

# Distribution and Current State of Rare and Endangered Tulips (Liliaceae) Arid Zones of Uzbekistan

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**How to cite this paper:** Abduraimov, O.S., Shomurodov, H.F., Daniyarov, S.A., Mamatkasimov, O.T. and Teshayev, M.I. (2020) Distribution and Current State of Rare and Endangered Tulips (Liliaceae) Arid Zones of Uzbekistan. *American Journal of Plant Sciences*, 11, 736-744.

<https://doi.org/10.4236/ajps.2020.115053>

**Received:** April 9, 2020

**Accepted:** May 24, 2020

**Published:** May 27, 2020

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## Abstract

Central Asia is considered to be the primary center of origin and diversity for the genus *Tulipa* L. (Liliaceae). The article considers the species of rare and endemic *Tulipa* L. species in the arid regions of Uzbekistan. There are nine registered species of the genus *Tulipa*. In the course of the study, the demographic indicators of the modern population of 39 populations were evaluated. 39 populations of the studied species were identified, most of which grow in the composition of the wormwood formations characteristic of the Turanian floristic province.

## Keywords

*Tulipa*, Population, Biodiversity, Plant Communities, Current State, Rare and Endemic

## 1. Introduction

The unique plant riches of our country require attentive and careful treatment. Due to the strengthening human press on the environment many became rare, areas and numbers of their populations decrease natural renewal is violated. It especially concerns beautifully flowering species, which suffer not only from pasture, haymaking, economic assimilation of lands, but also from collection for the bouquets, and often bulbs, for sale, by people.

The genus *Tulipa* L. (Liliaceae) has at least 87 species. These are divided into four subgenera, *Tulipa*, *Clusianae* (Baker) Zonn., *Eriostemones* (Boiss.) van

Raamsd., and *Orithya* (D. Don) Baker, and twelve sections [1]. Genome size and the presence of nearly complete crossing barriers between the sections [2] [3] confirmed the close relationships of the species within the different sections. Tulips occur naturally in southern Europe, North Africa, the Middle East, and Central Asia, including Western China. The Tien Shan and Pamir-Alay mountain ranges in Central Asia are believed to be the primary gene centers for the species [4] [5], with the Caucasus as a secondary centre. Most species have the same basic chromosome number,  $2n = 2x = 24$ . However, the somatic DNA 2C value is shown to range from 32 to 69 picograms for the diploids [1]. They are popular spring-flowering garden plants, millions of bulbs are sold annually and over 5000 cultivars have been registered [6].

*Tulipa* L. genus is represented by 63 species in Central Asia [7]. From the 63 species in Uzbekistan 34 are grown, Kazakhstan—37, Kyrgyzstan—22, Tajikistan—24, and in Turkmenistan—16 species. 8 species out of 34 members of the genus occur in Uzbekistan, native to arid habitats, where the amount of annual atmospheric condensation does not exceed 120 - 140 mm per year. The species are: *Tulipa lehmanniana* Mercklin, *T. korolkovii* Regel, *T. buhseana* Boisser, *T. borszczowii* Regel, *T. sogdiana* Bunge, *T. biflora* Pall, *T. turkestanica* Regel, *T. sharipowii* Tajibaev, *T. intermedia* Tojibaev, JJ. De Groot & N. M. Naralieva, *T. micheliana* Hoog [8] [9] [10] [11].

At present, the populations of the species of *Tulipa* where came from Central Asia are decreasing. The study and evaluation of the current distribution of species of Tulipa in the Central Asian region, the number and reasons for their disappearance are very important. Wild tulips are the national property of not only Uzbekistan, Kazakhstan and Kyrgyzstan, but also of the mankind, since they have been used in decorative horticulture all over the world, especially in Holland, for a long time.

*Tulipa lehmanniana*, *T. buhseana*, *T. biflora*, *T. borszczowii* and *T. sogdiana* are genuine desert species from the aforementioned species. The area of the first three species covers of Turan lowland and reaches to northern China (Kashgar), and the other two species are strict endemic of Turan phyto-geographical region. Two species—recently described from Fergana Valley—*T. sharipowii* and *T. intermedia* grow on gray-brown soils of the southern foothills of the Kurama Range (Western Tien-Shan). And finally, the last endemic species of Central Asia—*T. micheliana*, mainly distributed in the northwest of the Pamir-Alay and Kopetdag, the westernmost border of its range, comes in Kyzylkum (Nurata relict mountains and Kokchatau). *T. lehmanniana*, *T. korolkovii*, *T. sharipowii*, *T. intermedia* and *T. micheliana* are listed in the Red Book of the Republic of Uzbekistan from aforementioned species [12].

Wild tulips are the most impressive of all diversity of flora of Uzbekistan. In the last decades, as a result of intensive anthropogenic impact, the range and population numbers of many tulip species have considerably declined. The current Red Data Book of Uzbekistan [12] includes 18 species of *Tulipa*, 20 species are protected in national parks and nature reserves. But none of the Central

Asian tulips have been included in the IUCN Red List of Threatened Species (2011) [13] [14].

*T. buhseana* was included in the previous editions of the Red Data Book of Uzbekistan (1998, 2006). At present, according to progressive status of populations and for lack of threats of disappearance, this species was excluded from the Red Data Book [12].

*T. sogdiana* was included in previous editions of the Red Data Book of Uzbekistan (1984, 1998, 2006). At present, according to the progressive status of populations and for lack of threats of disappearance, this species was excluded from the Red Data Book [12].

*T. turkestanica* was included in previous editions of the Red Data Book of Uzbekistan (1984, 1998, 2006). At present, according to the progressive status of populations and for lack of threats of disappearance, this species was excluded from the Red Data Book [12].

### **Purpose of the Study**

Evaluating the modern status of rare genus of *Tulipa* L. species, spread in arid regions of Uzbekistan.

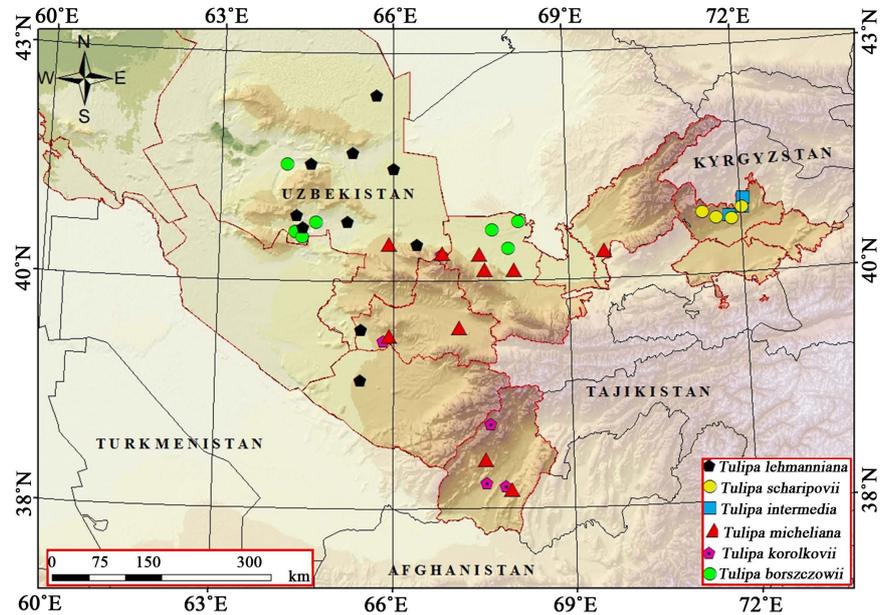
## **2. Materials and Methods**

Our field researches were conducted in 2012-2020 on the arid zones of Uzbekistan. These studies were carried out using geobotanical and population methods. We have defined the area and number of tulip populations, registered their coordinates, altitude, exposition, characteristics of the terrain, soil and vegetation. All data are loaded into the GIS with ArcGIS computer program, and have created the distribution map 39 populations. Observations were made in all populations during the study.

Transects were laid with a length of 10 m, they were divided into platforms of 1 m<sup>2</sup>. Each population contains from 20 to 50 plots of 1 m<sup>2</sup> (Figure 1). Ontogenetic structure of coenopopulations was defined as the ratio in coenopopulations of individuals of different ontogenetic conditions. For the counting unit was taken individual. The obtained results were analyzed on the basis of “Past” and “Statistic 10” programs.

## **3. Result and Discussion**

During the study, the demographic characteristics of genus of *Tulipa* L. species, which were spread in arid regions of Uzbekistan were evaluated. 70% of Uzbekistan's territory is composed of arid regions. The decline in the number of rare and endangered species in arid regions of Uzbekistan is inextricably linked with their inadequacies, the absence of reserves and national parks in these areas, and the ever-increasing antropogenic pressure. Here are tulips, *Tulipa intermedia*, *T. korolkovii*, *T. lehmanniana*, *T. micheliana*, *Tulipa scharipovii* included in the Red Book of the Republic of Uzbekistan [12].



**Figure 1.** Distribution map of species of *Tulipa* L. arid zones of Uzbekistan.

During the 2012-2020 study, modern conditions of *T. borszczowii*—7, *T. intermedia*—3, *T. korolkovii*—5, *T. lehmanniana*—10, *T. micheliana*—10, *T. scharipovii*—4 populations were evaluated (Figure 1). The rarity of these species was determined by their distribution, endemic and Red Book status.

In Uzbekistan, the tulip species have long been of great interest to humans. People planted it in their gardens as ornamental plants.

***Tulipa borszczowii***—One of the rare species of the genus in Uzbekistan. The tulip is described by Edward Regel in 1868 based on the collection of 1857 gathered in Karakum near the Aral Sea by a well-known Russian botanist Ilya G. Borszchow. It was believed that it is so rare in Uzbekistan that in some sources it is cited as endemic to Kazakhstan [15]. However, in the Central Herbarium of the Institute of Botany of the Academy of Sciences of Uzbekistan (TASH) there is a herbarium specimen of the species, collected in 1965 by V. Makarova and A. I. Vvedensky. It was assembled in the southeastern part of Kyzyl-Kum in the vicinity of the Chardar reservoir. During our 2012-2020 study, 7 new growth points were recorded.

***T. intermedia***—The species was described 2014 by Tojibaev, JJ. De Groot & N. M. Naralieva. *T. intermedia*, collected in the Ferghana Depression is described. It is species is endemic to the foothills surrounding the northern side of the Ferghana Depression. Morphologically, *T. intermedia* takes an intermediate position between *T. scharipovii* and *T. talassica* Lazkov [16]. From the species in a close proximity, *T. scharipovii*, it differs by non-coriaceous and strongly prolonged bulb tunics, its pubescence of tunics, shorter stem, the shape of outer petals and filaments (which are much longer than in *T. scharipovii*), and by its pale yellow (not green) bottle-shaped ovary. *T. intermedia* also differs in ecology, growing in *Artemisia* steppe on the plains and in low foothills with gravelly

slopes. The flowering occurs in March-April.

***T. korolkovii***—The species was described in 1875 by Edward L. Regel. The natural distribution area of *T. korolkovii* is North-Western, Western and South Pamir-Alay, South-Western Tien Shan. Due to its dwarf habitus, elegant cup-shaped bright red flowers and two-colored stamen filaments (black in the lower part and red in the top) it differs from other species. Plants growing on dry stony southern slopes are 7 - 10 cm long, on northern slopes up to 20 - 25 cm. Flowering in March-May, depending on altitude.

***T. lehmanniana***—The species was described in 1854 by Russian botanist K.E. Mercklin on specimens collected between Bukhara and Kermin. It is widespread on the territory of Turan floristic province: in Kyzylkum and Karakum deserts, on the piedmont plains of Western Tien Shan and Pamir-Alay, in Fergana Valley, Kopet-Dag, Badkhyz, Iran, Pakistan, Northern Afghanistan, Northern Muryunkums and south-western part of Betpakdala desert. Grows in sandy and clay deserts, on piedmonts, in stony-skeleton slopes and gypsaceous rocks on outlier mountains. It is one of the most beautiful species of Central Asian wild tulips, distinguished by fineness and bright various colors of flowers. The flowering occurs in March-April.

***T. micheliana***—The species was described in 1902 by Thomas Hoog on specimens collected in 1900 by German botanist Paul Sintenis near Ashkhabad. It is widespread in North-Western Pamir-Alay and Kopet-Dag, in Uzbekistan, Tajikistan, Turkmenistan and Iran. In Uzbekistan, this tulip occurs on the Nuratau mountains, on Zaravshan, Gissar and Kugitang ridges. It grows on stony-skeleton and clay slopes of foothills and low mountains. It is distinguished by leaves with violet stripes. The flowering occurs in March-April.

***T. scharipovii***—2009 years within the bounds of the Fergana valley (Uzbekistan) a new tulip species from *Tulipa* subgenus, *T. scharipovii* Tojibaev, has been found on the southern slopes of the Kurama and Chatkal ranges [8]. The species is named after the Uzbek tulip scientist, A. Kh. Scharipov. By its morphological structure, the new species shows its relationship to *T. ferganica* Vvedensky. The flowering occurs in March-April (Figure 2).

During the study, the density of populations in the arid regions of Uzbekistan has been studied. It should be noted that the species of *Tulipa* L. species is currently decreasing dramatically. This is due to regular livestock feed and geological prospecting.

Species density and area were determined based on generally accepted geobotanical and population methods. These methods help in conducting several years of monitoring of the species. Their level of reliability will be high [11].

*T. borszczowii* and *T. lehmanniana* species are spread in deserts of Uzbekistan. The high density of densities was found to be high in these species. That is, *T. borszczowii* showed that the figure was 2.85 - 17.7 per 1 m<sup>2</sup>, and *T. lehmanniana* was 1.95 - 17.76 pcs 1 m<sup>2</sup>.

The distribution of *T. korolkovii* and *T. micheliana* is relatively wider. These species are spread in the arid regions of Uzbekistan as well as in the middle part

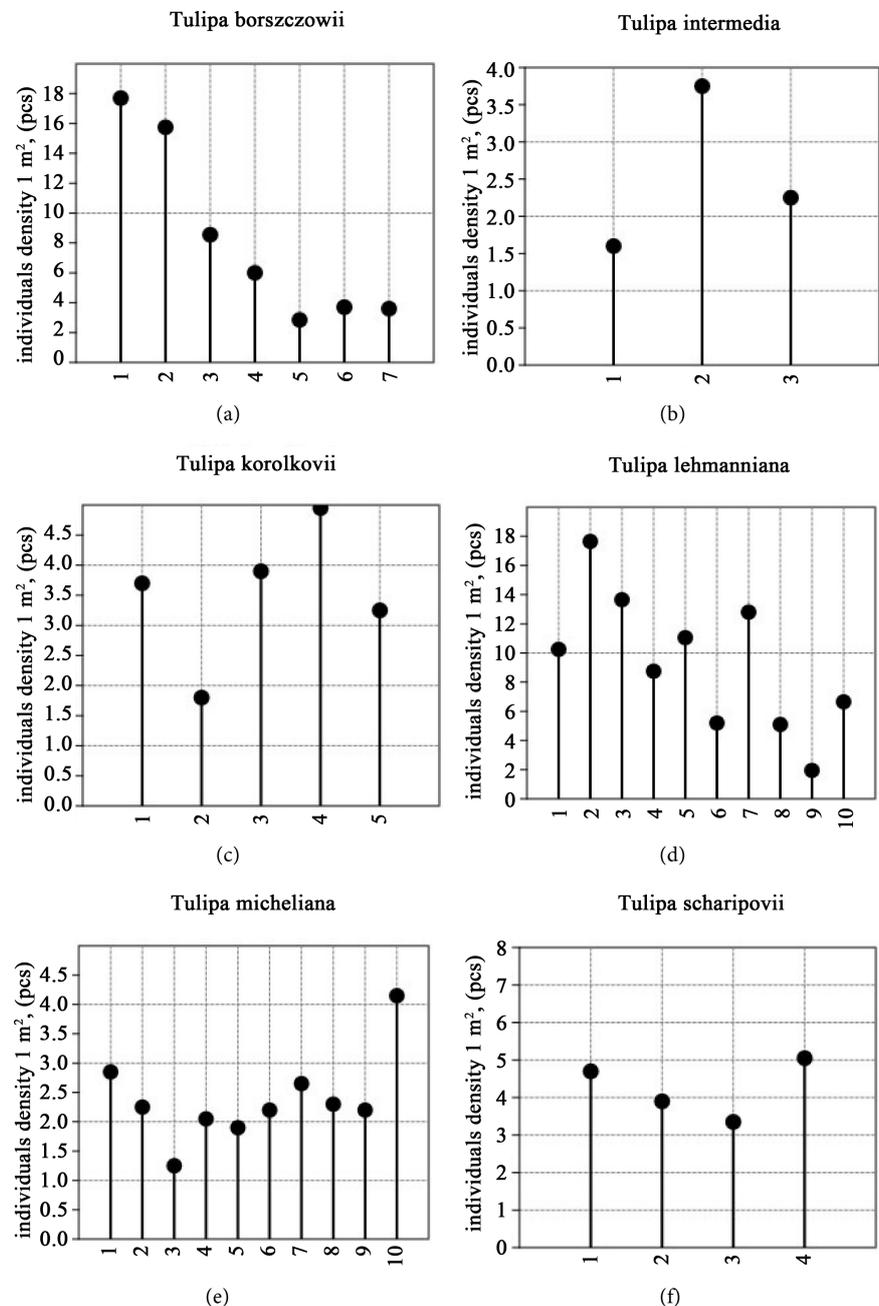
*Tulipa borszczowii* Regel*Tulipa intermedia* Tojibaev et al.*Tulipa korolkovii* Regel*Tulipa lehmanniana* Mercklin*Tulipa micheliana* Hoog*Tulipa scharipovii* Tojibaev

**Figure 2.** Rare and endangered species genus of *Tulipa* arid zones of Uzbekistan.

of the mountains. Population of these species is regularly affected by livestock breeding and the collection of flowers by humans. Both species were found to be between 1.25 to 4.95 pcs 1 m<sup>2</sup> (**Figure 3**).

One of the main reasons for the decline of *T. micheliana* populations in populations is that we can not grow vegetatively in natural conditions. Among the species studied are the most narrow, *T. intermedia* and *T. scharipovii*, which are the endemic flora of Uzbekistan. The density of these species varies from 1.6 to 3.75 (*T. intermedia*) and 3.2 to 5.1 per square 1 m<sup>2</sup> (**Figure 3**).

The problem of the protection of the environment and flora is of great and vital importance for the whole humanity. Using natural resources, people negatively influence on the natural age-old landscapes. Development of industry and agriculture, extensive reclamation of natural territories lead to the breach of ecological balance. As a result of this, the danger of impoverishment of species composition of flora and loss of plants' gene fund increases. Disappearance of any species causes irreversible consequences, as wild plants make the feedstock for the creation of valuable varieties of many cultures. There are about 4500 species of wild higher plants and over 2000 species of fungi in the territory of Uzbekistan. About 400 of them are rare, endemic and relict species (10% - 12% of flora). Effective measures are necessary for their protection. Although the status of flora protected in the reserves is rather good, natural stocks of wild species



**Figure 3.** Individuals density 1 m<sup>2</sup> (pcs) of the studied populations genus of *Tulipa* L. (Uzbekistan). (a)—*Tulipa borszczowii*; (b)—*T. intermedia*; (c)—*T. micheliana*; (d)—*T. lehmanniana*; (e)—*T. micheliana*; (f)—*T. scharipovii*.

have sharply reduced. Thus, intensified industrial stocking caused reduction of areals of tulip—*Tulipa*. A considerable number of species are on the verge of disappearance. Uncontrolled collection of rare medicinal and eatable plants (particularly bulbous, bulb-tuberiferous, rhizomatous dug out with under-ground organs) taking more and more threatening scale, causes great damage to wild flora. Thus, all studied populations are viable with a sufficient number of generative individuals providing seed reproduction. Minor fluctuations are observed only

in the proportion of the same ontogenetic conditions. Ontogenetic structure of populations is normal, in most cases incomplete due to the absence of senile individuals. Most of them (60%) have a left-sided type, coincide with the characteristic theoretical ontogenetic spectrum and reflect the biological features of the species. The deviation of the ontogenetic spectrum of specific populations from the characteristic one is due to the ecological-phytocenotic habitat conditions.

#### 4. Conclusions

The species is able to successfully maintain its abundance in the prevailing environmental conditions under certain types of permanent effects on their habitat. Population size in the study area is sharply decreasing everywhere. These species are unstable when grazing, recreational load, mowing, gathering on bouquets. They can be preserved in natural places of growth in specially protected natural areas (reserves, botanical reserves and natural monuments). For each specific population of plants, specific measures should be developed considering their ecological and biological features.

All the species studied are included in the Red Book of the Republic of Uzbekistan [12]. However just registering species on the page of the Red Book is not yet a guarantee of preserving its genetic fund in full. Special legislative acts and effective control of their execution are necessary. Only the involvement of all citizens of the Republic in the cause of protection of nature and its flora can allow achieving desired results. Only in this way the live nature can be saved for the next generations.

#### Acknowledgements

The current research is done under the project PZ-20170919165 “Cadastre of rare and endangered species of vascular plants of Navoi and Bukhara region”. The authors express their gratitude to Dr. K. Sh. Tojibaev and the employees of the National Herbarium of the Institute of Botany of the Academy of Sciences Republic of Uzbekistan, for making the data on the distribution and photos of genus of *Tulipa* L. We are also grateful to junior researcher U.Kh. Kadirov for the assistance in mapping the distribution of genus of *Tulipa* L.

#### Conflicts of Interest

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

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