

ANNOTATION

**thesis work by Kaliyev Bedel Shamilovich on the topic:
«Ecological phytocenotic evaluation valuable species of flora of the Northern
range of the Zhetysu Alatau mountains», submitted for the degree of Doctor
of Philosophy (PhD) in the specialty 6D060800 – «Ecology»**

Relevance of research topic.

Zhetysu Alatau, lying between 44 and 46 ° C., is an entire mountain system that consists of two parallel, high mountain chains. The northern and southern macrosclines are separated by a high-altitude depression, in which the Koksus and Mutter rivers flow. It is stretched in the latitudinal direction by 450 km, 100-250 km wide from west-southwest to east-northeast along the State border of the Republic of Kazakhstan and the People's Republic of China.

According to the botanical and geographical zoning, the northern macroscline of the Zhetysu Alatau belongs to the Jungar-North Tianshan mountain province of the Severojungar mountain subprovincion, which is characterized by the Trans-Ili-Severojungar type of belt.

The study of ecological and phytocenotic patterns of vegetation distribution is one of the most relevant areas in modern plant ecology. The flora and vegetation of the Zhetysu Alatau has been studied relatively well, as evidenced by the classical works of N.I. Rubtsov, V.P. Goloskokov and others. But these works lack the ecological and phytocenotic characteristics of rare, endemic and economically significant species of flora. In order to develop recommendations for the rational use, conservation and restoration of flora and vegetation, it is necessary to further clarify the geography of distribution and map their locations. Thus, it is possible to develop a National Strategy for the conservation of plants in Kazakhstan.

The cartographic research method allows us to visually show the patterns of distribution of vegetation cover, as well as individual species and formations. The geobotanical map is a unique document of the current state of vegetation. It makes it possible to identify the causes of natural and anthropogenic vegetation dynamics, helps to identify functional and ecological interactions, and create on its basis cartographic works of a predictive and recommendatory type.

The purpose of the thesis research.

Identification of economically significant flora species of the northern macroscline of the Zhetysu Alatau and assessment of their ecological and phytocenotic features. Development of recommendations for the rational use of vegetation.

Research objectives.

1. Identification of economically significant flora species and their populations, analysis of phytocenotic features of habitats.
2. Creation of an ecological and phytocenotic classification of vegetation of the northern macroscline of the Zhetysu Alatau.

3. The study of spatial patterns of altitude-belt distribution of soil and vegetation cover.

4. Creation of a map of the ecosystems of the Northern macroscline and a vegetation map of the key botanical territory.

5. Conducting molecular genetic analysis of *Aquilegia vitalii* Gamajun.

Objects and methods of research.

The materials for this work were the available literature data and collections stored in the Herbarium Fund of the Institute of Botany and Phytointroduction (AA), as well as the herbarium and geobotanical descriptions collected during field research from 2018 to 2022 in order to study the current state of the vegetation cover of the mountain system.

Field surveys were carried out in 2018 at 37 key sites ranging in altitude from 916 m (Topolevka River) to 2136 m above sea level. ur. m. (Segizbay pass), 2019 at 83 key areas from 777 m (Baiturbau tract) to 3078 m. ur. m. (area of Lake Verkhniy Zhasylkol). The research routes on the northern macroscline of the Zhetysu Alatau covered the boundaries of the Zhongar-Alatau State National Natural Park: the vicinity of the village. Lepsinsk, Krutoy Pass, Chernov gorges, Nikonova mane, Kokzhota, Shimbulak; outside the National Park in the tracts of Kargaly, Terekty, Ushbulak, Zhamant, Tokzhailau mountains, Zhunzhurek, Alabas, intermountain valleys of the western spurs of the Zhetysu Alatau – Kapal-Arasan and Aktekshe and other territories. Geobotanical expedition trips in 2022 were carried out at 35 key sites in the altitude range from 1178 m (lower course of the Kora River) to 1756 m above sea level (right bank of the Tekeli River) in the southwestern part of the northern macroscline, where the border between the northern and southern macrosclines of the mountain range runs along the valley of the Koksus River.

The study of the patterns of spatial structure of vegetation cover of the mountain system was carried out using methods of detailed route profiling and geobotanical description of plant communities, characterizing the diversity of vegetation types. In addition to traditional geobotanical research methods (Field Geobotany, 1959-1976; Bykov, 1978), modern developments were used in the field description of vegetation and their office processing (Rachkovskaya E.I., Safronova I.V., 1994; Isachenko A.G., 1998; Malakhov D.V., Islamgulova A.F., 2021; etc.), including remote sensing technologies (Polyakov V.G., 1982; Ogar N.P., Gel'dyev B.V., Steimaus K., 2002; Malakhov D.V., Islamgulova A.F., 2014; etc.).

The boundaries of the belts, sub-belts and coordinates of plant communities on the ground were recorded by a GPS device. Geobotanical descriptions by profiles were carried out in each vegetation type taking into account the diversity of plant communities and environmental conditions of ecotopes on sample plots of 100 m². Geobotanical forms were used to describe plant communities, including sections: relief, soils, moisture conditions, factors affecting vegetation (natural or anthropogenic), etc.

Plant species were identified using the Illustrated Guide to Plants of Kazakhstan in 2 volumes (1969, 1972) and Flora of Kazakhstan in 9 volumes (1956-1966); species names in Kazakh are given on the basis of Kazakhstan Osimdikteri (Arystangaliev S.A., Ramazanov E.R. 1977; Arystangaliev S.A., 2013). Species names are given taking into account the latest taxonomic changes (Plants of the World Online (POWO)).

The soil studies were based on the comparative geographical method (Rode, 1971; Zonn, 1984). Morphological methods were used to diagnose and characterize the properties of soils (Rozaev, 2004). The taxonomic definition of soil types, subtypes and varieties was carried out in accordance with the accepted classification (Classification and Diagnostics of Soils of the USSR, 1977). In addition, the study used materials on the refined scheme of vertical zonation and classification of mountain soils of Kazakhstani scientists (Pachikin, 1991, 1996, 2016).

In creating the vegetation classification, we adopted the ecological-physiognomic approach to identifying taxa (Rachkovskaya E.I., et al., 2003; Rush G.M., et al., 2003; Pérez-Harguindeguy N., et al., 2013). The dominant approach to describing vegetation was used in vegetation mapping (Ellenberg, 1956; 1973; Küchler, 1949; 1967; Map..., 1995; Lavorel S., et al., 2011). The categories of the ecological-phytocenotic classification were widely used in mapping the vegetation of the Northern macroslope of the Zhetysu Alatau, and the taxa of the typological classification served as the basis for constructing legends for the maps.

When mapping vegetation using GIS technologies, high-resolution Landsat 8-9 satellite data (25-30 m per pixel) were processed. The cartographic materials were organized in a GIS environment with an associated database in the ArcGIS 10.8 program.

Main provisions submitted for defense.

1. The phytocenotic features and ecological conditions of the habitats of economically significant flora species (*Tulipa brachystemon* Regel, *Aquilegia vitalii* Gamajun.) were determined.

2. The main ecological-physiognomic categories (class of formation) of the vegetation types of the study region were identified.

3. The identified ecological-physiognomic categories were used to create a map of the ecosystems of the Northern macroslope of the Zhetysu Alatau at a scale of 1:1,000,000 and a map of the vegetation of the key sector «Zhasylkol-Kabanbai-Tokzhaylau-Attapkan» at a scale of 1:300,000. Taxa of the typological classification were used in the process of constructing legends for the maps.

4. The results of sequencing of ribosomal DNA regions (molecular genetic analysis) showed the lack of identity of the Zhetysu population of the Vitalii catchment area (*Aquilegia vitalii*) with 61 sequences of other catchment species, including the species *Aquilegia atrovinosa*, *A. lactiflora*, *A. glandulosa* and *A. Karelinii* found in the Zhetysu Alatau.

Justification of the novelty and practical significance of the obtained results.

Scientific novelty.

- For the first time, a comprehensive study of the patterns of spatial distribution of the soil and vegetation cover of the Northern macroslope of the Zhetysu Alatau and its altitude-belt differentiation was carried out. What is new compared to previous studies is the combination of soil and phytocenotic studies, which were previously considered separately, which allowed us to present a more complete picture of the altitude zone. Its spatial differentiation within high-altitude belts and sub-belts is shown.

- For the first time, a molecular genetic study of the Vitaly catchment (*Aquilegia vitalii* Gamajun.) was conducted. The interspace sites of the ribosomal genes ITS1-ITS2 were analyzed, as a result of which a sequence with a length of 633 base pairs (p.o.) was obtained. This sequence of the Zhetysu catchment was compared with other nuclear DNA sequences available through the NCBI GenBank database.

Scientific and practical value of the work.

The obtained results allow us to assess the current state of economically significant species of flora of the northern macroslope of Zhetysu Alatau. The materials of the molecular genetic study allow us to plan the restoration of natural populations of *Aquilegia vitalii*. The data obtained on the floristic and phytocenotic composition were included in the regional publications «Green Book of Almaty Region» (2023), «Red Book of Almaty Region» (2023).

Description of the main results of the study.

The regularities of the altitudinal distribution of the soil and vegetation cover of the northern macroslope of the Zhetysu Alatau are studied. Its spatial differentiation within altitudinal belts and subbelts is shown, where a belt is defined as an altitudinal step in a mountain system, characterized by the dominance of a certain type of soil and vegetation. A subbelt is a part of a belt with a certain structure of plant communities of the dominant type of vegetation, confined to different types and subtypes of soil. The boundaries of the belts and subbelts mark the boundaries of the altitudinal distribution of a certain type of vegetation and soil.

The results of ribosomal DNA sequencing conducted for the first time are presented, which showed the lack of identity of the Zhetysu population of *Aquilegia vitalii* Gamajun. with 61 sequences of other species of the catchment area, including *Aquilegia lactiflora*, *A. glandulosa* and *A. Karelinii* species found in the Zhetysu Alatau.

PhD student contribution to the preparation of each publication. The PhD student was directly involved in expedition trips from 2018 to 2022; in desk processing, he was engaged in the analysis of literary, stock, cartographic materials and field research materials; determining phytocenotic features and environmental conditions of plant communities and individual species. Compiled a map of the "Ecosystems of the Northern Macro Slope of Zhetysu Alatau" at a scale of 1: 1,000,000 and a vegetation map of the botanical sector "Zhasylkol-Kabanbai-Tokzhailau-Attapkan" at a scale of 1: 300,000 in the ArcGIS software environment.

Based on the dissertation materials, 14 scientific papers were published, including 2 articles in publications indexed in the Scopus database, 4 articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Higher Education of the Republic of Kazakhstan, 8 articles in the proceedings of international scientific and practical conferences.

Compliance with the directions of development of science or state programs: Thesis was carried out within the framework of state scientific and technical programs: BR05236546 «Implementation by state botanical gardens of priority scientific and practical tasks for Kazakhstan of the global strategy for plant conservation as a sustainable system for maintaining biodiversity» (2018-2020); BR10264557 «Cadastral assessment of the current ecological state of flora and plant resources of the Almaty region as a scientific basis for effective management of resource potential» (2021-2023).

Structure and scope of thesis: The dissertation consists of an introduction, 4 chapters, a conclusion, a list of references (182 titles, including 30 in a foreign language), contains 5 tables and 21 figures. The total volume of the dissertation is 138 printed pages (including the main text - 121 pages, appendices - 17 pages).