Scientific Research Publishing

American Journal of Plant Sciences, 2023, 14, 613-624
https://www.scirp.org/journal/ajps
ISSN Online: 2158-2750
ISSN Print: 2158-2742

Analysis of the Distribution of *Tulipa fosteriana* and *Tulipa ingens*. The Importance of Protecting Wild Plants, in Particular Tulips All over the World

Shukrullozoda Roza Shukrullo Qizi[1*], Dekhkonov Davron Burxonovich[2], Khaydarov Khislat Kudratovich[3], Umurzakova Zebuniso Iskandarovna[3], Olimjonova Sadoqat Gùlomjon Qizi[1], Norimova Guljakhon Komiljon Qizi[3]

[1]Department of Genetics and Biotechnology, Samarkand State University, Samarkand, Uzbekistan
[2]Department of Biology, Namangan State University, Namangan, Uzbekistan
[3]Department of Botany, Samarkand State University, Samarkand, Uzbekistan

Email: roza_shukrullozoda@mail.ru

How to cite this paper: Shukrullo Qizi, S.R., Burxonovich, D.D., Kudratovich, K.K., Iskandarovna, U.Z., Gùlomjon Qizi, O.S. and Komiljon Qizi, N.G. (2023) Analysis of the Distribution of *Tulipa fosteriana* and *Tulipa ingens*. The Importance of Protecting Wild Plants, in Particular Tulips All over the World. *American Journal of Plant Sciences*, **14**, 613-624.
https://doi.org/10.4236/ajps.2023.145041

Received: March 4, 2023
Accepted: May 28, 2023
Published: May 31, 2023

Abstract

The assessment of the distribution and importance of the protection of tulip varieties around the world and separately rare, wild-growing ancestors of cultivated tulips, in particular *Tulipa fosteriana* and *Tulipa ingens* on the globe, including Central Asia, Uzbekistan and the Samarkand region, was described. A distribution map was introduced to visualize the data. Information about the morphological description of the studied species was also given.

Keywords

Distribution Area, Threat of Extinction, Protection, Subpopulation, "Hot Spot"

1. Introduction

Tulips are taxonomically complex. The reasons are complex and possibly numerous. For one reason, many tulips grow in non-native places on remote hills and valleys, where winters are harsh and summers are long and dry. There they can bloom only for a short time before going underground. Local botanists can thoroughly know the flora of their country, but to get a general idea of a species or group of closely related species, they need a broad geographical perspective, which is not easy when one species can be found on a vast territory covering several countries [1].

The problem of protecting the environment and flora is of great and vital im-

portance for all mankind. Using natural resources, people negatively affect the natural age-old landscapes. The increased development of industry and agriculture, extensive recultivation of natural areas has led to a violation of the ecological balance. As a result, the risk of impoverishment of the species composition of the flora and loss of the plant gene pool increases.

About 4500 species of wild higher plants and more than 2000 species of fungi grow on the territory of Uzbekistan. About 400 of them are rare, endemic and relict species (10% - 12% of the flora). Effective measures are needed to protect them [2]. The disappearance of any species leads to irreversible consequences, as wild plants serve as raw materials for the creation of valuable varieties of many crops. Uzbekistan, located in the heart of the Eurasian continent, has a high level of plant diversity and endemism, especially in some genera, including tulips [2] [3].

The areas where most tulip species live are described in the Flora of the former USSR (including Russia, Central Asia and the Caucasus), the Flora of Iran (including Iran, Afghanistan, west Pakistan, northern Iraq, Azerbaijan, Turkmenistan), Kazakhstan, Tajikistan and Uzbekistan [4]. The study and assessment of the current distribution of tulip species, the number and causes of their disappearance in the Central Asian region are very important. Wild tulips are a national treasure not only of Uzbekistan, Kazakhstan and Kyrgyzstan, but also of all mankind, since they have long been used in decorative gardening all over the world, especially in the Netherlands [2].

Tulips (Tulipa spp.) are one of the most popular ornamental plants. Wild species of tulips, due to the attractiveness of their flowers and importance for reproduction, have always been one of the priority objects of conservation [5]. Currently, populations of the *Tulipa* species that came from Central Asia are declining.

2. Materials and Methods

The purpose of this article is to analyze the species richness of tulips, especially *Tulipa fosteriana* and *Tulipa ingens* on the globe, in Central Asia, in Uzbekistan and in the Samarkand region.

Wild ancestors of cultivated tulips were studied as the object of the study: *Tulipa fosteriana* and *Tulipa ingens*, common in the Samarkand region. According to the literature data, the distribution of these species was studied in stages: 1) on the Globe, 2) in Central Asia, 3) in Uzbekistan, 4) in the Samarkand region.

Distribution maps are analyzed and distribution maps of the studied samples across Uzbekistan are constructed.

Wild tulips are the most impressive plants from the whole variety of flora of Uzbekistan. In recent decades, as a result of intensive anthropogenic impact, the range and the number of populations of many species of tulips have significantly decreased. Thus, increased industrial harvesting has led to a reduction in the area of the tulip—*Tulipa*. A significant number of species are on the verge of extinction. Uncontrolled collection of rare medicinal and edible plants (especially

bulbous, bulbous-tuberous, rhizomatous, excavated with the help of underground plants), which is taking on an increasingly threatening scale, causes great damage to wild flora. Thus, all the studied populations are viable with a sufficient number of generative individuals providing seed reproduction [2].

The current Red Book of Uzbekistan [6] includes 18 species of tulips, 20 species are protected in national parks and reserves. But in 2011, none of the Central Asian tulips was included in the IUCN Red List of Threatened Species. However, as of today, in 2022, 24 species of tulips of Uzbekistan have been listed in the International Union for the Conservation of Nature and Natural Resources along with the species we are studying.

The large genus *Tulipa L.* (Liliaceae) is distributed in southern and Eastern Europe, North Africa, the Middle East, Central Asia and China.

The mountains of Central Asia are a recognized hotspot and a center of diversity of wild tulips [5] [7]. The genus Tulipa L. (Liliaceae) has at least 87 species [2] [8]. *Genus tulipa* L. In Central Asia, it is represented by 63 species [9]. Out of 63, 34 species are grown in Uzbekistan, 37 in Kazakhstan, 22 in Kyrgyzstan, 24 in Tajikistan, and 16 in Turkmenistan. 8 species out of 34 representatives of the genus found in Uzbekistan grow in arid habitats where the amount of annual atmospheric condensation does not exceed 120 - 140 mm per year (**Figure 1**).

Species: *Tulipa lehmanniana Merckling, T. korolkovii Regel, T. buhseana Boissier, T. borszczowii Regel, T. sogdiana Bunge, T. biflora Pall, T. turkestanica Regel, T. sharipowii Tajibaev, T. intermedia* Tojibaev, J. De Groot and N. M. Naralieva, *T. micheliana* Hoog [2] [9] [10]. The distribution of tulip species in Uzbekistan covers four habitat categories defined by Sennikov *et al.* [1] [11] based on altitude and corresponding vegetation: alpine ((yaylau zone) (2800 - 3600 m), middle mountains (tau zone) (1200 - 2800 m), foothills (Adyr zone) (400 - 1200 m) and plains (cold zone) (1 - 400 m) [2].

Uzbekistan is widely known as one of the most diverse sources of Tulipa L. species. Tojibaev and Beshko in 2014 listed 34 species of tulips found in Uzbekistan,

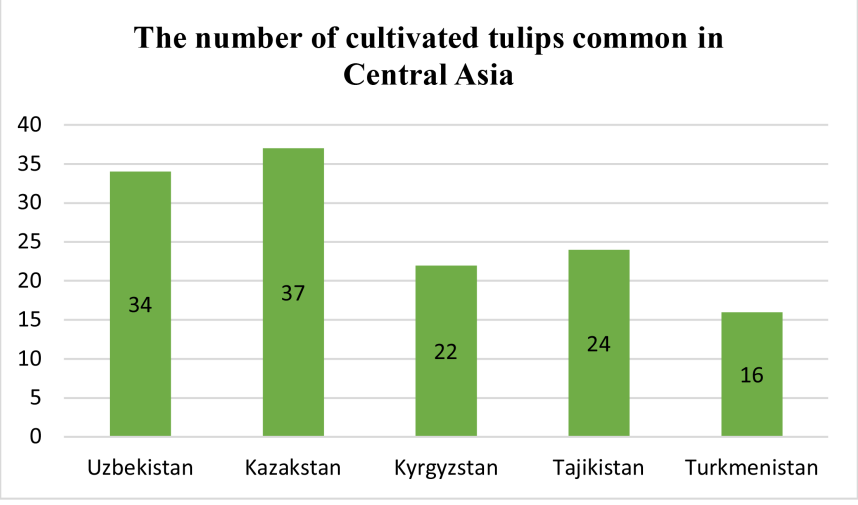

Figure 1. The number of cultivated tulip species common in Central Asia.

with six taxa endemic to the country. More than 3500 herbarium specimens are stored in the National Herbarium of Uzbekistan (TASH), at the Botanical Institute named after Komarova, St. Petersburg, Russia (LE), Moscow State University, Russia (MW), Herbariums of the Institute of Botany and Phytointroduction in Almaty, Kazakhstan (AA) and Herbariums of the Institute of Biology in Bishkek (FRU) [1].

The "hot spots" of the distribution of tulip species in Uzbekistan are the western Tien Shan (Kurama, Chatkal, Korzhantau, Ugam, Pskov and the Koksu Ranges) and the western Pamir-Alai Mountains (the Nuratau, Turkestan, Zeravshan, Hissar, Baysuntau, Kugitang and Babatag ranges). The largest number of tulip species is found in the middle and lower mountain belts. Nineteen species are known for the Pamir-Alai mountain system, and eighteen species are found in western Tianshan [1].

T. micheliana, T. buhseana and T. lehmanniana (in four regions) and *T. tubergeniana, T. lanata, T. affinis, T. dasystemon and T. bifloriformis* (in three regions). *T. borszczowii, T. orithyioides, T. dasystemonoides, T. ferganica, T. carinata, T. fosteriana, T. ingens* and *T. greigii* grow in two regions, and the remaining 14 species are found only in one region.

The distribution of tulip species in Uzbekistan is well documented, but there is no clear understanding of the importance of three classes of environmental variables—climate, soil type and terrain—in their distribution. Knowledge of the role of these factors as determining the range of the Tulipa species has very important practical consequences [12].

3. Results and Discussion

3.1. Brief Morphological Characteristics of *Tulipa ingens* and *Tulipa fosteriana*

3.1.1. *Tulipa ingens*

The bulb is elongated-ovate, 2 - 3 [5] cm thick; the shell is blackish-brown or brown, thinly subcortical, rather abundantly covered with long silky brown pressed hairs inside; the stem is 15 - 35 cm long, pale green, the upper part of the stem and pedicel are pubescent; leaves are 3 [8], spreading, scattered, slightly curved, glaucous, pubescent, with more or less ciliated margin, not exceeding the flower; basal leaf lanceolate, 2 - 5 [1] cm wide; upper leaves gradually decrease in size; the flower is single, bright red, broadly bell-shaped or broadly cup-shaped, almost star-shaped; the perianth segments are 4 - 11 cm long, more or less pointed to a pubescent point, the black spot is usually not bordered, blunt or sinuous (the black spot in the center of the flower resembles the "clubs" symbol in playing cards); the outer segments are oblong-diamond-shaped, slightly wider than oblong to oblong-the inner segments are elliptical; stamens from one-third to two-fifths of the length of the perianth; filaments are glabrous, black; anthers are blackish-purple, twice as long as anthers; pollen is black; the ovary is columnar, pale green, slightly longer than the threads, with a sessile stigma; the box is about 2 cm wide, 3-6 cm long [13] (**Figure 2**).

3.1.2. Distribution

General distribution: Western Pamir-Alai (Tajikistan, Turkmenistan, Uzbekistan) (Figure 3).

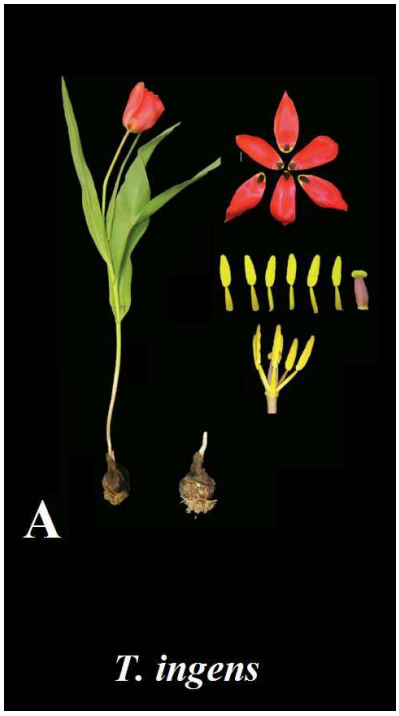

Figure 2. Morphological illustration of *Tulipa ingens* [4].

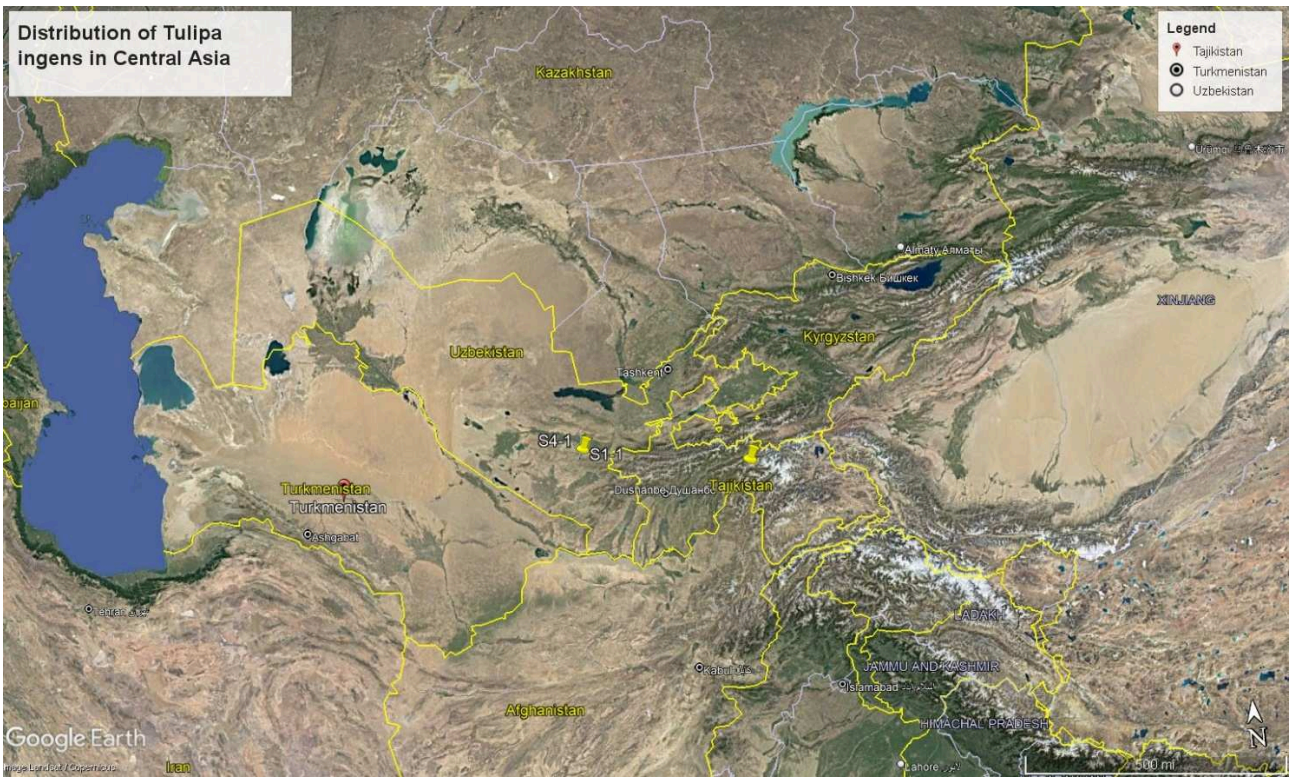

Figure 3. Distribution of *Tulipa ingens* in Central Asia.

Distribution in Uzbekistan: Kuhistan district (Urgut district), Western Hissar district (Kashkadarya region; Baysan district; Kuhitang district), Hissar-Darvaz district (Sangardak-Tupalang district) (**Figure 3**) [12]. This species is mainly found in the south of Uzbekistan in the Zeravshan and Hissar ranges of the Pamir-Alai, in particular, in the Surkhandarya, Kashkadarya and Samarkand regions, but can also be found abroad in the Tajik parts of the Hissar Range and the Zerafshan Valley, and in the northeastern corner of Turkmenistan near the border with Uzbekistan. The distribution area (EOO) of this species is small and is less than 20,000 km^2, while the habitat area is extremely limited and is less than 500 km^2. However, a large number of subpopulations and locations were recorded [3] (**Figure 4**).

Tulipa ingens

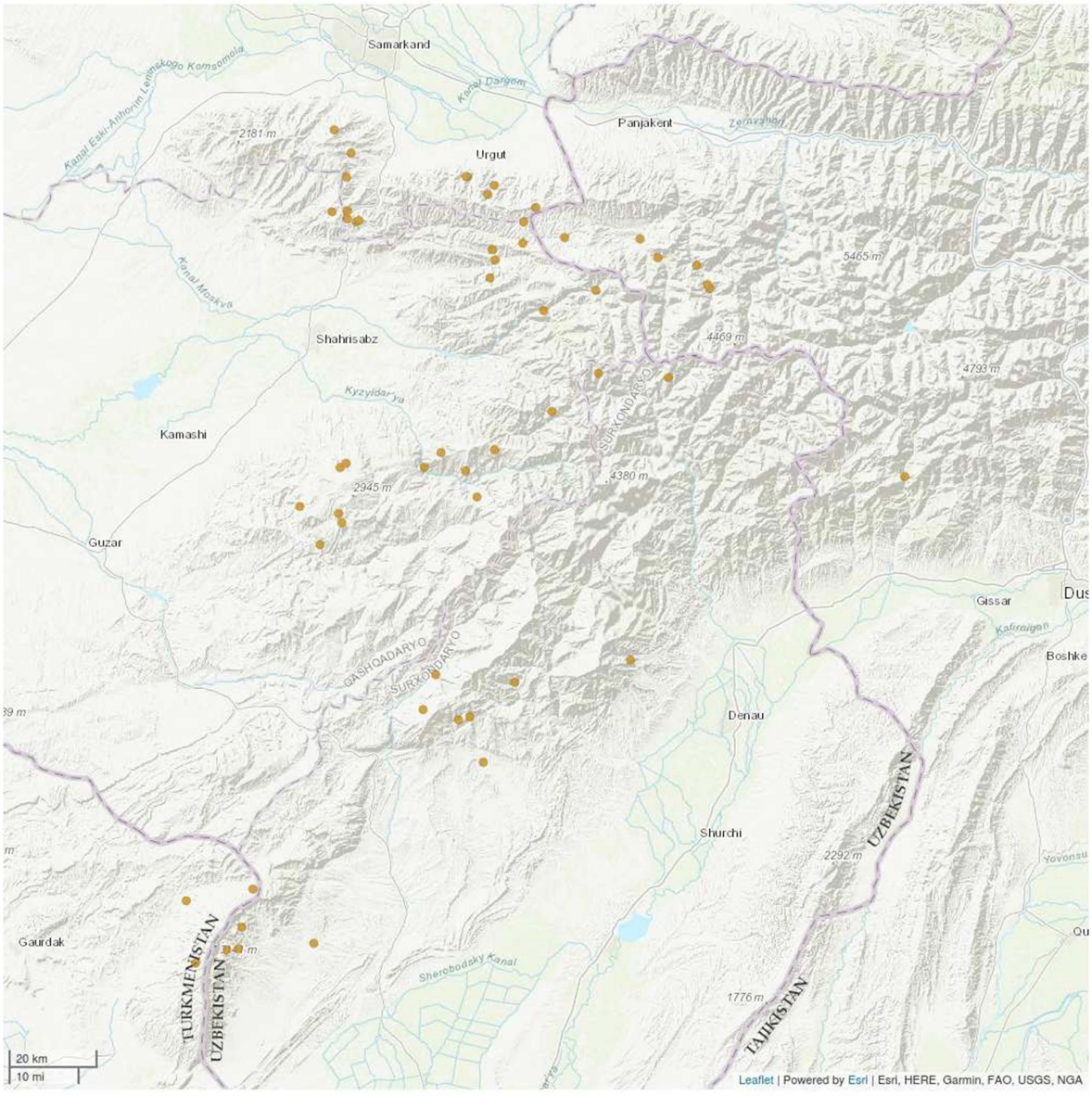

Figure 4. Distribution of *Tulipa ingens* in Uzbekistan and the Samarkand region [3].

Phenology: Flowering: April-May; fruiting: May-June.

Ecology: Clay, rocky and gravelly slopes, rocky ledges in the lower and middle mountain zone, 1200 - 2500 (−2800) m above sea level [1]. On December 11, 2022, this species was listed in the International Union for the Conservation of Nature and Natural Resources.

3.2. *Tulipa fosteriana*

Description: The bulb is ovoid, 2 - 5 cm thick; the shell is blackish-brown, heart-shaped, densely covered with long silky hairs inside, especially at the base and at the tip; the stem is 15 - 35 [8] cm long, strong, naked, the upper part of the stem and peduncle are pubescent; leaves are 3 - 4 [10], large, curved, scattered, slightly wavy, glaucous or green, pubescent, ciliated at the edges, not exceeding the flower; the lower leaf is oblong to elliptical, 3 - 15 cm wide, located at ground level; the upper leaves gradually decrease in size; the flower is single, large, broadly cup–shaped; the perianth segments are bright red, 4.5 - 12.5 cm long, usually blunt with a very short pubescent tip; the basal spot is usually three-pointed, sharp or blurred, black, dirty purple or olive color, more or less widely bordered with yellow (rarely without a yellow edge), sometimes yellow over the entire surface; outer segments from oblong-elliptic to oblong; inner segments obovate to oblong; stamens from one-third to two-fifths of the perianth length; filaments glabrous, black, sometimes yellow; anthers are purple, twice as long as filaments; pollen is purplish-brown or yellow; ovary is green, slightly shorter than anthers, with a sessile stigma; box 2.5 - 3.0 cm wide, 5 - 7 cm long [1] [4] (**Figure 5**).

General distribution: Western Pamir-Alai (Tajikistan, Uzbekistan), Afghanistan

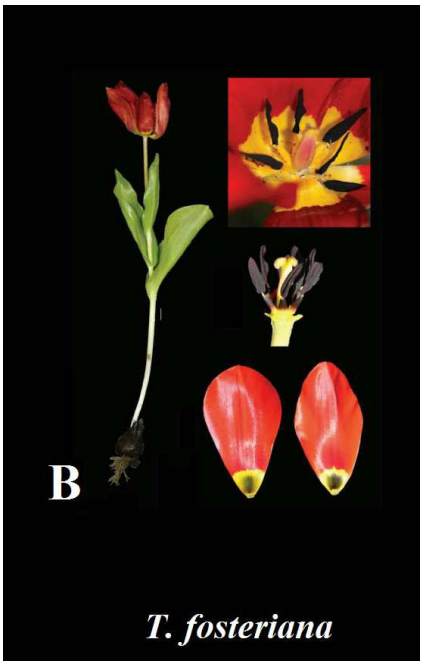

Figure 5. Morphological illustration of *Tulipa fosteriana*.

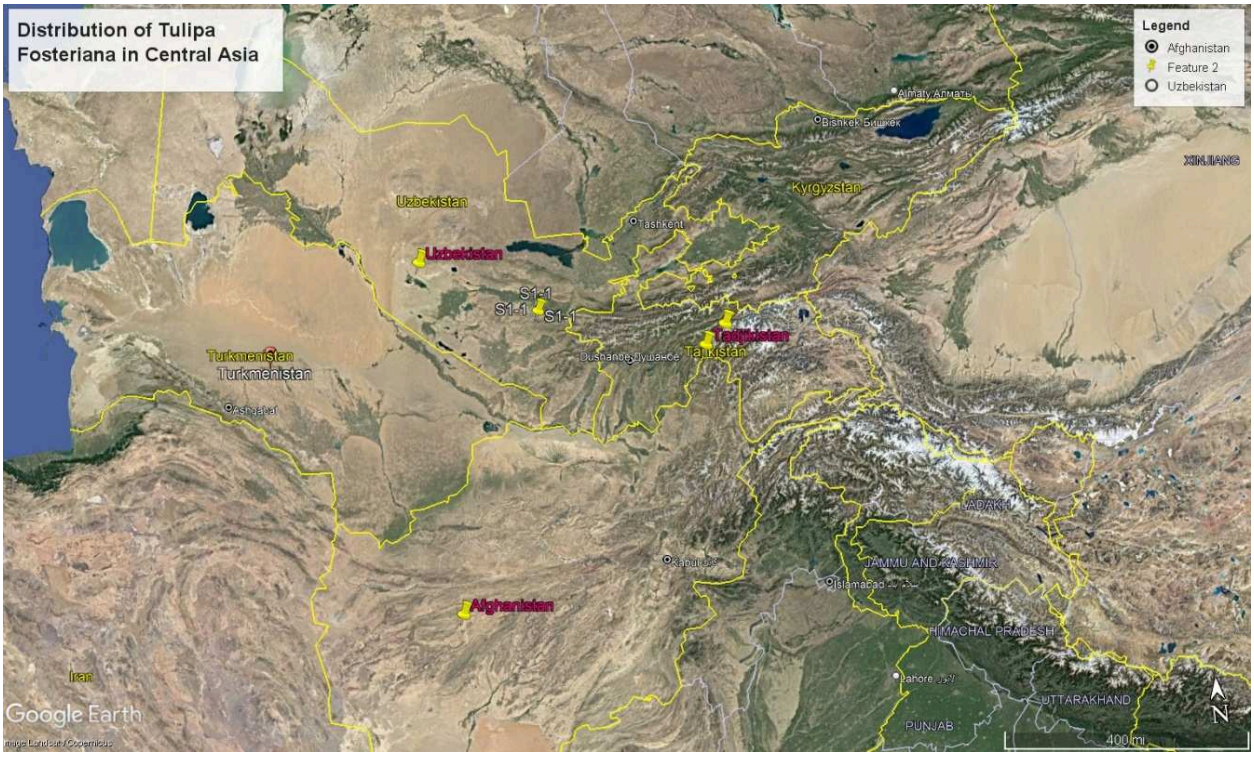

Figure 5. Distribution of *Tulipa fosteriana* in Central Asia.

(probably introduced) (**Figure 5**) [12].

Distribution in Uzbekistan: Kuhistan district (Urgut district) (**Figure 6**) [1]. This species is mainly found in low- and mid-mountain areas around the Nurata-tau Mountains in the Kuhistan Botanical region of Uzbekistan [10], as well as directly across the border in neighboring areas of Tajikistan. The estimated area of distribution (EOO) is 1097 km^2, and the area of settlement (AO) is 116 km^2. The largest subpopulations of this species occur at an altitude of 1600 to 1700 m. It is predicted that AOO will decline sharply over the next three generations [3] (**Figure 6**).

Phenology: Flowering: April-May; fruiting: May-June.

Ecology: Clay, rocky and gravelly slopes, rocky ledges in the mid-mountain zone, 1500 - 2600 m above sea level [1]. On December 11, 2022, this species was listed in the International Union for the Conservation of Nature and Natural Resources.

Seven taxa are subendemic because their distribution ranges extend slightly beyond the country. These are *T. affinis, T. fosteriana, T. tschimganica, T. mogoltavica, T. orithyoides, T. tubergeniana, and T. vvedenskyi. Tulipa fosteriana, T. mogoltavica, T. orithyoides, T. tubergeniana* and *T. vvedenskyi* are also found in Tajikistan [12]. Wild species of the genus in the Old World occupy a variety of habitats. Garden tulips are grown as ornamental plants throughout North America. One or possibly two species may be native to North America [14]. Below is an illustration of the distribution map of *Tulipa ingens* and *Tulipa fosteriana* in Uzbekistan (**Figure 7**).

Tulipa fosteriana

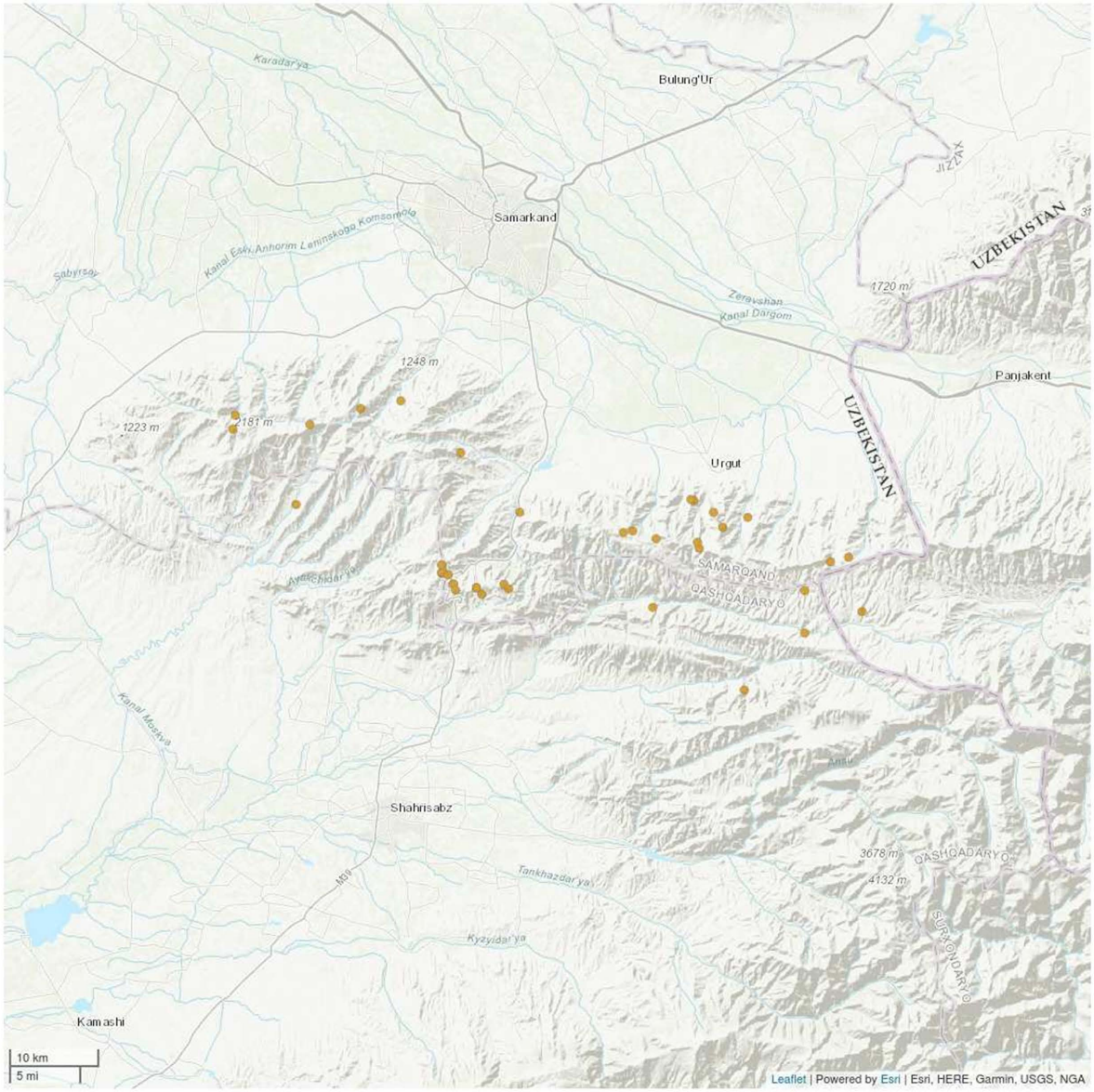

Figure 6. Distribution of *Tulipa fosteriana* in Uzbekistan and the Samarkand region [4].

These species are able to successfully maintain their numbers in prevailing environmental conditions with certain types of constant impact on their habitat. The population in the study area is sharply decreasing everywhere. These species are unstable during grazing, recreational loading, mowing, and gathering for bouquets. They can be preserved in natural places of growth in specially protected natural areas (nature reserves, botanical reserves and natural monuments). Specific measures should be developed for each specific plant population, taking into account their ecological and biological characteristics.

4. Conclusion

Understanding the patterns of distribution of wild tulip species in critical hot

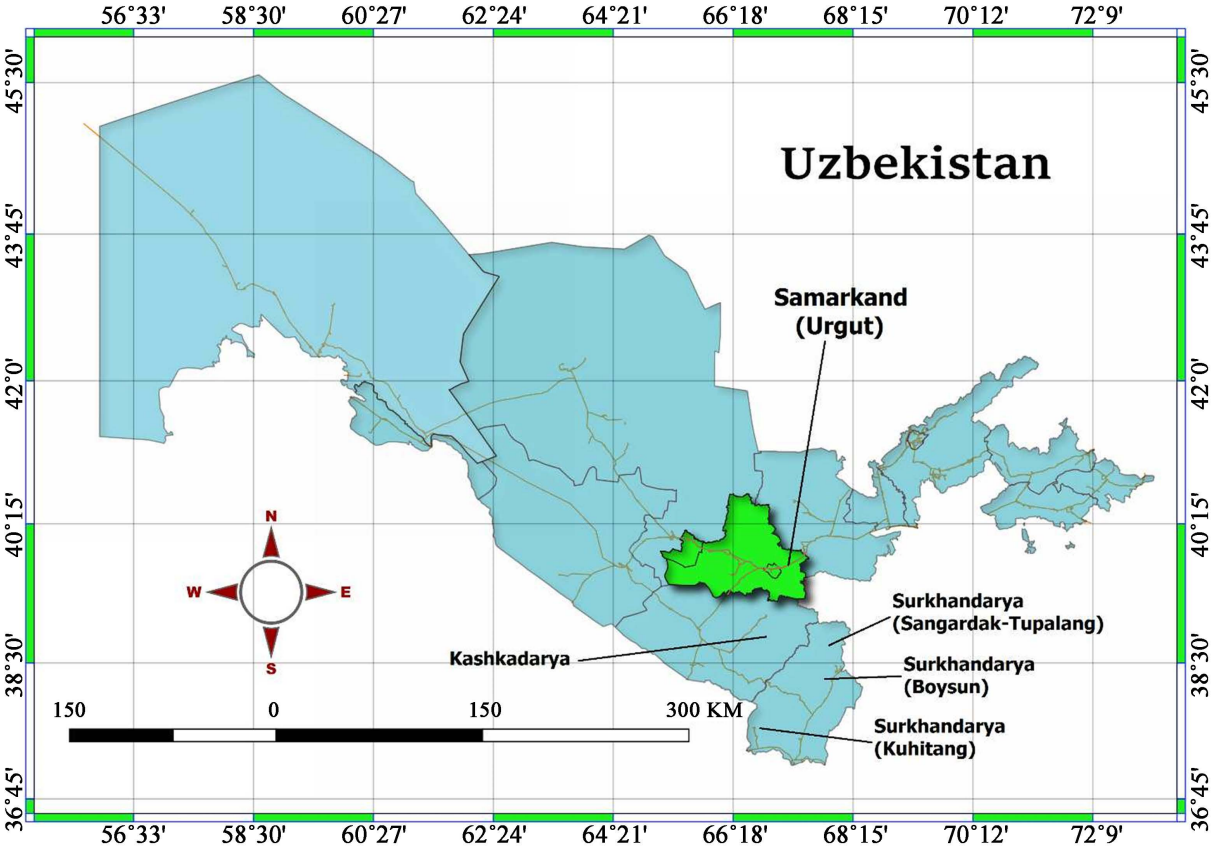

Figure 7. Distribution of *Tulipa ingens* and *Tulipa fosteriana* in Uzbekistan.

spots and identifying key threats can give a significant insight into their conservation status and help ensure their survival. Due to the high number of tulip species in different regions of Uzbekistan, attempts were made to analyze the distribution of species diversity in the context of regions densely populated with tulip species. Such regions were the Nuratau ridge and its surroundings [15], the Kyzyl Kum Desert [2], the Fergana Valley [15] [16] [17] and the Surkhandarya Province [18]. Despite the importance of analyzing the distribution of tulip species, only very limited attempts have been made to understand the natural requirements of tulip species and the reasons for their rarity [15]. All the studied species are listed in the Red Book of the Republic of Kazakhstan and Uzbekistan [6]. However, a simple registration of a species on the page of the Red Book is not yet a guarantee of the preservation of its genetic fund in full. Special legislative acts and effective control over their implementation are needed. Only the involvement of all citizens of the republic in the protection of nature and its flora can achieve the desired results. This is the only way wildlife can be preserved for future generations.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Eker, I., Babac, M.T. and Koyuncu, M. (2014) Revision of the Genus *Tulipa* L. (Liliaceae) in Turkey. *Phytotaxa*, **157**, 1-112. https://doi.org/10.11646/phytotaxa.157.1.1

[2] Botschantzeva, Z.P. (1962) Tulips: Taxonomy, Morphology, Cytology, Phytogeography and Physiology. Translated and Edited by Varekamp, H.Q., CRC Press, Rotterdam, 230. (In Russian) https://www.si.edu/object/siris_sil_149573

[3] Введенский, А.И. (1935) Флора_СССР_Т4_1935. Академия наук СССР, Ленинград, 760.

[4] Asatulloyev, T., Dekhkonov, D. and Tojibaev, K.S. (2022) What Determines the Distribution of Tulipa Species in Uzbekistan? *Plant Diversity of Central Asia*, **2**, 128-137. https://doi.org/10.54981/PDCA/vol1_iss2/a5

[5] Zonneveld. B.J.M. (2009) The Systematic Value of Nuclear Genome Size for "All" Species of *Tulipa* L. (*Liliaceae*). *Plant Systematics and Evolution*, **281**, 217-245. https://doi.org/10.1007/s00606-009-0203-7

[6] Baker, J.G. (1874) Revision of the Genera and Species of Tulipeæ. *Botanical Journal of the Linnean Society*, **14**, 211-310. https://doi.org/10.1111/j.1095-8339.1874.tb00314.x

[7] Hall, A.D. (1940) The Genus Tulipa by Sir Daniel Hall (z-lib.org)_Copy. The Royal, London, 136.

[8] Dekhkonov, D., Tojibaev, K., Yusupov, Z., Makhmudjanov, D. and Asatulloev T. (2022) Morphology of Tulips (*Tulipa*, Liliaceae) in Its Primary Centre of Diversity. *Plant Diversity of Central Asia*, **1**, 52-70. https://doi.org/10.54981/PCDA/vol1_iss1/a1

[9] Dekhkonov, D., Tojibaev, K., Makhmudjanov, D, Na, N.R., Baasanmunkh, S., Yusupov, Z., *et al.* (2021) Mapping and Analyzing the Distribution of the Species in the Genus *Tulipa* (Liliaceae) in the Ferghana Valley of Central Asia. *Korean Journal of Plant Taxonomy*, **51**, 181-191. https://doi.org/10.11110/kjpt.2021.51.3.181

[10] Sennikov, A.N., Tojibaev, K.S., Khassanov, F.O. and Beshko, N.Y. (2016) The Flora of Uzbekistan Project. *Phytotaxa*, **282**, 107-118. https://doi.org/10.11646/phytotaxa.282.2.2

[11] Tojibaev, K., Dekhkonov, D., Ergashov, I., Sun, H., Deng, T. and Yusupov, Z. (2022) The Synopsis of the Genus *Tulipa* (Liliaceae) in Uzbekistan. *Phytotaxa*, **573**, 163-214. https://doi.org/10.11646/phytotaxa.573.2.2

[12] Abduraimov, O.S., Shomurodov, H.F. and Abduraimov, A.S. (2017) Distribution Pattern and State of Coenotic Population of *Tulipa lehmanniana* Merckl. in Kyzylkum Desert Conditions (Uzbekistan). *American Journal of Plant Sciences*, **8**, 288-296. https://doi.org/10.4236/ajps.2017.82020

[13] Shukrullozoda, R. and Dekhkonov, D. (2022) Some Wild-Growing Ancestors of Cultivated Tulips Common in the Samarkand Region: Taxonomy and moRphology of T. Fosteriana and T. Ingens. NamDU ilmiy axborotnomasi-2022-yil_6-сон, 199.

[14] Baratov, P., Mamatkulov, M. and Rafikov, A. (2002) Natural Geography of Central Asia. Tashkent, 440.

[15] Chase, M.W., Christenhusz, J.M., Fay, M.F., Byng, J.W., Judd, W.S., Soltis, D.E., *et al.* (2016) An Update of the Angiosperm Phylogeny Group Classification for the Orders and Families of Flowering Plants: APG IV. *Botanical Journal of the Linnean Society*, **181**, 1-20. https://doi.org/10.1111/boj.12385

[16] Veldkamp, J.F. and Zonneveld, B.J.M. (2012) The Infrageneric Nomenclature of

Tulipa (Liliaceae). *Plant Systematics and Evolution*, **298**, 87-92. https://doi.org/10.1007/s00606-011-0525-0

[17] Vvedensky, A.I., Tojibaev, K.S. and Beshko N. (2014) Reassessment of Diversity and Analysis of Distribution in *Tulipa* (Liliaceae) in Uzbekistan. *Nordic Journal of Botany*, **33**, 324-334. https://doi.org/10.1111/njb.00616

[18] Shukrullo Qizi, S.R., Burxonovich, D.D., Kudratovich, K.K., Esanovich, K.B. and Sharobitdinovich, T.K. (2023) Morphology and Distribution Patterns of *Tulipa fosteriana* and *Tulipa ingens*. *Plant Science Today*, **10**, 426-438. https://doi.org/10.14719/pst.2296