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GENUS *ANABASIS* L. (CHENOPODIACEAE): REVIEW IN THE HERBARIA OF KAZAKHSTAN AND NEIGHBORING COUNTRIES

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SUMMARY

The inventory of the genus *Anabasis* L. collection in the herbaria of Kazakhstan and neighboring countries, particularly the specimens of the endemic and relict species *Anabasis cretacea* Pall., comprised this study. Systematizing and analyzing the herbarium collection focused on species diversity, their morphological characteristics, and ecological implications. The endemic species received special attention, highlighting the need for their conservation and preservation. The studied herbaria included the Institute of Botany and Phytointroduction and Al-Farabi Kazakh National University in Almaty, the Astana Botanical Garden and National Center of Biotechnology in Astana, and the Utemisov West Kazakhstan University in Uralsk. The collection made in Kazakhstan's own herbaria took place during field research in June-August 2025. Likewise, a visit to the personal herbaria of Prof. S.A. Aipeisova was fruitful. Similarly, virtual tours of herbaria took place in the study. These were Lomonosov Moscow State University; the N.V. Tsitsin State Library of the Russian Academy of Sciences; the V.L. Botanic Institute, Komarova RAS, St. Petersburg; and the Digital Herbarium of the Central Siberian Botanical Garden SB RAS, Novosibirsk. Thus, studying the various herbaria resulted in the 13 different species of the genus *Anabasis* L. found in Kazakhstan, five of which were in the Aktobe Region. Moreover, the location of the species *Anabasis cretacea* Pall succeeded in its identification in the study area at the Aktobe Region, Kazakhstan.

Keywords: *Anabasis* L., Chenopodiaceae, endemic, relict species, herbarium collection, samples, Aktobe region, Kazakhstan, neighboring states

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Key findings: Analysis of the genus *Anabasis* L. collection revealed the species diversity, distribution ranges, and ecological preferences, including relict and endemic types with the highest tolerance to salinity and drought. The results were of scientific and conservation values, providing insights into soil and environmental conditions, aridization processes, and speciation. The identification of the genus *Anabasis* L. species was successful in the study area at the Aktobe Region, Kazakhstan.

INTRODUCTION

The genus *Anabasis* L. comprised 30 species, wherein 17 species were existent in Kazakhstan (Komarov, 1936; Pavlov, 1960). *Anabasis* is one of the most important genera, with different species grown well in salt marshes, semi-deserts, and other harsh conditions (Shegebayev *et al.*, 2023). These species represent a group of vital semi-shrub plant genetic resources, which can highly withstand saline-alkaline loads, resist drought, prevent drift, and improve soil structure. Numerous studies have shown that plants of the genus *Anabasis* L. contain more than 70 compounds, indicating numerous pharmacological and phytochemical properties. However, studies reported that further in-depth research is essential to use them for clinical purposes (Mohammed *et al.*, 2021; Hawas *et al.*, 2022; Abdelaziz *et al.*, 2024; Amtaghri *et al.*, 2025).

Molecular phylogenetic analysis of 28 species of *Anabasis* sought to determine their distribution area (Lauterbach *et al.*, 2019). According to their findings, it was evident that 15 of 28 species proved to have distribution in the Turanian and Aral-Caspian provinces, as well as in the Dzungarian-Tien Shan province. Thus, genus *Anabasis* emerged to be widespread in arid regions, including steppes, semi-deserts, and deserts of North Africa, Western and Central Asia, and some parts of Europe. The species distribution, population size, and composition of communities incurred direct effects from varied climatic conditions, which eventually led to a transformation in the location, volume, and quality of distribution of habitats (Xiao *et al.*, 2019).

In addition to climatic and soil factors, salinity particularly influences the distribution of species. They tend to grow in areas with low or relatively high soil salinity (Khatibi *et al.*, 2017). Despite the vast territory and diverse

natural conditions of Kazakhstan, the dispersal of endemic taxa appears uneven in the said country (Kubentayev *et al.*, 2024). *Anabasis cretacea* Pall., *A. brachiata* Fisch., *A. turkestanica* Korov., *A. gypsicola* Iljin, *A. jaxartica*, and *A. turgaica* Iljin have become recognized as endemic species (Komarov, 1936; Pavlov, 1960). Relict and endemic plants possess unique genetic and biochemical characteristics that have enabled their survival to this day.

The growth and development and survival of relict and endemic taxa took place in different geological epochs. By studying the relict species, it is possible to trace the formation phases of the modern vegetation cover. Relict and endemic species can testify to different periods, including the warm Tertiary period, cold stages of glaciation, and temporary warming of the interglacial period. Species extinction is the loss of a particular gene set that is unique and, in many cases, extremely important for humanity (Takhtadzhyan, 1981).

The conducted research allowed us to certify the volume of the herbarium collection of the genus *Anabasis* L., the systematic affiliation of the different samples, and the distribution of *Anabasis* species. Currently, the herbarium collection contains samples of the *Anabasis* L. species, collected from Kazakhstan and neighboring countries. The analysis of the herbarium collection according to the different countries and regions is available in Table 1. The following study aimed to review the herbarium collection of the genus *Anabasis* L., housed in the herbarium funds of Kazakhstan and neighboring countries.

MATERIALS AND METHODS

The genetic material comprised specimens of the different species of the genus *Anabasis* L.

found in various herbarium collections of Kazakhstan. These are the Institute of Botany and Phytointroduction and Al-Farabi Kazakh National University in Almaty and the Astana Botanical Garden and National Center for Biotechnology in Astana. Other herbarium materials included those from the West Kazakhstan University named after M. Utemisov, Uralsk; the personal herbarium of Prof. S.A. Aipeisova; and our own herbarium collected during field research in June-August 2025. Others came from the virtual herbarium of the Lomonosov Moscow State University, the Tsitsin Russian State Medical University of the Russian Academy of Sciences, and the Komarov Botanical Institute of the Russian Academy of Sciences, St. Petersburg, in Moscow. Meanwhile, some specimens were available in the digital herbarium of the Central Siberian Botanical Garden of the SB RAS, Novosibirsk.

The acceptability of different species volumes was according to the Flora of the USSR (Komarov, 1936) and the Flora of Kazakhstan (Pavlov, 1960). The Latin names of genus *Anabasis* L. species came specifically according to S.K. Cherepanov (Cherepanov, 1981), while providing the Kazakh names of plants was according to S.A. Arystangaliev and E.R. Ramazanov (Arystangaliev and Ramazanov, 1977). A.S. Abdullina (Abdulina, 1998) summarized the plant species names with the modern nomenclature of plants found in Kazakhstan according to Aralbay *et al.* (2017). By compiling a brief description of the genus *Anabasis* L. species, the use of the following sources includes the Flora of the USSR (Komarov, 1936) and the Illustrated Determinant of Plants of Kazakhstan (Baitenov *et al.*, 1969).

A geodatabase compilation of distribution points of the relict species *Anabasis cretacea* Pall. in Kazakhstan has been successful. According to Cherepanov (1981), for three plant species, the use of two different names prevailed, i.e., *A. ramosissima* Minkw. = *A. salsa* (C.A. Mey.), *A. hispidulla* (Bge) Benth. = *A. jaxartica* (Bunge), and *A. balchaschensis* Iljin = *Arthrophytum balchaschense*.

RESULTS AND DISCUSSION

Genus *Anabasis* L. overview in herbarium

The latest results based on the study of the herbarium collection of the genus *Anabasis* L. in 2025, with more than 1000 herbarium sheets analyzed, have the following findings:

The Herbarium Fund of the Institute of Botany and Phytointroduction of the Kazakh Ministry of Agriculture, AA, Almaty, reached inclusion in the list of the largest Scientific Botanical collections of the CIS of national importance, with the international AA index. It has a herbarium collected by Pavlov N., Krashennikov I., Kuznetsov N., Rusanov F., and Gamayunova A. and a herbarium of 13 species. Genus *Anabasis* L. (364 sheets) revealed 11 species found in Kazakhstan (five species in the Aktobe Region). These are *Anabasis aphylla* L., *A. salsa* (C.A. Mey.), *A. cretacea* Pall., *A. truncata* (Bunge), *A. brachiata* Fisch. & C.A. Mey. ex Kar. & Kir., *A. brevifolia* C.A. Mey., *A. turkestanica* Korov., *A. eriopoda* (Schrenck) Benth., *A. elatior* (C.A. Mey.) Schischk, *A. gypsicola* Iljin, and *A. jaxartica* (Bunge) Benth. ex Iljin.

The Al-Farabi Kazakh National University, Almaty, also contains a herbarium with 165 sheets, having 11 species of the genus *Anabasis* L. found in Kazakhstan. These are *Anabasis aphylla*, *A. salsa*, *A. cretacea*, *A. truncata*, *A. gypsicola*, *A. elatior*, *A. eriopoda*, *A. jaxartica*, *A. brachiata*, *A. brevifolia*, and *A. turgaica*. In these species, the following three species succeeded in being recognized in the Aktobe Region, Kazakhstan—*Anabasis salsa*, *A. cretacea*, and *A. truncata*. There was another herbarium of *A. depressa* Eug. Kor. with nine sheets and *A. ramosissima* Minkw. (with 13 sheets), also reaching identification as types of the species *A. salsa* (Komarov, 1936; Cherepanov, 1981). The herbarium fund of the Astana Botanical Garden, NUR, Astana, contains a herbarium collection of the genus *Anabasis* L., which has three different species (with 10 sheets) found in Kazakhstan, viz., *Anabasis salsa*, *A. cretacea*, and *A. aphylla* (Figure 1).



Figure 1. Genus *Anabasis* L. with four species: *Anabasis salsa* (A, D), *A. cretacea* (B), and *A. aphylla* (C) in the herbarium of the Astana Botanical Garden.

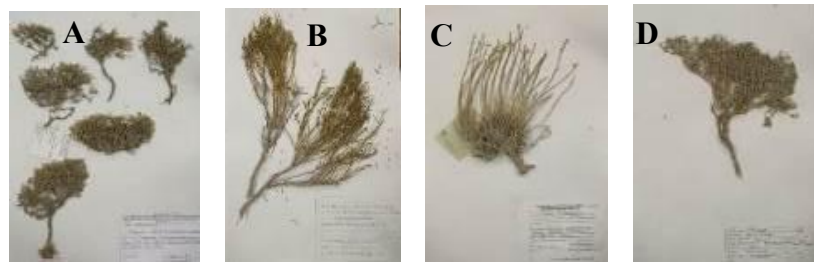


Figure 2. Genus *Anabasis* L. four species: *A. eriopoda* (A), *A. brachiata* (B), *A. salsa* (C), and *A. aphylla* (D) in the Herbarium of the National Center for Biotechnology, Astana.



Figure 3. Herbarium of *Anabasis cretacea* (A, B, and C) of the West Kazakhstan University named after M. Utemisov, Uralsk.

The herbarium fund of the National Center for Biotechnology of the Ministry of Health, Astana, contains a herbarium of the genus *Anabasis* L., which has four different species—*Anabasis eriopoda*, *A. brachiata*, *A. salsa*, and *A. aphylla* (Figure 2). The collection of the M. Utemisov West Kazakhstan State University, Uralsk (Darbaeva, 2007), comprises a herbarium of the species *Anabasis cretacea* collected in the territory of West Kazakhstan (Figure 3). In the personal herbarium of Prof. S.A. Aipeisova, the genus *Anabasis* L. has four species representing it available in the Aktobe

Region, Kazakhstan—*Anabasis aphylla*, *A. cretacea*, *A. salsa*, and *A. truncata* (Aipeisova, 2007).

Moreover, the herbarium of the Moscow State University named after V.M. Lomonosov (MW, Moscow) contains an extensive collection, including plant specimens procured from various regions and diverse climatic conditions; the specimens were of the genus *Anabasis* L. (with 456 sheets), belonging to 20 different species, 11 of which were recognized in Kazakhstan. These are *Anabasis cretacea*, *A. aphylla*, *A. salsa*, *A. truncata*, *A.*



Figure 4. Herbarium of the genus *Anabasis* L., Moscow State University named after V.M. Lomonosov. 10 species found in Kazakhstan: *Anabasis cretacea* Pall. (A), *A. aphylla* L. (B), *A. salsa* (C), *A. truncata* (D), *A. gypsicola* (E), *A. ebracteolata* (F), *A. elatior* (H), *A. eriopoda* (I), *A. turgaica* (J), and *A. jaxartica* (K).



Figure 5. Komarov Botanical Institute of the Russian Academy of Sciences (BIN RAS): *Anabasis ehrenbergii* (A), *A. zoharyi* Iljin (B), *A. haussknechtii* Bge (C), and *A. syriaca* I (D); Central Siberian Botanical Garden of the Siberian Branch of the Russian Academy of Sciences – *A. aphylla* (E).

gypsicola, *A. ebracteolata*, *A. elatior*, *A. eriopoda*, *A. turgaica*, *A. jaxartica*, and *A. brachiata*. The collection also included the herbariums of Blum (1817), Eversman, Gremiatschensky S.J. (1855), L. Kursanova (1898), P. Krylova (1901), N. Kaden (1949), P. Zhudovaya (1950), V. Pavlova (1951), V. Ekzertsev (1960), I. Krasnoborov (1978), G.

Kuznetsova (1993), M. Novikova (2002), and A. Sukhorukov (2006) (Figure 4) (Sukhorukov, 2009). In the Main Botanical Garden named after N.V. Tsitsin of the Russian Academy of Sciences, MHA, Moscow, 86 sheets of the genus *Anabasis* L. exist, with three different species grown in Kazakhstan—*Anabasis aphylla*, *A. salsa*, and *A. cretacea*.



Figure 6. *Anabasis cretacea* (A-O) stored in the herbarium funds of Kazakhstan and neighboring countries.



Figure 7. Personal collection of *Anabasis cretacea* (A-B).

The herbarium of higher plants of the V.L. Komarov Botanical Institute of the Russian Academy of Sciences, BIN, RAS (LE, St. Petersburg) is one of the three largest herbaria in the world and the largest in Russia. It contains 28 sheets of plants belonging to the genus *Anabasis* L. The genus has 15 different species, collected from 1796 to 2018 in various parts of the world, such as Iran, Iraq, Afghanistan, Syria, Saudi Arabia, and Algeria (Figure 5). The digital herbarium of the Central Siberian Botanical Garden SB RAS, NS+NSK, Novosibirsk, contains 28 herbarium sheets of the genus *Anabasis* L., belonging to five different species—*Anabasis salsa*, *A. cretacea*, *A. aphylla*, *A. truncata*, and *A. brevifolia*. The only sample of the species *Anabasis aphylla* L. found in Kazakhstan was a collection from the site in the Atyrau Region (Guryev Region) Besibek-mola tract, solonetzic soils, 17.09.1951, collected by Nepli G.N. (Figure 5).

***Anabasis* L. species distribution**

A list of specimens of the genus *Anabasis* L. collected in the territory of Kazakhstan was available, indicating their location, date of collection, and the name of the collector. The data on the accession label remained unchanged, including the names of the collector, the date of collection, and the geographic and administrative location. Particular attention centered on the relict and endemic species *A. cretacea* (having more than 20 accessions) (Figure 6), including a collection in the field studies in 2025 (Figure 7).

In the herbarium collection of the genus *Anabasis* L. collected from different countries and regions, the most represented species were *A. salsa* (154 sheets) and *A. aphylla* L. (109 sheets), which have an extensive distribution on the Eurasian continent (Table 1). One can also observe that the said species distribution showed a close association with arid ecosystems. In addition, the species revealed an obvious link with the type of soil, the degree of salinity, and moisture content. Some species exhibited endemism and a narrow ecological niche (Table 1).

Section *Adenophora* Iljin.

A. brevifolia is a subshrub that grows on gravelly and clay-saline slopes and scree and flowers in VI. The said species collection came from the different sites, i.e., Ural Region, Kamenny farm area, solonetz (21.VII.1929, Rubtsov N); Karabutak District, upper reaches of the Baz-Kara-butak river, spotted steppe on the watershed, bare clayey solonetz (31.III.1941, Kornilova V.S., L. Smirnov); Karaganda Region, Ulubaysky District (Shubarkul, 19.IX.1948); Northern Prizaisanye, eastern part of the city of Kara-Biryuk, outcrops of bedrock, and rocky-rubble ridge (18.IX.1985, Aralbaev N.K.) (two specimens).

A. turgaica grows on rocky slopes, endemic, and flowers in VII. The said species procurement was from different sites—Karsakpaysky District, South of the Kopa wintering site, on the Zhedeli Uzen River, outcrops on confluent sandstones (26.VII.1947, Kornilova V.S.); Central Kazakhstan, Turgay depression, between the Shagarly Zhylanchik and Sary Turgay rivers, and on destroyed quartz eruptions (10.VII.1948, Kornilova V.S.).

Section *Brachylepis* (C.A.M.) Bge.

A. salsa is a subshrub that grows on solonetz, desert cenoses on gravelly solonetzic soil, wormwood-saline deserts, and plump solonetz and blooms in VII–VIII. The collection points were Central Asia and Kazakhstan, Caspian Ustyurt, and Northern Aral Sea regions (M8), Kazakhstan 48°51'53" N, 51°99'46" E (1855, Coll. Gremiatschensky S.J.); Turgai Region, sandy-clay steppe near the Chelkar railway (09.08.1907, Androsov N.) (two specimens); Guryevsk Region and Novobogatensky District, flat area of a hillock at an altitude of 1.2 m, 47°3'78" N, 50°98'75" E, 24.07.1957. The said species also entailed collection by Zhuzhginov; Kyzylorda Region, along the road, on the sands, along the highway from Kazalinsk to Kyzylorda, N 45°37'069", E 063°55'568", h-103 m (06.01.2019, collected by Veselova P.V., Kudabaeva G.M., Nelina N.V., and OP. Osmanali B.B.).

Table 1. Genus *Anabasis* L. collection in the herbarium.

Countries, regions / Species names	Kazakhstan	Russia					Uzbekistan	Turkmenistan	Kyrgyzstan	Azerbaijan	Mongolia	China
		Orenburg region	Saratov region	Astrakhan region	Volgograd region	Altai region						
<i>Anabasis cretacea</i>	40	5	2									
<i>A. salsa</i>	167	1	2	3	10		2	4			3	
<i>A. aphylla</i>	109			37	20		2			7	4	
<i>A. elatior</i>	23										2	2
<i>A. gypsicola</i>	5											
<i>A. turkestanica</i>	3						12			1		
<i>A. brachiata</i>	26						2	8				
<i>A. eriopoda</i>	33						9			1		
<i>A. brevifolia</i>	5					7				2	41	4
<i>A. truncata</i>	39							1			6	
<i>A. turgaica</i>	6											
<i>A. annua</i>	-						1					
<i>A. jaxartica</i> =	29						5	2		1		
<i>A. hispidula</i>												
<i>A. ebracteolata</i>	1											

According to V.L. Komarov, the said species was extremely polymorphic, varying both in the length of leaves and internodes, juiciness, and stem color, which prompted E. Korovin to distinguish the species *A. depressa* Eug. Kor. as a type of *A. salsa* (Komarov, 1936). The collection points were Ust-Urt, southeast of the Bolshiye Borsuki sands; the Ak-Kulka ravine; and saline desert (8.X.1949, Ageeva N.); Betpak-Dala and Koyushik tract, 3 km from the weather station, on gravelly soil (17 June 1959, Kolesnikova).

As for *A. ramosissima* Minkw., V.L. Komarov reported it as a very young race of the species *A. salsa* (C.A.M.) Benth. (Komarov 1936). The collection points were Ustyurt, northern chink, tertiary clays (12.IX.1947, Solomchenko, Chulanova); Ust-Urt, 11 km northwest of the Aitman well (August 1, 1949, collected by Tarabaeva, determined by Bespayev); and Lake Balkhash, southwest bay, hills, and depressions (VI.16.1969, Ageeva, Amirzhanova).

A. eriopoda—The said species grows mainly in takyr, chalks, and saline saxaul forests, especially in sandy-clayey and rubble-saline deserts with wormwood and wormwood-biyurgun vegetation and flowers in VI-VIII in Buzachi. The said species collection came from the different sites, i.e., Adayevsky District, Buzachi Peninsula, Ashche-Urta tract, secondary scattered sands, and Kol-Bek-bas-Ashche-Urta (3.IX.1926, collected by M.D. Spiridonov); Betpak-dala, rocky hill, lower reaches of the Chu River (30.VII.1941, S.A. Nikitin, M.K. Deulina); Northern Ust-Urt, western cliff of Northern Ustyurt, Monata rise, rocky-rubble slope (13.VI.1987, G.M. Kudabaeva, Nelina); Kyzylorda Region, Karmakshinsky District, Northern Kyzylkum, from the village of T. Komekbaev, 36 km to the southwest, N 44°34'242", E 062°58'149", clayey desert (05.13.2017, collected by Veselova P.V., Kudabaeva G.M., Ospanali B., def. Ospanali B.).

Section *Euanabasis* Bge.

Anabasis aphylla is a subshrub on solonetz, solonetz-salt marshes, takyrs, solonchak saxaul, loess-like sierozems, sands with close saline groundwater, and on the deposits of irrigated crops. Grows in groups or scattered, often over large areas. The said species procurement occurred from the different sites, i.e., Ural region, environs of the town of Guryev, 47°10'68" N, 51°91'69" E (1895, collected by Anonymous); Kazakh ASSR, Sary-Chaganak tract along the B. Uzen river, Slokhinskaya Village, on the salt marsh steppe (1904.VII.21, collected by V. Bogdan); Northern Caspian Region, Western Kazakhstan Region, Taipak district, 48°86'76" N, 51°83'83" E (06.21.1951, collection of V. Pavlov); Western Kazakhstan, Guryev Region, near the village of Irmen, 46°58'33" N, 48°91'67" E (22.08.1993, collected by V. Sagalaev); Kyzylorda Region, the left bank of the Syrdarya river from the village of Zhosaly to Kyzylorda is approximately 10 km. Perennial shrub-forb community with the participation of saxaul N 45°23'2870", E 64°03'9440", h-98 m (09.18.2020, collected by Veselova P.V., Kudabaeva G.M., Nelina N.V., Ospanali B.B.).

A. truncata grows on chalk, variegated clays, solonchak-gravelly slopes of the VII-VIII. Collection points: Semipalatinsk Region, Karkaraly District, sandy steppe (July 3-5, 1890, collected by S. Korzhinsky). The said species collection came from the different sites, viz., Aktobe Province, Mugodzhar, between the Emba and Ashche-sai rivers (a tributary of the Kundyzdy), outcrops of white clays (07.07.1927, collected by Krashennikov I.); eastern low hills, salt marshes near the eastern Chingiz-Tau trails, Zhana-arka ridge (10.VII.1948, A. Gamayunova, A. Vasilyeva); Alma-Ata Region, Uyghur Region, plateau between the Charyn-Temirlik rivers, east of the Katu Mountains (28.IX.1961, Z.V. Kubanskaya); Betpakdala, Central Betpakdala, meteorological station, and southeastern rocky slopes (28.07.1986, collected by Baitenov M.S., Ospanbekova B.K.).

A. brachiata—the said species grows well on chalk, calcareous, and gypsum-bearing

slopes and is an endemic species. The said species procurement transpired from different sites—Kazakh SSR, coast of Sary-Chagan Bay, on the northern shore of Lake Balkhash, rocky slopes (1935.IX.25, N.I. Rubtsov, M.G. Popov); Dzhabul Region, clay desert, Lake Ashchi-kul (12.VI.1940, N.V. Pavlov); Ustyurt, Sam tract, 20 km south of the Kara-kuga k-za, edge of a sor (12.VIII.1947, Petko V.I., Chulanova O.N.); Mangyshlak, Northern Ak-tau in the Kara-Shimrau tract, Upper Cretaceous outcrops (6.VIII.1952, Novikova, Ayazbaeva); Ustyurt, western cliff, Honore Spring, Kogusem Well, Zhosala Rise, on chalk, glided, limestone placers, and gravel-sandy slopes (28.V-1.VI.1986, Kudabaeva, Orazimbetov, Ospanbekova) (two specimens).

A. turkestanica species grows well in clayey, saline deserts; it is endemic and flowers in VII. The said species collection came from the different sites of the South Kazakhstan Region, 28 km west of Arys (10.VI.1959, M.I. Godvinsky); Alma-Ata Region, Kok-su state farm, 1940, *A. elatior* S.A.M. corrected to *A. turkestanica* Kor. (15.XII.1973, U. Pratorov); Ustyurt, Western Chink, Onore Spring, along salt marshes and takyrs (1.VI.1986, Kudabaeva, Nelina, Orazymbet, Ospanbekova) (two specimens).

A. elatior is a low subshrub, growing well on saline saxaul forests, saline edges of sands, desert cenoses on gravelly and saline soils, which flowers in VII-VIII. The said species collection from different sites includes the Ketmen Mountains, foothill plain near the village of Chundzha, hamada (10.08.1937, Popov M., Goloskov, Bykov B.); Zailiyskiy Alatau, piedmont plain near the village of Chilik, salt marsh (09.14.1937, Popov M., Bykov B.) (two copies); Kazakh SSR, northwestern foothills of the Tarbagatai Range (Semipalatinsk Region), small hillock 667 m high, 65 km southwest of the settlement of Koepekty, chye (19.VIII.1966, collected by Z.V. Karamysheva, N.I. Nikolskaya, E.I. Rachkovskaya, I.N. Safronova); Kazakh SSR, spurs of the Ketmen Range, Kattu Mountains, on a rubble-clay slope, opposite the wintering site (16.X.1971, collected and determined by A. Vassiljeva).

A. gypsicola is a subshrub plant that is endemic, with flowering in VII, and grows well on gypsum-bearing, fluffy clays and on saline soils near Arys Station (12.08.1952). The said species entailed collection from the different sites, i.e., Egorov (determined by Ageeva N.T.) (two specimens); Southern Ust-Urt, Ustyurt, western chink, Kol. Kogusem, ascent to Monata, on gypsum-bearing clays (24-28.V.1986, Kudabaeva, Nelina, Orazymbetov, Ospanbekova) (two specimens); Aktobe Region, Bogenbay-shoky Upland, between Chelkar and Irgiz, 40 km from Irgiz (10/28/1998, collected by Aralbaev N., Akhmetova, and Syedina, determined and collected by Danilov M.).

A. jaxartica is an endemic species, with flowering in VI, and grows well on dry solonchaks, solonetzic, rocky slopes. The said species collection emerged in different sites—Kazakh SSR, Karatau, South Kazakhstan Region, rubble trail of the Ulkun-Buru Mountains (14.VII.1930, N.V. Pavlov); Turkestan, Syrdarya District, Kele District, Volkova, Western Betpak-dala, 23 km north of Chulak-Espe (16 VI.1957, M. Godvinsky); South Kazakhstan Region, Suzak District, Prikaratavskaya Plain (27 September.1948, Stepanova); Kyzyl-Orda Region, Yaip-Kurgan District, 3 km northwest of height 232, flat depression at the foot of hills on loamy soils (16.06.1952, collected by Tkanova); Dzhambyl Region, Talas District, Ilyicha Village, intermountain valley, on sierozems, and on ordinary solonchak-loamy soils (15.10.1988, Kolpachnikov, Kazenas O.D.).

A. ebracteolata—The one specimen of the said species has storage in the herbarium collection of the Lomonosov Moscow State University (Figure 4). The said species collection came from different sites, viz., the Mangistau Region; Northwestern Chik of Ustyurt, Beineu District, 13 km northeast of the village of Beineu, and the gypsum slope of a hill (11.09.2001, collected by Sukhorukov A.).

A. cretacea grows well on chalk, limestone, variegated clay and rarely on gravelly slopes. It is an endemic species that blooms in VII-VIII. The said species gained

collections from various sites, i.e., Embensky, Adayevsky District, between the Emba and Ust-Urt Rivers (3.X.1926, collected by Knorring O.) (A); Ural Province, Dzhambeitinsky District, on a chalk outcrop near the Kara-Tai River (31.VII.1927, collected by R.Yu. Rozhevich and N.G. Zhezhel) (three specimens) (B); Dzungarian Alatau, Lepsinsky District, rocky-rubble desert in the Dzungarian Gates (27.VII.1928, S.Yu. Lipshits) (C); western small hills, Kzyl-Orda District, middle part of Karsakpai District, near the Aral-Tyube Hill, rocky peak of the Aral-Tyube Mountain (9.VII.1929, collected by N.V. Shipchinsky) (D); Aktobe Region, chalk mountains, cattle breeder No. 48 (06.09.1930, collection of Skryabin, identified by Dmitrieva) (E); Ural District, southwestern slope to the Burli River at the exits (04/03/1930, Rubtsov, Dmitrieva) (F); Kazakh ASSR, Ural District, Dzhambeitinsky District, near the village of Ak-Bulak, on chalk deposits (15.VII.1930, N. Rubtsov) (G); Tobolsk-Ishim, Kustanai District, along the road between the villages of Shorakul and Koblansky, on the slopes (11.V.1931, determined by M. Avramchik) (H); Bekpak-dala, Kazakh SSR, Northeastern Balkhash Region, in the vicinity of Bes Aba Hills, shale outcrops (4.VII.1938, A. Dmitrieva) (I); Ustyurt, vicinity of the Kos-Kuduk Well, takyr (8.V.1941, Ageeva N.) (J); Central Kazakhstan, to the east of the right bank of the Dulygasy Zhilanchik River, 3 km from the cliff of tertiary clays at an altitude of 300 m, on the slope of "floury" sands, very rare (06.08.1947, Kornilova V.S.) (three specimens) (K); Aktobe Region, Baiganinsky District, white clay (25.06.1950, collected by Tukanova, determined by Lozhkova) (L); Tarbagatai, foothills of the southern slope of the Ters-airyk Ridge, foothills (11.08.1950, Bykov, Stepanova) (four specimens) (M); Dzhzhkazgan Region, 10 km north of Nikolsky, clayey red hills (12.VII.1982) (N); Western Kazakhstan Region, Aktau Tract, Mirgorodsky northwest, Burlinsky District, slopes of chalk mountains, fescue-wormwood association (collected by Zhovtobruk, collected and verified by Darbaeva T.E.) (O) (Figure 7) (Darbaeva, 2007).

***Anabasis cretacea* Pall and its location**

In botanical and geographical terms, the Aktobe Region was particularly interesting as one of the most significant industrial regions of Kazakhstan. On its territory, unique steppe communities, chalk massifs, relict forests, and swamp areas have reached preservation, requiring protection of the flora (Aipeisova, 2011). S.A. Aipeisova classifies such obligate calciphyte flora comprising the species *Anthemis trozkiana*, *Linaria cretacea*, *Silene cretacea*, *Artemisia salsoides*, *Crambe tataria*, *Capparis herbacea*, *Anabasis cretacea*, *Matthiola frangans*. Others are *Anabasis salsa*, *Nanophyton erinaceum*, and *Thesium refractum*, as desert-steppe Pliocene relicts (Aipeisova, 2013a; 2013b).

The species *Anabasis brachiata*, *A. cretacea*, *A. eriopoda*, and *A. truncata* as Aral-Caspian relicts received classification from Darbaeva (2007) and Darbaeva and Karagoishin (2007). Moreover, S.A. Aipeisova carried out an analysis of the family Chenopodiaceae. Such analysis had the flora of the Aktobe floristic district, the genus *Anabasis* L., with representations of four different species, i.e., *Anabasis aphylla*, *A. cretacea*, *A. salsa*, and *A. truncata* (Aipeisova, 2007). On chalk outcrops, one can encounter the most ancient representative of the flora—the relict species *Anabasis cretacea*, with its first description from the German-Russian botanist Peter Simon Pallas in 1771. Darbaeva (2006) considers the species *Anabasis cretacea* to be a paleorelict with a Miocene-Pliocene age.

The species *Anabasis cretacea* is a perennial herbaceous plant of the family Chenopodiaceae, which includes more than 100 genera and about 1500 species of predominantly herbaceous plants (less often shrubs and small trees) (Belousova *et al.*, 1979). The species *Anabasis cretacea* prevails in Southeastern European-Kazakh petrophytic-steppe species, common in Southeastern Eastern Europe, the Mediterranean, and the South of Western and Central Asia (Belov, 2019). The said species grows well on chalk, less commonly on marly outcrops or variegated (gypsum-bearing) clays—a characteristic species of chalk hills (Ryabinina, 1998). The

research conducted in June-August 2025 confirmed the distribution of the species *Anabasis cretacea* on chalk uplands and cliffs. The exact location of the relict species *Anabasis cretacea* was noteworthy in the Khobdinsky District, on the Ishkargantau chalk massif, with coordinates N 50°32'13.3", E 054°54'32.2", h-241 m. The population's discovery occurred southwest of the village of Akyrap, on the chalk ridge of the Ishkaragan River valley.

The geodatabase (<https://github.com/Asstra-BU/-Anabasis-cretacea-Pall-.git>) of specimens of the relict species *Anabasis cretacea* Pall and the size of the herbarium collection of the genus *Anabasis* L. by country and region in the format of a standardized Darwin Core table (occurrence.csv) had the following fields: occurrenceID, scientific name, country, region, locality, collection date, location, geographic location, collectors, etc.

CONCLUSIONS

Based on the presented results of studying the herbarium collections of Kazakhstan and neighboring countries, successful identification of 13 species of the genus *Anabasis* L. occurred in Kazakhstan. These are *Anabasis aphylla*, *A. salsa*, *A. cretacea*, *A. truncata*, *A. gypsicola*, *A. elatior*, *A. eriopoda*, *A. jaxartica*, *A. brachiata*, *A. brevifolia*, *A. turgaica*, *A. turkestanica*, and *A. ebracteolata*. In the study area located in the Aktobe Region, Kazakhstan, confirmation of five species, namely, *Anabasis cretacea*, *A. gypsicola*, *A. aphylla*, *A. salsa*, and *A. truncata*, succeeded, with the growth sites of the relict species *Anabasis cretacea* Pall. also confirmed. The study also clarified the species composition, abundance, and geographical distribution of the genus *Anabasis* L. in herbarium collections by country and region.

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