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Tulipa biflora Pall. (*Liliaceae*) - a new species for the flora of Georgia (South Caucasus)

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A B S T R A C T

Tulipa biflora Pall. is reported from Georgia for the first time. The species was found on Iaghluja Ridge in the vicinity of Rustavi (Kvemo Kartli region). The area belongs to the semi-arid climate zone. *T. biflora* grow on a ridge of marine and continental molasses on grey-cinnamonic soils with clay and small stones in phryganoid vegetation habitat, particularly in the plant community of thorny goat's-wheat (Atraphaxietum spinosae). The total area of occupancy of the newly discovered populations of *T. biflora* is approximately 350 m²; they are under heavy anthropogenic pressure. The populations consist of approximately 350-400 individuals. The article contains coordinates and a map of the new location of *T. biflora*, as well as a description of the habitat with reference to all the key features. The herbarium specimens of *T. biflora* are stored at the National Herbarium of Georgia (TBI). The photo documentation is included in this article.

Keywords: *Tulipa biflora,* Distribution area, Iaghluja Ridge, Rustavi environs, Habitat, Populations.

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Introduction

Tulipa biflora Pall. (Fig. 1) belongs to the family *Liliaceae.* It is an ephemeroid bulbous plant (Fig. 2), mostly developing two gray-green leaves. It produces 1-3 or more flowers. Perianth is white, tinged on the outside with greenish and pale brownish-crimson, and with yellow at the base inside (Fig. 3a, 3b). According to the Raunkiaer classification of plant life forms [1], it is a geophyte.

Fig. 1. *Tulipa biflora* Pall. growing on Iaghluja Ridge (photo by N. Lachashvili).

Fig. 2. Bulb of *Tulipa biflora* Pall. (Photo by N. Lachashvili)

Fig. 3a. Flower of *Tulipa biflora* Pall. - front-view (Photo by N. Lachashvili)

Fig. 3b. Flower of *Tulipa biflora* Pall. - view from above (Photo by N. Lachashvili)

The distribution area of *Tulipa biflora* includes South-East Europe, South-West Asia, Middle Asia, the western part of Central Asia (North-West China - North and West Xinjiang) and Caucasus. It is also found in North-East Africa (Egypt) [2-5]. Considering its global distribution area and center of gravity of spread, in our opinion, it belongs to the Eurasian Steppe-Southwest Asian chorotype.

T. biflora grows on dry slopes and plains, scree and stony ecotopes, clay and saline soils, etc. It is distributed in plant communities of various arid and semi-arid ecosystems (desert and semi-desert, steppe, arid open woodland, hemixerophilous and xerophilous shrubberies, etc.).

Objectives and Methods

The aim of our study was to determine the area and habitat of the identified populations of *Tulipa biflora*, to assess population abundance and condition of specimens and habitat of *T. biflora,* to identify current and potential threats and make a preliminary regional (Georgia) assessment according to IUCN categories and criteria [6].

The target species was recorded and monitored during both flowering (April) and fruiting (May) phases. Therefore, the phytosociological surveys of the vegetation were conducted twice. This allowed to identify vegetation structure of the *Tulipa biflora* habitat and the rhythm of the plant community development. Phytosociological surveys were carried out using traditional methods [7-13].

Taxa are cited according to The plant list (2021) [14]. *T. biflora* was assessed using IUCN Red List categories and criteria.

Climatic data follows Kordzakhia 2018 [15] and Kartvelishvili [16], soils - T. Urushadze [17, 18] and that of geology - Gamkrelidze [19].

Coordinates and altitude above sea level were recorded using Global Positioning System (GPS).

Results and Analysis

Tulipa biflora was found in the eastern part of Iaghluja Ridge (Fig. 4) in the vicinity of Rustavi, at the altitude of 500-550 m asl. In addition to the core population at N41.541083,

E44.972217 smaller groups comprising several individuals are scattered within approximately 500 m long zone along the eastern slopes of the ridge (Fig. 5).

Fig. 4. Eastern part of Iaghluja Ridge – distribution area of *Tulipa biflora* Pall. (Photo by N. Lachashvili)

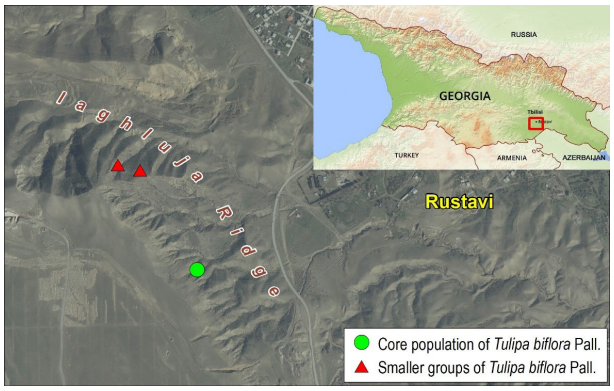

Fig. 5. Map of distribution of *Tulipa biflora* Pall. on Iaghluja Ridge

Terrain. The area is characterized by the alternation of slopes and ravines of different exposures and inclinations. The surface of the slopes is slightly hillocky and traversed by trails.

Climate. The study site is situated in the semi-arid climate zone, particularly in moderately warm steppe climate with dry summers and two minimum of precipitation per year. The average annual temperature is up to 13°C. The average annual precipitation is in the range of 400-440 mm. Evaporability exceeds 1000 mm. Humidity ratio is lower than 0.6.

Soil. Loamy and skeletal (with small stones) dry gray-cinnamonic soils are developed.

Habitat. Tulipa biflora grows in phryganoid vegetation habitat, particularly in the plant community of thorny goat's-wheat (Atraphaxietum spinosae) (Fig. 6). This plant community is developed on the slope of the macro north-eastern exposure. The micro exposures of the slopes are north-east, south-east and north-west. The slope inclination is 30°-35°.

Fig. 6. Habitat of *Tulipa biflora* Pall. on Iaghluja Ridge (Photo by K. Kereselidze)

The data summary of phytosociological surveys, conducted in April and May, are given below (Table). The field data collection was carried out in the core part of population supporting highest number of specimens.

Table. *Key characteristics of Tulipa biflora habitat*

Abbreviations: M – meter, N- north, E – east, S – south, W – west, H – hemicryptophyte, G – geophyte, Th – therophyte, Spec. – specimen

Date of description	**05.04. 2021**	**11.05. 2021**
Physical-geographical characteristics		
Location	East Georgia, Kvemo Kartli, vicinity of Rustavi, eastern part of Iaghluja Ridge	
Coordinates	N41.541083, E44.972217	
Elevation (m)	500-550	

Relief	Slightly hillocky and traversed by trails			
Exposition macro	N-E			
Exposition micro	N-E, S-E, N-W			
Inclination	30°-35°			
Soil	Grey cinnamonic, clay, small stony			
Exploitation	Pasture			
Geobotanical characteristics of the vegetation				
Overall projection coverage (%)	40		58-60	
Distribution	Even		Even	
Layer	Two vegetation layers		Three vegetation layers	
I Layer				
Average height (cm)	30		65-70	
Projection coverage (%)	20-25		25	
Distribution	More or less even		More or less even	
II Layer				
Average height (cm)	5		50	
Projection coverage (%)	25		25	
Distribution	More or less even		Even	
III Layer				
Average height (cm)	-		(5)10-25(30)	
Projective coverage (%)	-		18-20	
Distribution	-		More or less even	
Floristic composition				
Species	Layer	Coverage (%)	Layer	Coverage (%)
Shrubs				
Atraphaxis spinosa L.	I	25	II	25
Caragana grandiflora (M.Bieb.) DC.	I	+	II	+
Semishrubs and undershrubs				
Artemisia fragrans Willd.	II	4-5	III	10
Bassia prostrata (L.) Beck [*Kochia prostrata* (L.) Schrad.]	I	+ (1 spec.)	II	+ (1 spec.)
Scutellaria orientalis L.	II	+	III	+
Teucrium polium L.	II	+	III	+
Thymus coriifolius Ronniger	-		III	+
Perennial herbs (H)				
Prangos ferulacea (L.) Lindl.	II	6-7	I	25
Malabaila dasyantha Fisch. & C.A.Mey ex K.Koch	II	+	I	+
Astragalus bungeanus Boiss.	-	-	III	+
Scorzonera biebersteinii Lipsch.	-	-	III	+
Medicago sp.	-	-	III	+
Perennial herbs (G)				
Allium sp.	II	+	III	+
Gagea commutata K.Koch	II	1	III	+
Poa bulbosa L.	II	+	III	+
Podospermum canum C.A.Mey.	-	-	III	+
Tragopogon tuberosus K.Koch	-	-	III	+
Tulipa biflora Pall.	II	3-4	III	3
Biennials (H)				

Nonea lutea (Desr.) DC.	II	1	III	1
Silene cyri Schischk.	-	-	I	+
Annuals (Th)				
Aegilops tauschii Coss.	-	-	III	+
Carduus pycnocephalus subsp. *cinereus* (M.Bieb.) P.H.Davis	-	-	III	+
Carthamus lanatus L.	-	-	III	+
Caucalis platycarpos L.	-	-	III	+
Cerastium pumilum var. *glutinosum* (Čelak) E.Rico (*Cerastium glutinosum* Fr.)	-	-	III	+
Echinaria capitata (L.) Desf.	-	-	III	+
Erodium cicutarium (L.) L'Hér.	II	1	III	1
Filago pyramidata L.	-	-	III	+
Holosteum marginatum C.A.Mey.	II	+	III	+
Lamium amplexicaule L.	II	+	III	+
Linum sp.	-	-	III	+
Lolium rigidum Gaudin	-	-	III	+
Medicago minima (L.) L. [*Medicago minima* (L.) Bartal.]	-	-	III	+
Alyssum linifolius Stephan ex Willd. [*Meniocus linifolius* (Stephan ex Willd.) DC.]	II	+	III	+
Papaver arenarium M. Bieb.	-	-	III	+
Crepis sancta (L.) Bornm.	-	-	III	+
Rapistrum rugosum (L.) All.	II	+	I	+
Sideritis montana L.	-	-	III	+
Thlaspi perfoliatum L.	II	+	III	+
Veronica hederifolia L.	II	+	III	+
Viola kitaibeliana Schult.	II	+	III	+

The floristic nucleus of the habitat consists of characteristic species of arid and semiarid ecosystems. They are xerophilous and hemixerophilous plants, growing on the dry loamy and skeleton soils. Almost all plant life forms were present, from which shrubs and perennial herbs (hemicryptophytes) are distinguished by their coenotic role. However, annual weeds and widespread plants were also recorded (*Rapistrum rugosum*, *Carthamus lanatus*, *Aegilops tauschii*, *Thlaspi perfoliatum*, *Carduus pycnocephalus* subsp. *cinereus*, *Erodium cicutarium*, *Papaver arenarium*, *Filago pyramidata*, etc.), which should be considered as a result of grazing. Nevertheless, the structure and condition of the vegetation is satisfactory and corresponds to the physical-geographical parameters and the structure of phryganoid vegetation.

Data on *Tulipa biflora*. The area of occupancy of *Tulipa biflora* populations is ca. 350 m². The core population is comprised of unevenly distributed approximately 350-400 individuals (the average density is 2 individuals per 1 m²), while other smaller populations support 3-5 individuals each.

Observations of the target species revealed its main phenophases:

Flowering: End of April – May;

Fructification: End of April – May;

Seed maturity: The second half of May.

The developmental rhythm of *Tulipa biflora* in different parts of the global area are largely the same. However, in some parts of the area, such as the Negev Desert (Israel), it blooms relatively early (early March) [20]. The main phenophases of *Tu-*

lipa biflora, growing on Iaghluja Ridge, coincide with its phenophases in different areas.

Threats, concerns and ecological status. The area is used for grazing and is under anthropogenic impact. During the field data collection, cattle were grazing near the area. Given that Iaghluja Ridge is a winter pasture, it is assumed that sheep flocks over-winter here from autumn to early spring. Due to heavy grazing pressure most of the individuals of *T. biflora* showed gnawed leaves (Fig. 7) and a considerable part of them were small and undersized indicating stress-induced flowering (A. Schröter, unpublished raw data).

Fig. 7. Damaged leaves of *Tulipa biflora* Pall. (Photo by N. Lachashvili)

Most individuals of *Tulipa biflora* produce flowers and fruits (Fig. 8, 9) and fully complete the developmental life cycle.

Fig. 8. *Tulipa biflora* Pall. in fruits (Photo by N. Lachashvili)

Fig. 9. Mature fruits of *Tulipa biflora* Pall. with seeds (Photo by K. Kereselidze)

The preliminary regional assessment of *Tulipa biflora* using the IUCN categories and criteria. According to the IUCN categories and criteria [10], based on the decline of distribution area and habitat quality (grazing), the target species in Georgia was preliminarily assessed as critically endangered [CR B1 ab (iii) + 2ab (iii)].

Conclusions

1. The populations of *Tulipa biflora*, a species new for the flora of Georgia are located in East Georgia, in the eastern part of Iaghluja Ridge, in the vicinity of Rustavi, at an altitude of 500-550 m asl.
2. Physical-geographic characteristics of the area (climate, terrain, soil, etc.) and habitat both largely coincide with the relevant data typical for *Tulipa biflora*.
3. The area of occupancy of *T. biflora* populations is about 350 m².
4. The populations of *T. biflora* are composed of approximately 350-400 individuals;
5. Most individuals of *T. biflora* produce flowers, bear fruits and fully complete the developmental life cycle.
6. The populations of *T. biflora* are under permanent anthropogenic pressure (grazing).
7. In accordance with the IUCN regional assessment, *T. biflora* was preliminarily assessed as critically endangered [CR B1ab(iii) + 2ab(iii)].

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