

ABSTRACT

thesis for the degree of Doctor of Philosophy (PhD) in the educational program

“8D05108 – Geobotany”

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"Assessment of the status, number and structure of populations of the narrow-local North Tien Shan endemic *Tulipa tarda* Stapf "

General characteristics of the work. The dissertation is devoted to assessing the structure, abundance, and condition of populations of the Northern Tien Shan endemic *Tulipa tarda* Stapf using geobotanical and molecular-genetic methods.

Relevance of the dissertation. Wild tulips are a national symbol of Kazakhstan. The importance of preserving biological diversity, particularly plant life, is especially relevant for Kazakhstan in the current context of climate change and increasing anthropogenic pressure. Among the rare species requiring special protection, wild ornamental plants, including tulips (genus *Tulipa* L.), hold a priority position, as the southern regions of Kazakhstan are the center of origin of this genus. In terms of species richness (ranging from 33 to 45 species, depending on the classification), Kazakhstan ranks first in the world. Our tulips not only adorn landscapes, bringing aesthetic pleasure to people, but are also objects of breeding, and in recent years have become an important focus of ecological tourism.

These plants are also widely used in landscaping of urban and rural areas and have practical value as a genetic resource for developing new cultivated varieties and hybrids. They are characterized by early flowering, frost resistance, ease of propagation, and wide application potential. Tulips are commonly used for decorating flower beds, borders, alpine hills, walking paths.

Scientific interest in tulips dates back more than 500 years, and today research continues actively in Western Europe, the CIS countries, Turkey, and Japan. However, the taxonomy, distribution, and biology of wild tulips are still not fully studied.

To preserve the species and genetic diversity of plants belonging to the genus *Tulipa*, it is necessary to assess the current state of their populations, their numbers, and the impact of various factors, including both natural and anthropogenic influences. These species are in the focus of attention of scientists worldwide, who study both their taxonomy and conservation. In Kazakhstan and neighboring regions, this genus remains insufficiently studied, and work on describing new species is ongoing. The international community also places great importance on the conservation of tulips from our region. In particular, in 2022, the International Union for Conservation of Nature (IUCN) updated the Red List of Central Asian tulips, including 27 species from Kazakhstan. The conservation of the species and genetic diversity of all rare plant species should be based on a detailed study of their distribution, biological characteristics, population numbers, and condition under different habitat conditions. Unfortunately, many species — including Kazakhstan's tulips — remain under-researched in this regard. Botanists mainly

focus on taxonomy, distribution, and cultivation of species, both in Kazakhstan and abroad.

Recently, *T. tarda* has been identified as a tulip species that is completely unstudied in natural populations. Although this species is widely cultivated and has been studied in introduced populations, no data on its natural populations are currently available. Therefore, a comprehensive study of *T. tarda* in its natural habitats is a highly relevant and necessary research task.

Study object. The narrow-local endemic of the Northern Tien Shan – late tulip (*T. tarda*).

Objective: To study the current state of the population of the late tulip (*T. tarda*), a narrow-local endemic of the Northern Tien Shan, using botanical and molecular-genetic methods to preserve biological diversity.

The objectives are as follows:

1. Study of the range, distribution, and ecological-phytocoenotic characteristics of *T. tarda* in Kazakhstan.
2. Study of the morphological variability, density, and age structure of *T. tarda* populations
3. Determination of seed productivity of *T. tarda*, seed characterization, and study of their germination and germination dynamics
4. Investigation of the cultivation and introduction features of *T. tarda*, as well as identification of its consortial relationships with other ecosystem components.
5. Identification of genetic diversity and the degree of population differentiation in *T. tarda* populations.

Research methods. The study employed descriptive, correlation, and experimental methods, as well as geobotanical and molecular-genetic research techniques.

Scientific novelty of the dissertation.

For the first time, a comprehensive study of *T. tarda* has been conducted, including clarification of its range in Kazakhstan, its ecological and phytocoenotic characteristics, morphological variability in interannual dynamics (2021–2024), density, abundance, age structure of populations, reproductive potential, cultivation features, adaptive capacities, molecular-genetic variability, and consortial relationships. Populations of rare wild tulip species in Kazakhstan represent a valuable genetic resource and the natural heritage of the country. In this regard, the morphological and genetic variability of *T. tarda* has been studied in various ecological populations. This study expands knowledge of the ecology, biology and variability of the species, contributing to the conservation of its diversity on a broad scale.

Based on the analysis of our own data, herbarium specimens, literature sources and certain online resources, a point distribution map of the species in Kazakhstan has been compiled. A general floristic list of communities involving *T. tarda* has been prepared.

The morphological variability of the species, its density, abundance, and age structure of populations under various habitat conditions have been studied.

Seed productivity has been determined, seed characteristics (size, weight) described, and their germination and germination dynamics investigated.

The cultivation features of the species and its adaptive capacities have been identified. Consortial relationships with vertebrate and invertebrate animals (consumers, pollinators, pests) have been revealed.

A molecular-genetic study of the species has been carried out, and the degree of its genetic diversity determined.

Scientific and practical significance of the research work.

The obtained scientific results and conclusions make it possible to assess the current state of populations of the narrow-range endemic of the Northern Tien Shan *T. tarda*. During the dissertation work, collected and dried herbarium specimens of *T. tarda* were transferred to the herbarium collection of the following institutions: Kazakh Research Institute of Forestry and Agroforestry named after A.N. Bukeykhanov (Appendix A); Herbarium collection of the Faculty of Biology and Biotechnology, Al-Farabi Kazakh National University (Appendix B); Herbarium collection of the Astana Botanical Garden (Appendix C).

The comprehensive approach used to assess the state of *T. tarda* coenopopulations serves as a theoretical foundation for developing recommendations for their conservation and protection.

The research results on the cultivation characteristics of *T. tarda* can be used to formulate recommendations for the use of this species in landscaping.

The research results obtained in the course of this dissertation form the basis for proposals to improve the protection of this species.

Key provisions of the thesis put forward for consideration are the following:

1. The distribution of the species in Kazakhstan has been clarified; new sites in the eastern part of the range (Ushkonyp and Kargaly gorges) have been identified, and more than 20 habitats of the species, ranging from foothills to the middle belt (1,900 m a.s.l.), have been described.

2. The floristic composition of plant communities involving *T. tarda* includes 240 species belonging to 162 genera and 50 families. New plant communities with the participation of *T. tarda* have been identified—apricot forests, in contrast to the previously known steppe and shrub communities.

3. The age structure of the populations is complete and characterized by sufficient juvenile recruitment (juveniles – 31.6%); the most favorable conditions for their existence and the highest density (64.1 individuals/m²) were recorded within the Kargaly Gorge.

4. Even without special storage conditions, the seeds of *T. tarda* retain germination capacity for 3–4 years, and with increased storage time their germination decreases approximately twofold. These data confirm the broad adaptive potential of *T. tarda* to various cultivated conditions, especially in terms of seed productivity and high germination, which forms the basis for its cultivation and use in landscaping..

5. It was found that the studied species is characterized by a high level of adaptation, successfully naturalizes, and is capable of forming self-sown introduced populations on lawn areas through the spontaneous dispersal of seeds.

6. The obtained data, both from cpDNA and from the nuclear ITS1-2 region, indicate the genetic differentiation populations of *T. tarda* into two groups.

Personal contribution of the author to the work. The author independently formulated the aim and objectives of the study, conducted a literature review, studied the research object using selected methods both in the field and in laboratory conditions, summarized and processed the obtained results, and was fully involved in writing and formatting the dissertation.

Approbation of the work. The results of the dissertation work were presented and published at the following international scientific and practical conferences:

– International Scientific and Practical Conference ‘30th Anniversary of Kazakhstan’s Independence: Aspects of Biodiversity Conservation’ dedicated to the 80th anniversary of Doctor of Biological Sciences, Professor, Honorary Member of the National Academy of Sciences of the Republic of Kazakhstan, Academician of KazNAEN Mukhitdinov N.M. (Almaty, 2021);

– Asian Grassland Conference. Virtual Conference (Ukraine, 2022);

– IV International Scientific Conference ‘Biological Diversity of Asian Steppes’ (Kostanay, 2022);

– International Scientific Conference ‘Zoological Research in Kazakhstan in the 21st Century: Results, Problems and Prospects’ dedicated to the 90th anniversary of the RSE “Institute of Zoology” of the CS MES RK (Almaty, 2023);

– International Scientific and Practical Conference ‘Conservation of Biodiversity of Mountain Ecosystems under Climate Change’ dedicated to the 80th anniversary of the Institute of Biology of the NAS KR (Bishkek, 2023);

– International Scientific and Practical Conference ‘Introduction, Breeding and Conservation of Plant Biodiversity’ dedicated to the 85th anniversary of the Botanical Garden Research Institute of the NAS KR (Bishkek, 2023);

– International Scientific and Practical Conference ‘Desertification Problems in the Republic of Kazakhstan and Their Solutions’ dedicated to the 80th anniversary of Candidate of Biological Sciences, Associate Professor A.A. Ametov (Almaty, 2023);

– International Scientific and Practical Conference of Young Scientists ‘Ideas of N.V. Pavlov through the Eyes of a New Generation of Botanists’ dedicated to the 130th anniversary of Academician N.V. Pavlov (Almaty, 2024);

– Proceedings of the 5th Congress of the Ukrainian Botanical Society (30 September – 4 October 2024, Ivano-Frankivsk, Ukraine).

Publications. The main content of the dissertation is presented in 15 publications, including: 1 article in a scientific journal indexed in the Scopus database; 3 articles in national scientific journals included in the list approved by the Committee for Quality Assurance in the Field of Science and Higher Education of the Republic of Kazakhstan; 9 abstracts published in the proceedings of international scientific conferences; and 2 articles published in scientific journals.

Structure of the Dissertation. The dissertation consists of 102 pages and includes the following sections: introduction, literature review, materials and methods, results and discussion, conclusion, a reference list of 136 sources, 4 appendices, 32 tables, and 33 figures.