

DISTRIBUTION OF ACANTHOPHYLLUM GYPSOPHILOIDES REGEL IN CENTRAL ASIA

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Jorayev Z. N

Akbarov F. I

Razzaqova O. B

¹*Junior Researcher, Institute of Botany, Academy of Sciences, Republic of Uzbekistan.*

²*PhD Student, Institute of Botany, Academy of Sciences, Republic of Uzbekistan.*

Annotatsiya: *Based on the analysis of literary sources, major herbarium collections (funds), and online databases, information regarding 130 herbarium specimens and photographs of the investigated species was compiled. This data was analyzed over the years to study the annual dynamics of specimen collection. Furthermore, the most effective collectors who contributed to the species collection were identified, and the main herbarium funds were investigated. As a result of this study, a modern distribution map of the species across Central Asia was created for the first time, and a synopsis detailing its distribution by country is presented.*

Keywords: *Acanthophyllum C.A. Mey., Acanthophyllum gypsophiloides Regel, herbarium, collector, geographical distribution.*

INTRODUCTION

Acanthophyllum C.A. Mey. (1831: 210) is a genus belonging to the family Caryophyllaceae Juss (1789: 299). This family encompasses 81 genera and 2,625 species ("Caryophyllaceae Juss." Plants of the World Online, Royal Botanic Gardens, Kew, retrieved 2025-09-03), while 348 species from 32 genera occur in Central Asia (Li & Tojibaev, 2025). The main distribution range of the genus *Acanthophyllum* is the Irano-Turanian region, and it consists of about 80–90 perennial subshrub species (Bittrich 1993, Ghaffari 2004, Pirani et al. 2014). Of these species, 31 are found within the territory of Central Asia (Li & Tojibaev, 2025). Furthermore, according to the phylogenetic studies by Pirani and colleagues (2014), this genus is divided into 11 sections.

Acanthophyllum gypsophiloides Regel (1877: 249) (syn. *Allochrusa gypsophiloides*) is a perennial herb with a height between 30–60 cm. Its stems are slender and numerous. The leaves are 10–25 mm long, flat, subulate, and spineless.

The pink flowers form a diffuse paniculate inflorescence at the top of the stem. The fruit is a capsule (Figure 1.). It flowers in May–August, and the fruits ripen in August–September (Red Data Book of the Republic of Uzbekistan (2019).). It is an endemic species to Central Asia (Kamelin, 2017.), mainly growing on gravelly slopes of foothills (Bondarenko, 1971.). This plant holds significant economic importance due to its phytochemical composition, particularly the high level of triterpene saponins in its roots (Khatuntseva et al. 2012). Historically, its raw material was widely used in the food, pharmaceutical, construction, and perfumery industries (Jakimiuk et al. 2022; Temirgaziev et al. 2019). The annual collection volume of its dry roots reached 700–800 tons in the last century, which testifies to the intensive exploitation of its resources (Mamadalieva et al. 2024).

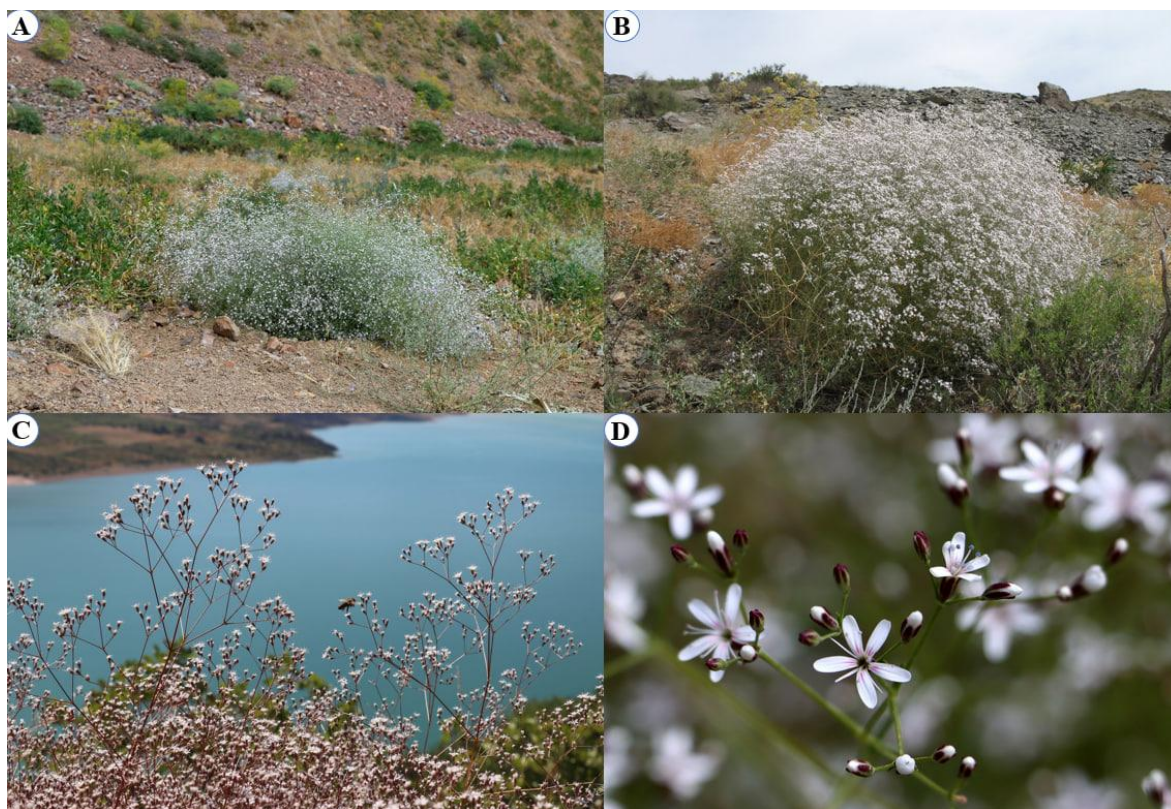


Figure 1. *Acanthophyllum gypsophiloides* Regel

A) General view (Photo by To'lg'in Tillayev, 13.06.2012. www.plantarium.ru). B) General view (Photo by Vladimir Kolbintsev, 13.06.2012. www.plantarium.ru). C) View of the inflorescence (Photo by Nataliya Beshko, 22.07.2024. www.plantarium.ru). D) Flower (Photo by Doston Turdiyev, 22.07.2024. www.plantarium.ru).

Based on the foregoing, the objective of this study is to critically analyze all available information regarding the distribution of the species *A. gypsophiloides* in Central Asia by reviewing fundamental literature, major herbarium funds, and modern online platforms, to prepare a synopsis of its geographical distribution at the country level, and to create a distribution map based on georeferenced data.

MATERIALS AND METHODS

To visualize the georeferenced herbarium specimens available in the database on a grid map, SDMtoolbox v10.9 was used for integrating species diversity indices and collection density indicators into Microsoft Excel, using ArcGIS v10.6.1. The conversion from shapefile format to kml and kmz formats to ensure the integration of the grid map with mobile applications (Tracklia, Google Earth) was performed using ArcGIS v10.6.1 software. JASP v14 software was used to perform statistical analyses. The data pool was formed using materials from the TASH and MW herbarium funds, materials uploaded to the GBIF portal (BR, EURISCO, K, NL, OPUN, USNM, US, MO), online platforms (plantarium.ru, iNaturalist, and gmoca.org), and herbarium data collected during field surveys.

ANALYSES AND RESULTS

Herbarium Specimen Analysis:

When analyzing the collection dynamics of herbarium specimens in the 20th century, the highest intensity corresponded to the years 1921–1940. These years can be linked to the peak period of flora research in Central Asia and the active publication of national floras. Due to the development of the information age and the formation of digital online platforms, the distribution of species in the 21st century is being uploaded to information sites such as iNaturalist, plantarium.ru, gmoca.org, and GBIF (Global Biodiversity Information Facility). This is substantiated by 59 records of georeferenced data collected between 2001 and 2024.

During the analysis of herbarium specimens, the MW and TASH herbarium funds were found to be leading in terms of the largest collections and the number of specimens stored (Table 1).

Among the most effective collectors for this species, whose specimens are stored in the MW herbarium fund, are Khlebnikova, Pavlov N. V., Parfentyeva N. S., and Chilikina L. (Table 2).

Table 1.**Analysis of Herbarium Funds Storing Species Specimen**

No	Existing Herbarium Databases and Digital Information Websites	Herbarium	Number of Records	Number of Collectors	Collection Years
		Number of Specimens			
1	Moscow University Herbarium (MW)	40	7	0	1914-1989
2	Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan (TASH)	37	9	4	1934-2020
3	Plantarium: Plants and Lichens of Russia and Adjacent Countries: An Open Online Atlas and Plant Identification Guide	19			2011-2024
4	Grid Mapping of Central Asia Plants (https://www.gmoca.org/)	9			2023
5	iNaturalist Research-grade Observations	6			2016-2024
6	Royal Botanic Gardens, Kew - Herbarium Specimens	4			1876-2008
7	NMNH Extant Specimen Records (USNM, US)	4			1880-1881
8	Naturalis Biodiversity Center (NL) - Botany	3			1973-1958
9	OPUN - Middle Asia	3			2009-2018
10	Meise Botanic Garden Herbarium (BR)	2			1881
11	Tropicos MO Specimen Data	2			1965-1968
12	EURISCO, The European Genetic Resources Search Catalogue	1			-

Table 2.**Effective Collectors of Herbarium Specimens**

	Collector Name (F.I.SH.)	Number of Herbarium Specimens	Number of Records	Collection Years	Existing Database
	Capus M.	2	1	1881	BR, US
	Fedtschenko	2	1	*	US, NL
	Landrein S.	1	1	2008	K
	Nikitina, E. V.;et al.	1	1	1968	MO
	Nowak Arkadiusz	1	1	2018	ZSA
	Nowak Arkadiusz, Nobis Marcin	2	2	2009- 2010	ZSA
	Regel A.	4	4	1880	BR, US, K
	Sudnitsyna, I. G.;et al.	1	1	1965	MO
	Vasák V	1	1	1973	NL
0	Z. von Minkwitz.	1	1	1914	MW
1	A. Markova, A. Medvedeva	1	1	1958	NL
2	Abdullaeva M.	1	1	1964	TASH
3	Abduraimov A.	3	2	2019	TASH
4	Barabanov E.	1	1	1961	MW
5	Beshko N. Yu.	2	2	2012- 2013	TASH
6	Bogdanovich N.	2	1	1927	TASH
7	Vvedensky A. I.	3	2	1927	TASH
8	Vernik	5	1	1946	TASH
9	Vipper P.	3	1	1943	TASH
0	Gnezdillo A.	1	1	1934	TASH
	Drobov V. P.	1	1	1919	MW

1					
2	Dukhananov	1	1	1969	MW
3	Ilyin M. M.	1	1	1930	MW
4	Klyuikov E. V.	1	1	1989	MW
5	Kultiasov M.	1	1	1922	MW
6	Massagetov	1	1	1932	MW
7	Meien S.	1	1	1952	MW
8	Mikeshin G.	1	1	1934	MW
9	Nabiev M., et al.	1	1	1978	TASH
0	Nazarenko	1	1	1953	TASH
1	Nikolaev A.	1	1	1935	MW
2	Pavlov N. V.	6	5	1931-1953	MW
3	Parfentyeva N. S.	4	2	1952	MW
4	Pimenova M. E.	1	1	1974	MW
5	Pitaeva I.	3	1	1965	TASH
6	Pyataeva A. D.	2	2	1934-1935	TASH
7	Tekutyev G. V.	3	3	1935	MW
8	Tojibaev K., et al.	12	1	2020	TASH
9	Turginov O. T.	3	3	2012	TASH
0	Hamidov G.	1	1	1973	TASH
1	Khasanov F.	1	1	1983	TASH
2	Khlebnikova	5	4	1934-1935	MW
3	a Kholmukhamedov	1	1	1976	TASH
	Chilikina L.	4	3	1934-	MW

4				1936	
5	Esankulov A.	1	1	2012	TASH
6	Unknown Collector	4	3	1931	MW, EURISCO

Online Platforms

7	Epiktetov V.	2	1	2016	plantarium.ru
8	Tillaev T.	1	1	2024	plantarium.ru
9	Kolbintsev V.	4	3	2012- 2017	plantarium.ru
0	Davkaev E.	9	2	2011- 2014	plantarium.ru
1	Gaziev A.	3	1	2015	plantarium.ru
2	Vladimir Epiktetov	1	1	2016	iNaturalist.org
3	Turdiev D.	2	1	2024	iNaturalist.org
4	Aleksandr Ebel	3	2	2023- 2024	iNaturalist.org
5	Tajidinova, Karimov	2	1	2023	gmoca.org
6	Sotiboldiev O.	7	1	2023	gmoca.org

When the collection of herbarium specimens in the 20th century was analyzed across 20-year intervals, the periods from 1901–1980 were found to be dominant. This situation can be explained by the periods of publication of the Central Asian plant identification guides and local floras of the former Soviet Union (USSR) (Figure 2.).

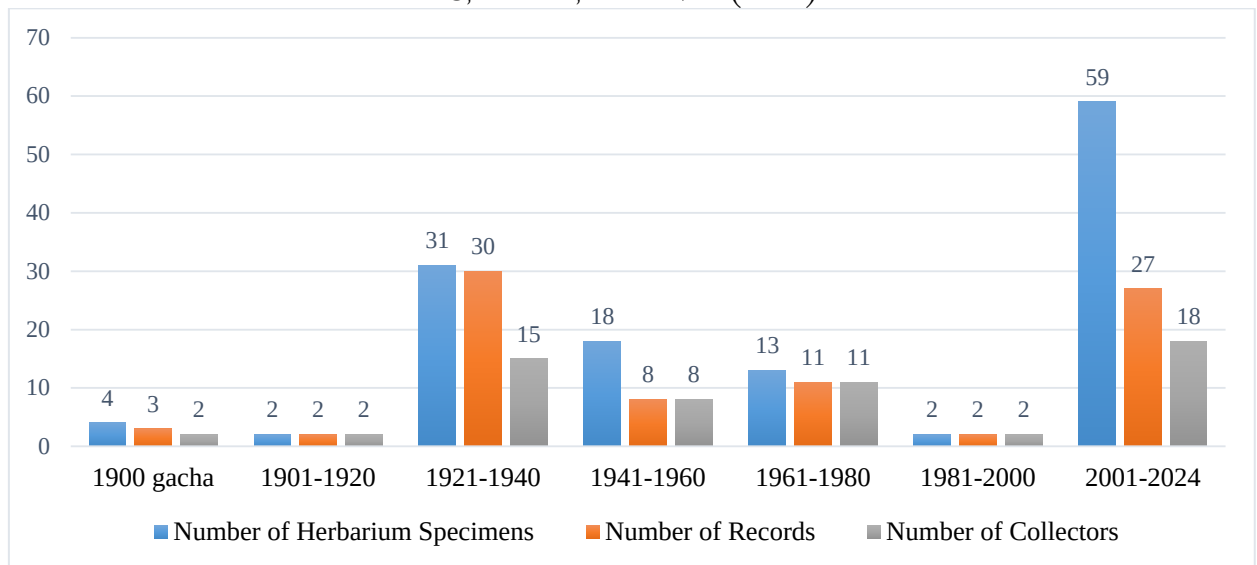


Figure 1. Dynamics of Herbarium Specimen Collection

Of the 130 herbarium specimens collected from herbarium funds and digitized information websites, it was observed that 3 (2.3%) lacked label information, 3 (2.3%) lacked the collection year, 8 (6.15%) lacked the collection month, 12 (9.3%) lacked the collection day, and 4 (3%) lacked the collector's name. Due to the aforementioned issues and other influencing factors, we were unable to perform georeferencing for 3 (2.3%) of the herbarium specimens. Ultimately, a distribution map of the species across Central Asia was developed. The regions where the highest number of herbarium specimens of this plant—whose primary distribution area is the Western Pamir-Alay and Western Tien Shan—were collected are Kazakhstan and Uzbekistan (Figure 3).

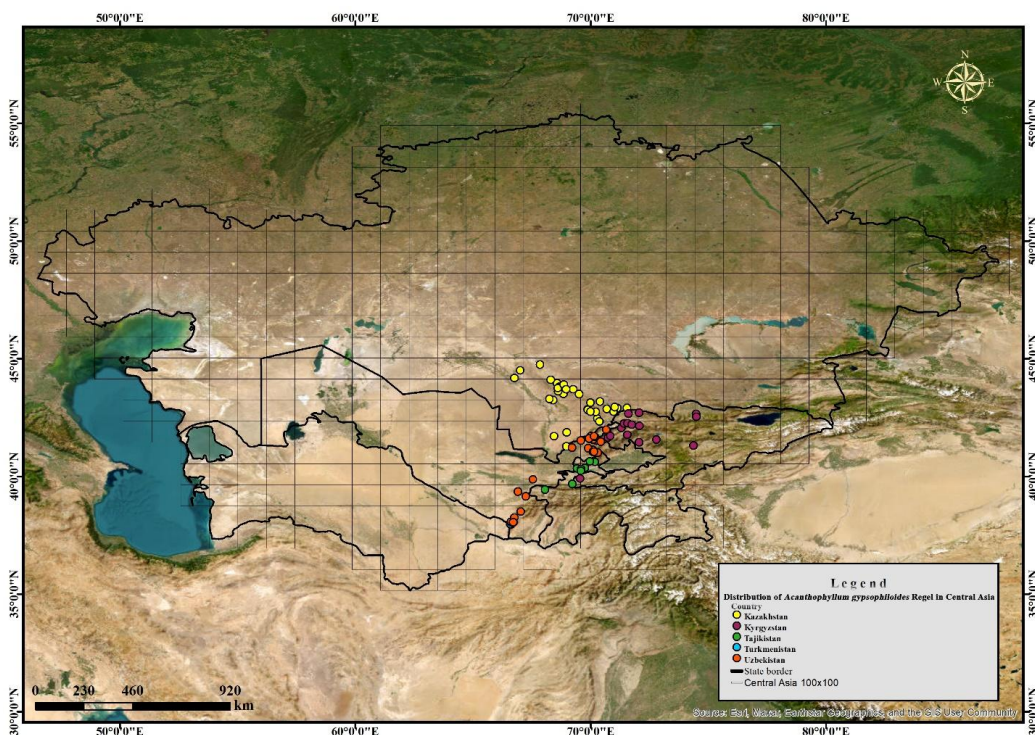


Figure 3. Distribution Status of *A. gypsophiloides* in Central Asia

Synopsis of the Geographical Distribution of Herbarium Specimens and Digitized Photo Materials Across Central Asian Countries:

Kazakhstan: Iter Turkestanicum. Boraldai, 1876, Regel A., Schmalhausen 37 (K); Turkestan. Boraldai, *Regel A.* s.n. (US)(BR); Syr-Darya Province. Chimkent Uezd. Kiche-Tura Mountains, 11.07.1922, *Kultiasov M.* 101 (MW); Karatau Range. Kuyuk-tau Mt., 17.07.1931, 246 (MW); Karatau Range. Kuyuk-tau Mt., 22.07.1931, (MW); Karatau Range. Kuyuk-tau Mt., 23.07.1931, 308 (MW); Karatau Mountains, stony slopes near Saya-su River, 25.06.1931, *Pavlov N. V.* 376 (MW); Karatau Range. Gravelly-fine earth eastern slope of Uzak-tsya Tract, 15.07.1934, *Pyataeva A. D.* 509 (TASH!); Karatau Range. Bastau, Tash-tal River valley, 11.07.1934, *Mikeshin G.* (MW); Karatau Expedition. Karatau. Koktau Mt. near Leninsky village, South slope, 02.06.1934, *Chilikina L.* 147 (MW); Karatau Range. Kok-tau River, near Akchatau village. Stony slopes of the peaks, 05.07.1934, *Chilikina L.* 147 (MW); Karatau Range. Karatau along the slope of a steppe hill near Vishnevsky settlement, 09.07.1934, *Pavlov N. V.* 401 (MW); Karatau Expedition. Karatau Range. Southern slopes, eastern exposure, 25.06.1934, *Khlebnikova* (MW); Karatau Expedition. Karatau Mountains, 06.07.1934, *Khlebnikova* (MW); Western Tian Shan. Karatau Mountains, 1935, *Pyataeva A. D.* (TASH); Karatau Range. North-western part, 10.06.1935, *Tekutyev G. V.* 229 (MW); Karatau Range. North-western part, 16.06.1935, *Tekutyev G. V.* 312 (MW); Karatau Range. North-western part, 13.06.1935, *Tekutyev G. V.* 214 (MW); Karatau Range. Karatau Mountains, 17.06.1935, *Nikolaev A.* (MW); Karatau Expedition. Karatau Mountains. Kok-sai Tract, fine-earth slope, 1935, *Khlebnikova* (MW); Karatau Expedition. Karatau Mountains. Kok-sai Tract, fine-earth slope, 12.07.1935, *Khlebnikova* 576 (MW); Western Tian Shan. Eastern part of Karatau Mountains. Northern foothills. Gravelly-fine earth slope of a ravine near Suleyman-sai mine, 19.06.1936, *Chilikina L.* 418 (MW); Keles District. At the bottom of a ravine, 01.07.1946, *Vernik* (TASH); Keles District. Southern foothills of Alimtau Mt., 01.07.1946, *Vernik* (TASH); Keles District. At the bottom of a ravine. Near Kaunchi collective farm, 01.07.1946, *Vernik* (TASH); Dzhabul Steppe Plain. By the road between Sulu-tyube and Bashi-tyube, 25.06.1948, *Pavlov N. V.* (MW); Turkestan Province. Approximately 50–60 km northeast of Turkestan city. At the north-western foothills of the Karatau Range. Near the Moyynkum desert, 03.06.1952, *Parfentyeva N. S.* 8 (MW); Karatau Expedition. Karatau Mt., Kurman-sai River valley with an apricot grove. Along the bed of a mudflow stream 2 km from the mouth, 20.06.1952, *Parfentyeva N. S.* (MW); Karatau Expedition. Kara-Tau, 20.06.1952, *Meien S.* (MW); Chimkent Province. Sardaryinsky Karatau, Eastern, 19.07.1974,

Pimenova M. E. 948 (MW); Chimkent Province. Beltau (Alatau) Mountains, 21.05.1989, *Klyuikov E. V.* 505 (MW); Verkhniy Borolday, Karasay gorge, eastern ridge, 30.06.2011, *Davkaev E.* (www.plantarium.ru); Karatau Range, Kuyuk pass, 1050 m a.s.l., 13.06.2012, *Kolbintsev V.* (www.plantarium.ru); Alatau Mountains (Daubaba), Vostochnoe gorge, 14.06.2014, *Davkaev E.* (www.plantarium.ru); Syrdarya Karatau, Ulkunburultau Mountains, ≈ 900 m a.s.l., dry steppe on fine-earth, 28.06.2016, *Kolbintsev V.* (www.plantarium.ru); Karatau Range. Baidibek District, 18.05.2023, *Aleksandr Ebel* (www.plantarium.ru); Karatau Range. Baidibek District, 17.05.2024, *Aleksandr Ebel* (www.plantarium.ru); Ulkun-Burlya-tau Mountain, Kok-tebe soilless steppe at the foothills on their fan, 30.06.1930, *Ilyin M. M.* 12 (MW); Kazakh SSR, Dzhambul Province, Karangu Mountain, foothill steppe below Myn-tyube peak, 28.06.1940, *Pavlov N. V.* 787 (MW); Western spurs of the Kirghiz Range, Botamoynak Mountains in the vicinity of Taraz city, gentle stony slope of the northern exposure near the ridge, ≈ 950 m a.s.l., 25.06.2017, *Kolbintsev V.* (www.plantarium.ru); Talass Alatau. Aksu-Zhabagly Reserve, Aksu canyon, 14.07.1961, *Barabanov E.* (MW); Tian Shan, Talass Range, Aksu-Zhabagly Reserve, Aksu canyon, 21.06.2016, *Epiktetov V.* (www.plantarium.ru); Tyulkubas District, 21.06.2016, *Vladimir Epiktetov* (www.plantarium.ru).

Uzbekistan: Tashkent. Turkestan, 1878, *Fedtschenko O.* s.n. (US); Tashkent. Turkestan, 1878, *Fedtschenko O.*, *Korolkow* 24 (NL); Tashkent Alatau. Charik Stream, 20.05.1880, *Regel A.* s.n. (US)(K); Syr-Darya Province. Tashkent Uezd. Sergeli stony hills in northern Kok-Yangaq, 22.06.1919, *Drobov V. P.* (MW); Bostanlyk, Ugam Range. Signak-sai. Stony slopes, 2000 m, 22.07.1953, *Pavlov V.* 433 (MW); Ugam River Gorge. Stony slopes, 12.07.1958, *Markova A.*, *Medvedeva A.* (NL); Uzbekistan, Tashkent Region. Galva-sai (Kazan-kent). By the road, 08.07.1969, *Dukhananov* 933 (MW); Western Tian Shan. Chatkal Range, Kaynarsay Tract. 26.06.1973, *Hamidov G.* 48 (TASH); Asia centralis, 35 km situated north-east of the center of Tashkent city, near Ak-kalak village, 03.07.1973, *Vasák V.* s.n. (K)(WAG); Western Tian Shan. Cherek River basin. Beginning of the foothills 1000 m, 01.07.1976, *Kholmukhamedova* (TASH); Chatkal Range. Tashkent Region. Maidantal section of the Chatkal Reserve. Tashkesken. Confluence of Tashkesken with Bolshoy Piyazly Stream. Fine-earth slope in the mountain steppe, 10.08.2013, *Beshko N. Yu.* (TASH); Uzbekistan, Tashkent Region, western spurs of the Chatkal Range, slope above the Chatkal River opposite Obirahmat Tract, 09.06.2015, *Gaziev A.* (www.plantarium.ru); Uzbekistan, Tashkent Region, southern slope of the Chatkal Range, Ahangaran River basin, vicinity of Yangiabad town, right bank of Katta-sai River, stony-sandy soil, 13.07.2024, *Tillaev T.* (www.plantarium.ru); Uzbekistan. Tashkent Region, Bostanlyk District, 22.07.2024,

Turdiyev D. (www.inaturalist.org); Western Tian Shan. Kurama Range. Maylikutansky River valley, h-1415 m, 01.06.2020, *Tojibaev K. et al* 1062119 (TASH); Western Tian Shan. Kurama Range. Maylikutansay River valley. 1370 m, 01.06.2020, *Tojibaev K. et al* 1062139 (TASH); Malgozar Range, northern slope. Pishagarsay, h=1200 m a.s.l. Valley of a dry stream, 16.07.2012, *Beshko N. Yu.* (TASH); Jizzakh Region. Zaamin District. Northern slope of the Malgozar Range. Pishagarsay, 16.07.2012, *Esankulov A.* (TASH); Zarafshan Range. Aman-Kutan. Herbaceous steppe on dry slopes, 21.07.1932, *Massagetov* 12-136 (MW); Kashkadarya Region. District: Kitab Reserve. Tract: Darape. Dry steppe, 21.05.1943, *Vipper P. s.n.*, 112 (MW); Pamir-Alay. Spurs of Southwestern Gissar. Baysuntau. Kyzylkum, 05.05.2012, *Turginov O. T.* (TASH); Pamir-Alay. Spurs of Southwestern Gissar. Baysuntau, Machay-darya River basin. Upper Machay, 02.06.2012, *Turginov O. T.* (TASH); Pamir-Alay. Spurs of Southwestern Gissar. Baysuntau, Machay-darya River basin. Upper Machay. 13.05.2012, *Turginov O. T.* (TASH); Torkopchigay BGR. Kashkadarya Region. Dekhkanabad District. Sebatlik. h-1585, 29.06.2019, *Abduraimov A.* 29062019041 (TASH); Torkopchigay BGR. Kashkadarya Region. Dekhkanabad District. Kunokdara. h-1408, 30.06.2019, *Abduraimov A.* 30062019054 (TASH); Uzbekistan. Surkhandarya, Kamchibulak, 18.06.2023, Tajidinova, *Karimov* (www.gmoca.org); Uzbekistan. Surkhandarya, Kamchibulak, 16.06.2023, *Sotiboldiev O.* (www.gmoca.org).

Kyrgyzstan: Tian Shan. Northern slopes of the Kyrgyz Alatau. Middle part of the Ala-Archa River valley, 01.07.1965, *Pitaeva I.* 286 (TASH); Basin of the Kaza-Archa River, its tributary Tauk, right bank, 26.07.1968, *Nikitina, E. V. et al.* 1 (MO); Namangan Uezd, Padsha-ata River valley, between the mouths of Iersu and Kaznakh-Terek rivers, 12.07.1914, *Z. von Minkwitz* 1553 (MW); Chatkal River Basin, its tributary Tez Sandalashsky Range, southeastern slope, 19.07.1965, *Sudnitsyna, I. G. et al.* 2 (MO); Jalal-Abad Oblast, Chatkal Rayon, Gazetteer Ters Valley, outside Besh-Aral State Res[erve], 09.07.2008, *Landrein S.* 160 (K); Kyrgyzstan. Jalal-Abad Oblast, near Tash-Kumyr city, 14.07.2018, *Nowak Arkadiusz* (ZSA); Kyrgyzstan, Dosgon Pass 3330 m a.s.l. - stony, gravelly slope, 12.08.1964, *Abdullaeva M.* 329 (TASH).

Tajikistan: Kara Koraum; Turkestan, 28.08.1881, *Capus M.* 203 (US) (BR).

Turkmenistan: Kugitang Range. 2 km northeast of Hojapil (Khojapiy) spring on variegated formations (pestrocvet), 16.05.1978, *Nabiev M., Li, Tsukervanik* 292 (TASH); Kugitang-tau, op. №9 Hojapil pistachio 600 m, 27.06.1983, *Khasanov F.* (TASH).

CONCLUSION

A. gypsophiloides holds significant economic importance due to its phytochemical composition, particularly the high level of triterpene saponins in its roots. Historically, its raw material was widely used in the food, pharmaceutical, construction, and perfumery industries. The annual collection volume of dry roots reached 700–800 tons in the last century, which testifies to the intensive exploitation of its resources. The uncontrolled and large-scale harvesting of roots led to a sharp decline in population numbers and a significant reduction in the species' range. As a result, *A. gypsophiloides* has been included in the Red Data Books of Uzbekistan, Kazakhstan, and Kyrgyzstan. Despite the high economic importance and urgent conservation status of the species, there is a lack of generalized modern information regarding its current distribution status, range boundaries, and populations across the Central Asian scale.

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