

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy (PhD)
in the educational program «8D05108 – Geobotany»

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«Ecological and biological features and structure of cenopopulation of the rare species *Hepatica falconeri* (Thoms.) Steward. (Ranunculaceae Juss.) in the south-east of Kazakhstan»

Relevance of the dissertation. Today, scientific and technological progress, as well as the intensive development of industrial and agricultural production, are essential prerequisites for the advancement of human society. However, large-scale economic development leads to the exploitation of land resources, which in turn results in the reduction of natural ecosystems and, consequently, the decline and extinction of biological diversity. Particularly vulnerable are rare plant species distributed over limited areas, which are under real threat of extinction. At the same time, many rare plants, which are endemics with limited ranges or relict species preserved from the past, play a crucial functional role in modern ecosystems. Many of them are of great economic importance: they serve as valuable medicinal, technical, food, and ornamental plants, and they also possess immense aesthetic, historical, and scientific value. Therefore, the preservation of these species and their natural habitats is a priority task.

In recent times, due to increased global anthropogenic pressure on plant life, there has been a significant rise in threats to plant populations. These include reductions in phytomass, the disappearance of certain species and biomes, pollution by xenobiotics, climate change, and other factors. These processes negatively impact the structure and functioning of ecosystems, posing a threat to the sustainable use of natural resources and the stability of agriculture. Furthermore, climate change and environmental crises can shift plant distribution boundaries and affect their phenotypic and genotypic characteristics. Such changes can reduce the biological diversity of ecosystems and disrupt ecological balance, which, in turn, may hinder the effective use of agricultural and natural resources and the conservation of biodiversity.

Biologists and ecologists now face a new and vital task — to determine the mechanisms that ensure population stability and to investigate the specific prerequisites leading to plant species extinction. In this context, questions regarding

changes in species composition of ecosystems, population dynamics, and the preservation of genetic diversity become particularly relevant. The decline or extinction of rare species can diminish the ability of ecosystems to provide essential ecological services. Therefore, the preservation of plant species, protection of their genetic diversity, and restoration of their habitats require special attention. The extinction of biological species is an irreversible process, which is why the protection of rare plants and the prevention of their disappearance is one of the most important tasks for modern botanists and ecologists. An especially important direction of current scientific research is the conservation of the genetic resources of plant species, maintaining their development in natural conditions, and finding ways to artificially restore them. To ensure species conservation within ecosystems, it is essential to develop integrated strategies for the protection and restoration of ecological environments, as well as to manage anthropogenic impacts across various research fields.

Kazakhstan's flora comprises 29 regions with 387 species of rare and endangered plants. Taking this situation into account, a National Strategy was adopted in the country, based on the International Environmental Protection Convention, to preserve and effectively utilize the genetic resources of Kazakhstan. Over the past 70–80 years, the intensification of anthropogenic impacts has made the study of rare plant species an urgent and complex problem. To date, the botanical characteristics and features of some rare endemic plant species in Kazakhstan have been studied to a certain extent. However, comprehensive studies on the population characteristics of rare and endemic herbaceous plants, including age structure and anatomical features, have not yet been conducted at a sufficient level.

One of Kazakhstan's rare plant species is *Hepatica falconeri* (Thoms.) Steward, from the Ranunculaceae family. This species, which holds special ecological, scientific, and cultural value, was included in the list of protected environmental objects and added to the Red Book of Kazakhstan in 2014. A comprehensive study of the *Hepatica falconeri* populations, including the determination of population size, age structure, the level of morpho-anatomical variability, and an in-depth analysis of these results, has not yet been conducted in Kazakhstan. This underlines the significance and relevance of the present research.

Study object. Three natural populations of the plant *Hepatica falconeri*: the first population is located in the Kolsai Lakes State National Nature Park, on the left bank of the Taldy River in the Taldy Gorge; the second population is also in the Kolsai Lakes State National Nature Park, on the left bank of the Taldy River in the

Tsarskiye Vorota Gorge; the third population is in the Chon-Aksu Gorge, on the left bank of the Chon-Aksu River.

Objective. Study of the ecological and biological features and structure of the cenopopulation of the rare *Hepatica falconeri* (Thoms.) Steward. (Ranunculaceae Juss.) species in the southeast of Kazakhstan for biodiversity conservation.

The objectives are as follows:

To achieve the set goal, the following tasks were carried out:

1. Identification of the floristic composition of plant communities involving *Hepatica falconeri* (Thoms.) Steward.
2. Determination and assessment of the variability of morphological parameters of *Hepatica falconeri* (Thoms.) Steward individuals.
3. Determination of the ontogenetic state, population size, and density of the *Hepatica falconeri* (Thoms.) Steward cenopopulation.
4. Comprehensive assessment of the condition of *Hepatica falconeri* (Thoms.) Steward cenopopulations based on the age spectrum.
5. Comparative study of the anatomical structural features of *Hepatica falconeri* (Thoms.) Steward.
6. Evaluation of the current state of the *Hepatica falconeri* (Thoms.) Steward cenopopulation in its natural habitat and development of conservation recommendations.

Research methods. Geobotanical and morpho-anatomical methods were used during the research.

Scientific novelty of the dissertation.

Research Results. For the first time, a study was conducted on *Hepatica falconeri*, the only representative of its genus in the flora of Kazakhstan and a rare plant species found in the foothills of the Kungoy Alatau.

The floristic composition of plant communities involving *Hepatica falconeri* (Thoms.) Steward was identified.

The variability of morphological parameters of *Hepatica falconeri* (Thoms.) Steward individuals was revealed and assessed.

The ontogenetic state, population size, and density of the *Hepatica falconeri* (Thoms.) Steward cenopopulation were determined.

A comprehensive assessment of the state of *Hepatica falconeri* (Thoms.) Steward cenopopulations was carried out based on the age spectrum.

The anatomical structural features of *Hepatica falconeri* (Thoms.) Steward were comparatively studied.

The current state of the *Hepatica falconeri* (Thoms.) Steward cenopopulation was evaluated, and conservation recommendations were developed.

Scientific and practical significance of the research work.

The scientific significance of the work lies in the acquisition of new information based on the comprehensive assessment of the characteristics of *H. falconeri* cenopopulations, which allows for the evaluation of the condition of the studied populations of *H. falconeri*.

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

1. A total of 133 species belonging to 43 families and 106 genera were identified in the flora of the studied communities.

2. The morphology of *Hepatica falconeri* was studied, along with its morphological variability.

3. The population size, density, and ontogenetic state of *Hepatica falconeri* cenopopulations were determined.

4. The age condition of *Hepatica falconeri* was described.

5. The anatomical structural features of *Hepatica falconeri* were comparatively studied.

Personal contribution of the author to the work.

The author of the research analyzed the literature, utilized various methods to achieve the research goals and objectives, and studied the research subject in both field and laboratory conditions. The obtained results were compiled, processed, and the author made a full contribution to the writing and formatting of the dissertation.

Approbation of the work.

The results and main principles of the dissertation were presented and discussed at international scientific conferences:

➤ International scientific-practical conference «Kazakhstan Independence: Aspects of Biodiversity Conservation» (Almaty, Kazakhstan, 2021);

➤ International scientific conference «The World of Farabi» for students and young scientists (Almaty, Kazakhstan, 2021, 2022);

➤ International scientific-practical conference «Issues of Botany of Southern Siberia and Mongolia» (Barnaul, Russia, 2022).

Publications.

The main content of the dissertation is presented in 11 published works, including 1 article in a scientific journal indexed in Scopus and Web of Sciences databases, 4 articles in national scientific journals listed by the Committee for Control in Science and Higher Education of the Republic of Kazakhstan, and 3 articles and 3 theses in the proceedings of international scientific conferences.

Structure of the thesis. The dissertation consists of 108 pages, including an introduction, literature review, materials and methods, results and discussion, conclusion, a list of 145 references, 15 tables, and 17 figures.