



**EREMURUS M.BIEB. (ASPHODELACEAE) IN THE FLORA OF
KAZAKHSTAN: A MODERN CHECKLIST AND GEOREFERENCED
DISTRIBUTION ANALYSIS**

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Annotatsiya. Qozog‘iston Markaziy Osiyodagi *Eremurus* M.Bieb. turkumi tarqalishining shimoliy va shimoli-sharqiy chegaralarini, shuningdek G‘arbiy Tyanshan, Qaratau, Jung‘or Olatog‘i va Ili havzasidagi muhim xilma-xillik markazlarini qamrab oladi. Ushbu tadqiqotda klassik Flora Kazakhstana, M.S. Baytenov ma‘lumotlari, 2023-2026-yillarda qozog‘istonlik botaniklar tomonidan chop etilgan *Eremurus* tadqiqotlari, 2025-yilgi global monografiya, jamlangan gerbariy-Plantarium ma‘lumotlari va sifat nazoratidan o‘tkazilgan GBIF natural-only ma‘lumotlari birlashtirildi. Jamlangan ma‘lumotlardan Qozog‘iston davlat chegarasi ichida 1 168 ta aniq dublikatlardan tozalangan georeferensiyalangan yozuv ajratildi. Taksonomik va geografik sifat nazoratidan so‘ng 1 088 ta yozuv 12 ta zamonaviy qabul qilingan turga biriktirildi. Eng ko‘p qaydlar *E. inderiensis* (264) va *E. altaicus* (246) turlariga tegishli bo‘lib, ular birgalikda tasdiqlangan yozuvlarning 46,9 foizini tashkil etdi. Mustaqil GBIF natural-only to‘plamida Qozog‘iston uchun 738 ta yozuv va 11 ta tur qayd etildi. Klassik Flora Kazakhstana 13 turni, keyingi M.S. Baytenov talqini va zamonaviy qozog‘istonlik tadqiqotlar 15 turni ko‘rsatadi; biroq 2025-yilgi monografiyaning mamlakatlar bo‘yicha tarqalish ma‘lumotlari hamda bevosita georeferensiyalangan dalillar Qozog‘iston uchun konservativ zamonaviy ishchi ro‘yxat sifatida 12 turni qo‘llab-quvvatlaydi. *E. spectabilis*, *E. olgae* (= *E. angustifolius*), *E. stenophyllus*, *E. alberti*, *E. aitchisonii* va *E. zoeae* nomlari bilan mavjud ayrim tarixiy yozuvlar qayta aniqlashni talab qiladigan muammoli qaydlar sifatida ajratildi. Natijalar

Qozog‘iston *Eremurus* turlarining taksonomik reviziyasi, raqamli floristik kartografiyasi va maqsadli dala tekshiruvlari uchun tekshiriladigan asos yaratadi.

Kalit so‘zlar: *Eremurus*; Asphodelaceae; Qozog‘iston; gerbariy namunalari; turlar ro‘yxati; georeferensiyalash; GBIF; Plantarium; taksonomik reviziya.

Аннотация. Казахстан охватывает северную и северо-восточную часть ареала рода *Eremurus* M.Bieb. в Центральной Азии и включает важные центры разнообразия в Западном Тянь-Шане, Каратау, Джунгарском Алатау и бассейне Или. В работе объединены сведения классической Flora Kazakhstan, данные М.С. Байтенова, публикации казахстанских ботаников по *Eremurus* за 2023-2026 гг., глобальная монография 2025 г., объединённые гербарные и Plantarium-данные и прошедший контроль качества набор GBIF natural-only. В пределах государственной границы Казахстана из объединённого массива данных выделено 1 168 точных дедулицированных геореференцированных записей. После таксономического и географического контроля 1 088 записей были отнесены к 12 современно принимаемым видам. Наиболее полно представлены *E. inderiensis* (264 записи) и *E. altaicus* (246), вместе составляющие 46,9 % подтверждённых записей. Независимый набор GBIF natural-only включал 738 записей и 11 видов. Flora Kazakhstan приводила 13 видов, тогда как М.С. Байтенов и современные казахстанские исследования указывают 15. Однако страновые сведения монографии 2025 г. и непосредственно геореференцированные данные поддерживают консервативный современный рабочий список из 12 видов. Ряд исторических записей под названиями *E. spectabilis*, *E. olgae* (= *E. angustifolius*), *E. stenophyllus*, *E. alberti*, *E. aitchisonii* и *E. zoeae* требует повторной проверки определений. Полученный синтез создаёт проверяемую основу для дальнейшей таксономической ревизии, цифрового картирования и целевых полевых исследований рода в Казахстане.

Ключевые слова: *Eremurus*; Asphodelaceae; Казахстан; гербарные образцы; список видов; геореференцирование; GBIF; Plantarium; таксономическая ревизия.

Abstract. Kazakhstan encompasses the northern and north-eastern part of the Central Asian range of *Eremurus* M.Bieb. and includes important diversity centres in the Western Tien Shan, Karatau, Dzungarian Alatau and the Ili basin. This study integrates the classical Flora Kazakhstan, the synthesis of M.S. Baitenov, *Eremurus*-focused publications by Kazakhstan botanists from 2023-2026, the 2025 global monograph, a compiled georeferenced herbarium-Plantarium dataset and a quality-controlled GBIF natural-only dataset. Spatial screening of the compiled georeferenced dataset recovered 1,168 exact-deduplicated georeferenced records within Kazakhstan. After taxonomic and geographic quality control, 1,088 records were assignable to 12 currently accepted species. *E. inderiensis* (264 records) and *E. altaicus* (246) were the best documented taxa and together represented 46.9% of accepted records. The independent GBIF natural-only dataset contained 738 Kazakhstan records representing 11 species. Flora Kazakhstan reported 13 species, whereas Baitenov and recent Kazakhstan literature refer to 15 species. In contrast, country-level distributions in the 2025 monograph together with directly georeferenced evidence support a

conservative modern working checklist of 12 species. Historical records identified as *E. spectabilis*, *E. olgae* (= *E. angustifolius*), *E. stenophyllus*, *E. alberti*, *E. aitchisonii* and *E. zoeae* are treated as distributionally discordant records requiring renewed voucher-based verification. The synthesis provides an auditable baseline for taxonomic revision, digital floristic mapping and targeted field surveys of *Eremurus* in Kazakhstan.

Keywords: *Eremurus*; Asphodelaceae; Kazakhstan; herbarium specimens; checklist; georeferencing; GBIF; Plantarium; taxonomic revision.

Introduction. *Eremurus* M.Bieb. is one of the well-represented geophytic genera of Asphodelaceae in the flora of Central Asia, with its principal diversity associated with the Tien Shan, Pamir-Alai and adjacent arid plains and foothill regions [10, 11]. Kazakhstan occupies an important northern part of the generic range, where species occur across habitats ranging from psammophytic deserts to montane meadows and rocky slopes. The vast territory of the country and the strong ecological differentiation among its floristic regions make it difficult to assess *Eremurus* distribution comprehensively using any single source of evidence.

The number of *Eremurus* species reported from Kazakhstan has varied among sources. V.P. Goloskokov recognized 13 species in the treatment of the genus for Flora Kazakhstana [1]. M.S. Baitenov later estimated the national diversity at 15 species [2], a figure repeated in Kazakhstan-based studies published in 2024-2025 [5, 6]. However, the proceedings of a 2023 conference of young researchers explicitly noted that although Baitenov reported 15 species, a complete corresponding list was not provided [3]. The rapid expansion of digitized biodiversity data therefore makes it necessary to reassess historical floristic counts against current nomenclature and verifiable herbarium evidence.

In recent years, researchers in Kazakhstan have actively investigated the genus. Mukhadil et al. [5] analysed the distribution of *E. inderiensis* and *E. anisopterus* in the sandy desert zone of Kazakhstan using herbarium and field data and showed that *E. anisopterus* is sensitive to anthropogenic disturbance. Daulet et al. [6] examined more than 130 specimens from AA, TASH, LE and MW to clarify the contemporary distribution of *E. robustus* and *E. tianschanicus*. Subsequent anatomical studies revealed xeromorphic adaptations in these two montane species, including a thick cuticle, sunken stomata and water-storage cells [7, 8]. In 2026, an updated national checklist of vascular plants of Kazakhstan comprising 6,035 taxa further emphasized the need to reassess the country flora using modern digital and phytogeographic approaches [9].

The aim of this study was to reassess the current taxonomic composition of *Eremurus* in Kazakhstan using historical floristic literature, recent Kazakhstan-based studies, the 2025 global monograph and georeferenced occurrence evidence; to establish a species checklist supported by direct records; to identify problematic historical determinations requiring renewed verification; and to characterize the digital distributional evidence available for the genus.

Materials and methods. The study used herbarium records from LE, TASH, AA, MW, FRU and TAD, observations from Plantarium.ru, and quality-controlled GBIF natural-occurrence records. Except for GBIF records already supplied with geographic coordinates, historical localities from herbarium specimen labels were individually georeferenced in Google Earth, and coordinates were stored as decimal degrees in the WGS84 geographic reference system.

Coordinates were spatially compared with the modern state boundary of Kazakhstan. Completely identical rows were removed as exact duplicates. Taxon names were reconciled against The genus *Eremurus* M.Bieb. of the world (2025) [11] and the POWO/WCVP 2026 nomenclatural backbone [12]. Records identified as *E. sogdianus* or *E. sagdianus* were harmonized with *E. soogdianus*. The name *E. angustifolius* was treated as a synonym of *E. olgae*; however, because the currently accepted country distribution of *E. olgae* does not include Kazakhstan, such records were not automatically included in the national checklist. Likewise, records identified as *E. spectabilis*, *E. stenophyllus*, *E. alberti*, *E. aitchisonii* and *E. zoeae* that were discordant with current country-level ranges were retained as records requiring taxonomic re-examination.

For the Kazakhstan subset of the compiled georeferenced evidence, the contribution of each source and the number of records per accepted species were calculated. The independent GBIF natural-only dataset was not mechanically merged with the compiled georeferenced evidence because digital representations of the same herbarium specimen may occur on multiple portals; instead, it was treated as an independent evidence layer. Darwin Core principles were used as the general standard for interpreting digital occurrence records [15].

Results and Discussions. Spatial screening of the compiled georeferenced evidence followed by exact duplicate removal yielded 1,168 unique georeferenced records from Kazakhstan. After taxonomic and country-range quality control, 1,088 records could be confidently assigned to 12 accepted species. The remaining 80 records were separated as historical or taxonomically problematic determinations. The independent GBIF natural-only dataset contained 738 records representing 11 species in Kazakhstan.

Table 1.

Interpretations of *Eremurus* species richness in Kazakhstan according to different sources

Source / approach	Number of species	Comment
Flora Kazakhstana, 1958 [1]	13	Classical national flora
M.S. Baitenov, 2001 [2]	15	Later floristic estimate; complete corresponding list remains unclear
Kazakhstan authors, 2024-2025 [5,6]	15	Recent studies following Baitenov's estimate
2025 global monograph [11]	12	Species explicitly reported for Kazakhstan in “General distribution”

Present study, georeferenced evidence	12	1,088 directly supported records
GBIF natural-only	11	738 independent digital records

The most important taxonomic result is that the same 12 species explicitly reported for Kazakhstan in the 2025 monograph are directly represented in the quality-controlled georeferenced evidence. This agreement supports the use of these 12 species as a conservative modern working checklist for Kazakhstan. At the same time, historical totals of 13 and 15 species are not necessarily erroneous; they may reflect older species concepts, synonymy, or floristic interpretations based on broader geographic concepts and different treatment of national boundaries.

Table 2.

Eremurus species in Kazakhstan directly supported by georeferenced evidence

N	Accepted species	Records	Share, %
1	<i>Eremurus inderiensis</i> (M.Bieb.) Regel	264	24.3
2	<i>Eremurus altaicus</i> (Pall.) Steven	246	22.6
3	<i>Eremurus regelii</i> Vved.	94	8.6
4	<i>Eremurus lactiflorus</i> O.Fedtsch.	92	8.5
5	<i>Eremurus cristatus</i> Vved.	77	7.1
6	<i>Eremurus robustus</i> (Regel) Regel	70	6.4
7	<i>Eremurus tianschanicus</i> Pazij & Vved. ex Pavlov	62	5.7
8	<i>Eremurus fuscus</i> (O.Fedtsch.) Vved.	59	5.4
9	<i>Eremurus soogdianus</i> (Regel) Benth. & Hook.f.	48	4.4
10	<i>Eremurus anisopterus</i> (Kar. & Kir.) Regel	37	3.4
11	<i>Eremurus hilariae</i> Popov & Vved.	34	3.1
12	<i>Eremurus turkestanicus</i> Regel	5	0.5
	Total	1,088	100.0

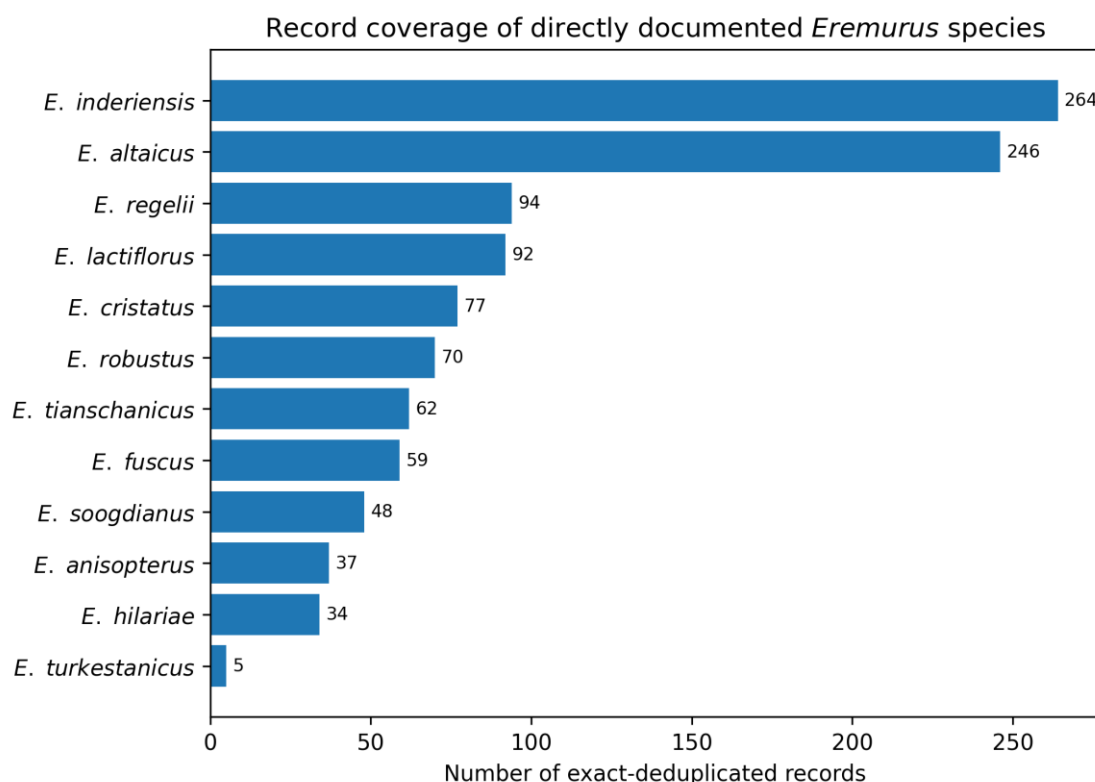


Figure 1. Number of records per accepted *Eremurus* species in the compiled georeferenced evidence.

E. inderiensis (264 records) and *E. altaicus* (246) are the best documented species, together accounting for 510 records or 46.9% of all accepted records. More than 90 records are also available for *E. regelii* and *E. lactiflorus*. By contrast, *E. turkestanicus* is represented by only five records. Such differences should not be interpreted directly as differences in biological rarity because the historical geography of collecting, the coverage of major herbarium collections and the tendency of observers to work close to accessible road networks strongly influence the number of digitized records.

Results from Kazakhstan researchers provide an ecological context for this spatial pattern. In sandy deserts, *E. inderiensis* has been shown to occupy a wider range of psammophytic communities, whereas *E. anisopterus* is mainly associated with relatively undisturbed sand massifs of the Balkhash-Alakol floristic region [5]. In the mountainous south-east, the ranges of *E. robustus* and *E. tianschanicus* are linked with the Dzungarian-Northern Tien Shan floristic complexes [6]. Xeromorphic anatomical characters in these species have been interpreted as adaptations to water limitation in foothill and montane habitats [7, 8].

Table 3.

Source composition of the principal Kazakhstan georeferenced dataset

Source	Records	Share, %
LE	385	33.0
TASH	265	22.7
Plantarium.ru	216	18.5
AA	204	17.5
MW	76	6.5
FRU	21	1.8
TAD	1	0.1
Total	1,168	100.0

LE contributed the largest share, with 385 records (33.0%). TASH with 265 records (22.7%), AA with 204 (17.5%) and MW with 76 (6.5%) preserve much of the historical herbarium evidence for *Eremurus* in Kazakhstan. The 216 Plantarium.ru records (18.5%) substantially enrich the modern field-observation component. Reliance on any single collection would therefore considerably underestimate the actual national coverage of the genus.

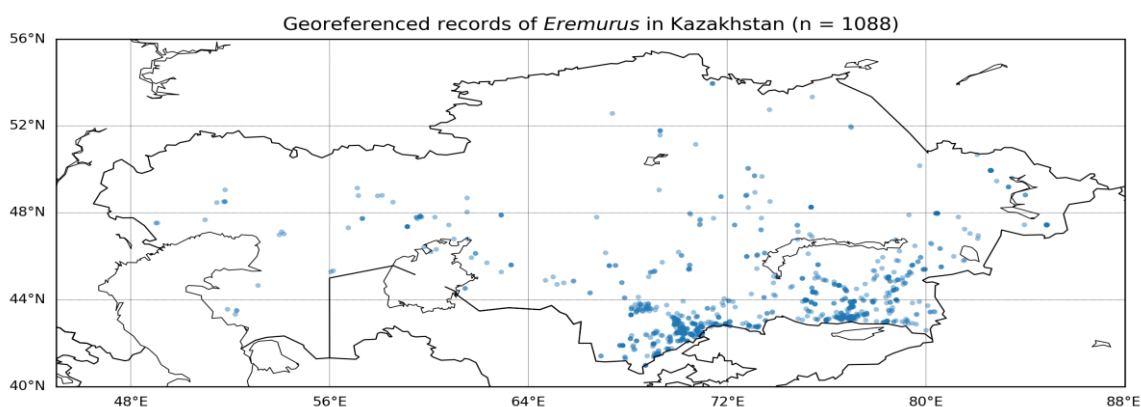


Figure 2. Overall distribution of taxonomically quality-controlled *Eremurus* records in Kazakhstan. Points combine georeferenced coordinates reconstructed from historical herbarium localities with modern observations.

The map shows that the highest density of records is concentrated in the mountain systems of southern and south-eastern Kazakhstan and in the Ili-Balkhash region, whereas *E. inderiensis* extends much more widely into central and western arid areas. This pattern is consistent with a 2026 phytogeographic analysis of the flora of Kazakhstan, which identified southern and south-eastern Kazakhstan, particularly the Western Tien Shan, Trans-Ili-Kungey Alatau, Dzungarian Alatau and Karatau, as major centres of vascular-plant diversity [9].

Taxonomic problems and the need for re-verification. Among the 80 records excluded during quality control, the largest groups were records identified as *E. spectabilis* (29) and *E. angustifolius* (29); the latter name is treated in current nomenclature as a synonym of *E. olgae*. In addition, seven records were identified as *E. olgae*, two as *E. stenophyllus*, and one each as *E. alberti*, *E. aitchisonii* and *E. zoeae*, together with ten unidentified *Eremurus* records. Current country-level distributions presented in the 2025 monograph do not support Kazakhstan for these names [11]. They should therefore not be interpreted automatically as new national records. The corresponding herbarium images, original labels, identification histories and georeferencing accuracy should be re-examined first.

The historical use of the names *E. spectabilis* and *E. inderiensis* requires particular caution: one of the earlier nomenclatural combinations associated with *E. inderiensis* was *E. spectabilis* f. *inderiensis* [12]. Consequently, the occurrence of the name “spectabilis” on an old determination does not necessarily demonstrate the presence of modern *E. spectabilis* sensu stricto in Kazakhstan. This nomenclatural history illustrates the risk of using digitized occurrence databases directly as species checklists without voucher-based re-identification.

Conclusion. Integration of classical and modern evidence for *Eremurus* in Kazakhstan yielded 1,168 exact-deduplicated georeferenced records. Of these, 1,088 could be confidently assigned to 12 currently accepted species: *E. inderiensis*, *E. altaicus*, *E. regelii*, *E. lactiflorus*, *E. cristatus*, *E. robustus*, *E. tianschanicus*, *E. fuscus*, *E. soogdianus*, *E. anisopterus*, *E. hilariae* and *E. turkestanicus*. The independent GBIF natural-only dataset contained 738 records representing 11 species. Differences from the 13 species reported in Flora Kazakhstan and the historical total of 15 species based on Baitenov can be explained by current synonymy, older species concepts and unverified historical distribution records. The 12-species checklist is therefore proposed here as a conservative and auditable modern working hypothesis, while problematic records should be re-examined using voucher specimens. The results provide a basis for regional digital mapping in GMOCA, targeted field collecting in Kazakhstan and future taxonomic revision.

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Data availability. Georeferenced records that passed taxonomic, geographic and duplicate quality control have been integrated into the GMOCA (Grid Mapping of Central Asian Plants; www.gmoca.org) regional platform.

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