 m a.s.l.	+	New location
13	<i>Pyrus regelii</i> Rehder	04.05.2025 Turar Ryskulovsky district, Makpal gorge (1100 m)	–	It is not uncommon, including on the territory of RSNP
Rare species of flora of the Kazakh part of the Kyrgyz Alatau range				
14	<i>Allium margaritae</i> B. Fedtsch.	26.08.2024. Zhambyl region, Zhambyl district, Ulken Almalysay gorge, southern slope. Altitude 1200 m a.s.l.	+	Places of natural growth are limited
15	<i>Allium renardii</i> Regel	21.08.2025. Merke district, south of the village of Aktogan, the valley of the Molaly River, the Molaly Gorge. Altitude 1911 m a.s.l.	+	New location

Note: The symbol «+» indicates that there is a threat to the survival of the species, while the symbol «–» indicates that there is no such threat.

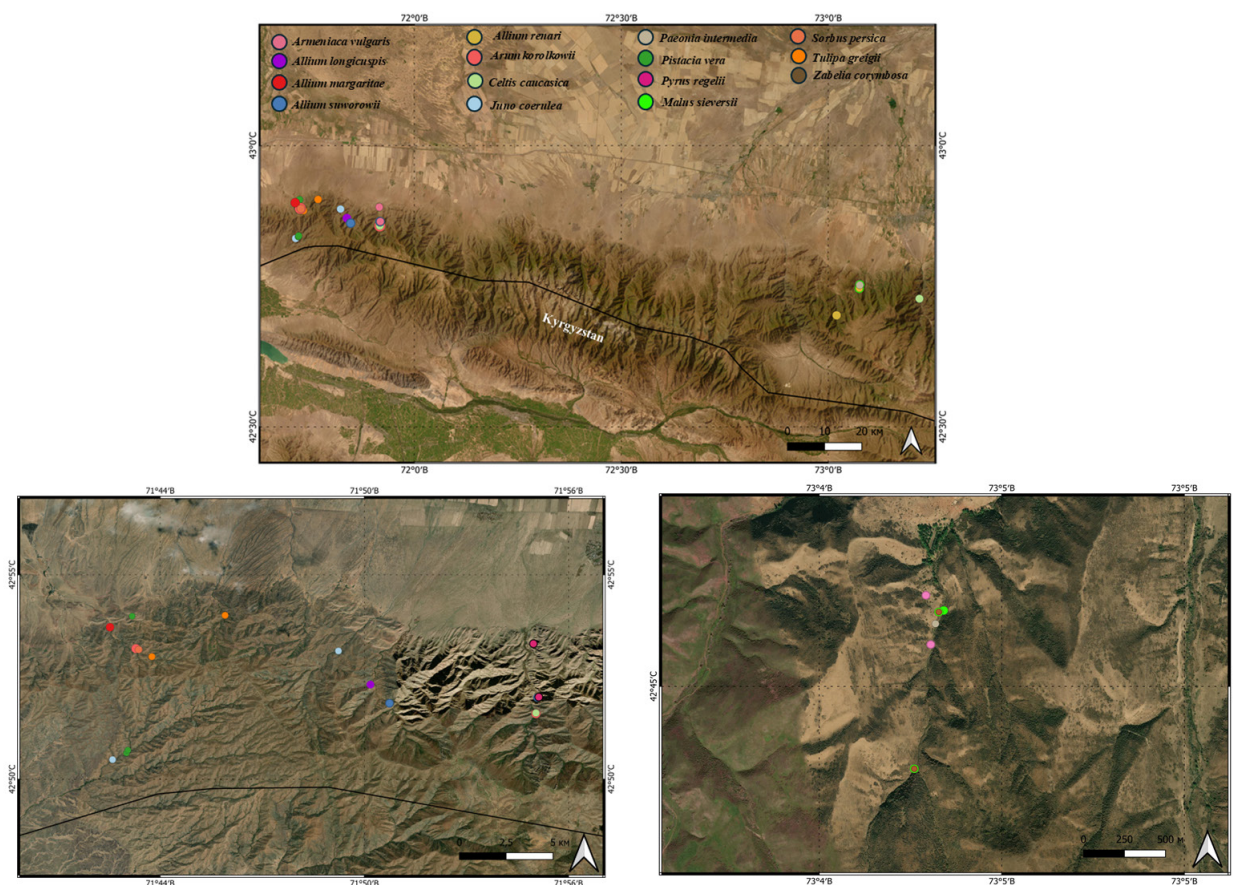
RSNP* – Regional State Nature Park

Most of the rare species listed in Table 1 are threatened within the Kyrgyz Alatau; therefore, the establishment of the RSNP “Merke” is of great importance for their in situ conservation. At the same time, species such as *Allium suworowii*,

Celtis caucasica, *Zabelia corymbosa*, and *Pyrus regelii* do not show immediate threats to their survival in this territory, which may indicate stable local populations or favorable ecological conditions.

Figure 3

Map of the location of rare species of the Kyrgyz Alatau



A separate note should be made regarding three representatives of the genus *Allium* L. Firstly, *Allium sativum* L. (*Allium longicuspis* Regel), which is included in the Regional Red Book of the Zhambyl Region (Red Data Book of Zhambyl region, 2007). During the autumn field expeditions of 2024 in the Kyrgyz Alatau, one population of this species was discovered (Table 1). Its small size is largely due to local harvesting of the plant for food purposes. Secondly, during field research conducted under the grant project AR23484591, new localities of two additional onion species were identified in the Kyrgyz Alatau: *Allium margaritae* (autumn 2024) and *Allium renardii* (autumn 2025). The rarity status of

A. renardii for this region and for Kazakhstan as a whole requires further clarification (Gemejiyeva et al., 2025; Vesselova et al., 2025).

Conclusion

In summary, it should be noted that the Kyrgyz Alatau is one of the key transboundary ecological territories for the conservation of rare plant species in Kazakhstan. The significant number of rare species found in the flora of this range demonstrates its high floristic uniqueness and confirms the need for further scientific, including monitoring, research.

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References

- Rachkovskaya, E.I. (2003). Principy i osnovnye edinicy rajonirovaniya // Botanicheskaya geografiya Kazakhstana i Srednej Azii (v predelakh pustynnoj oblasti) [Principles and main units of regionalization // Botanical geography of Kazakhstan and Central Asia (within the desert region)]. 172–195. Saint-Petersburg [in Russian].
- Zhaylybayeva, T. M. (2024). Analysis of the flora of the western part of the Kyrgyz Alatau (PhD dissertation). Abai Kazakh National Pedagogical University, Almaty, Kazakhstan. [in Kazakh].
- Baitenov, M. S. (1985). Vysokogornaya flora Severnogo Tyan'-Shanya [High-mountain flora of the Northern Tien Shan]. Alma-Ata: Nauka KazSSR.
- Mukhtubayeva, S. K., Nelina, N. V., Sitpayeva, G. T., Kudabayeva, G. M., Vesselova, P. V., Bilibayeva, B. K., & Zhumadilova, A. (2017). Redkie, endemichnye, reliktovye i ischezayushchie vidy rastenii Severnogo Tyan'-Shanya (Kungei i Kyrgyzskiy Alatau) [Rare, endemic, relict, and endangered plant species of the Northern Tien Shan (Kungey and Kyrgyz Alatau)]. Kazakhstan Respublikasy, 103 pp. [in Russian].
- Krasnaya kniga Kazakhstana [Red Data Book of Kazakhstan] (2014). Baitulin, I.O. (Ed.), & Sitpayeva, G.T. (Assoc. Ed.). (2nd ed., Vol. 2, Pt. 1: Plants). Astana: ArtPrintXXI., 452 p. [in Russian].
- Kubentayev, S. A., Alibekov, D. T., Perezhogin, Y. V., Lazkov, G. A., Kupriyanov, A. N., Ebel, A. L., & Kubentayeva, B. B. (2024). Revised checklist of endemic vascular plants of Kazakhstan. *PhytoKeys*, 238, 241.
- Guryeva, I. I. (2013). Gerbarnoye delo: Rukovodstvo po organizatsii gerbariya i rabote s gerbarnymi kollektsiyami [Herbarium practice: A guide to herbarium organization and work with herbarium collections] (2nd ed.). Tomsk. 194 pp. [in Russian].
- Pavlov, N.V. (Ed.). (1956–1966). Flora Kazakhstana [Flora of Kazakhstan] (Vols. 1–9). Alma-Ata: Academy of Sciences of the Kazakh SSR [in Russian].
- Goloskokov, V.P. (Ed.). (1969–1972). Illyustrirovannyi opredelitel' rasteniy Kazakhstana [Illustrated guide to plants of Kazakhstan] (Vols. 1–2). Alma-Ata: Nauka [in Russian].
- Plantarium. (2007–2026). Open online atlas and identification guide of plants and lichens of Russia and neighboring countries. Electronic resource. Regime of access: <http://www.plantarium.ru>.
- Plants of the World Online (2026). Royal Botanic Gardens, Kew. Electronic resource. Regime of access: <https://powo.science.kew.org>.
- Krasnaia kniga Zhambylskoi oblasti [Red Data Book of Zhambyl region]. (2007). Almaty [in Russian].
- Gemejiyeva, N., Abdildanov, D., Kudabayeva, G., Vesselova, P., Nelina, N., & Friesen, N. (2025). Виды рода *Allium* L. западной части хребта Киргизский Алатау: современное состояние и перспективы изучения. *Fundamental and Experimental Biology*, 11830(2), 13-25.
- Vesselova, P. V., Kudabayeva, G. M., Abdildanov, D. S., Osmonali, B. B., Ussen, S., Skaptsov, M. V., & Friesen, N. (2025). Integral assessment of species of the genus *Allium* L. (Amaryllidaceae) in the western part of the Kyrgyz Alatau. *Plants*, 14(18), 2890.

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