

## **ANNOTATION**

of the dissertation for the degree of Doctor of Philosophy (PhD) in the specialty  
"6D061300 - Geobotany"

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### **Patterns of spatial distribution of plants in the southern macroslope of the Dzhungarian Alatau ridge**

**General description of the work.** In the dissertation work is given a summary characteristic of the vegetation cover of the southern macroslope of the Dzhungarian Alatau mountain system.

#### **Relevance of the topic.**

Mountain systems are characterized by high dynamism of geosystems, strong dissection of the relief, as well as an extraordinary combination and richness of botanical diversity. That is why they are highly vulnerable to external influences. At the UN Conference on Environment and Development in Rio de Janeiro in 1992, mountain regions were classified as fragile ecosystems, and their study was recognized as one of the priority topics of 21<sup>st</sup> Century.

Dzhungarian Alatau stretches in latitudinal direction by 450 km, width 100 - 250 km. The main massif of the Dzhungarian Alatau consists of two parallel - the northern and southern ridges, which are separated by the Koxu River. Along the demarcation strip of the northern and southern macroslopes, it is possible to draw the border between the mountainous Siberian and north Tien Shan floras. In the mountains of the Dzhungarian Alatau grow Siberian fir, juniper thickets and the Tien Shan spruce (Shrenk spruce). The flora of the Dzhungarian Alatau is well studied, its richness (2168 species) and high endemism (76 species) are noted. To clarify the boundaries of the altitudinal zones, additional herbarium collections were required. In the literary sources of the last decade, more attention was paid to the vegetation of the northern macroslope. The vegetation of the southern macroslope is most fully reflected in the classical works of N.I. Rubtsov, written in the middle of the twentieth century. Therefore, the assessment of the current state of the vegetation cover of the southern macroslope has become an important task for determining the trends in the development of mountain ecosystems. Topical research issues were: identifying patterns of altitudinal zonality, typology of vegetation cover, mapping a key site and locations of rare and economically valuable plant species, identifying rare plant communities of the southern macroslope of the Dzhungarian Alatau. With the creation of the State Scientific and Production Enterprise Altyn-Emel in 1996, the unique ecosystems of the southern macroslope are preserved on an area of 209,553 hectares.

Geobotanical and floristic characteristics of altitudinal belts, factors influencing the assessment of botanical diversity and their differentiation, can be solved only by analyzing the entire altitudinal-belt spectrum of vegetation. Therefore, the typological structure of the vegetation cover of the southern macroslope of the Dzhungarian Alatau has been analyzed, the ecological and physiognomic types of vegetation at the level of altitudinal zones have been determined based on the results of field studies carried out in the period from 2014 to 2019, taking into account literary sources.

**The purpose of dissertation work:** Revealing the patterns of spatial distribution of the vegetation cover of the Dzhungarian Alatau southern macroslope and developing effective recommendations for the conservation of vegetation.

**Research objectives:** To achieve the goal the following tasks were set:

1. Study of the patterns of altitudinal zonation;
2. Identification of ecological and physiognomic types of vegetation;
3. Phytocenotic characteristics of vegetation types;
4. Assessment of anthropogenic transformation of vegetation cover;
5. Mapping vegetation of key areas;
6. Mapping of locations of economically valuable plants;
7. Identification of rare plant communities;
8. Development of recommendations for the conservation of vegetation.

**Object of the study.** Vegetation of the southern macroslope of the Dzhungarian Alatau ridge.

**Research methods.** Research work on the vegetation cover of mountainous areas was carried out by the Institute of Botany and Phytointroduction in the framework of integrated botanical expeditions using the route research method in the period from 2014 to 2019. The studies used classical geobotanical methods [7-13], including: geobotanical description of the main plant communities; landscape and ecological profiling; vegetation mapping at survey scale. In the classification of vegetation cover, a dominant (physiognomic) approach was used.

**Scientific novelty of the research.**

- For the first time the modern characteristics of the vegetation cover of the southern macroslope of the Dzhungarian Alatau ridge are given;
- The altitudinal-belt patterns of vegetation cover for the southern macroslope have been clarified;
- Ecological and physiognomic types of vegetation are determined and detailed description of the most common types is given;
- A map of vegetation of the key site "Tyshkantau-Borokhudzir" was compiled;
- The factors of anthropogenic transformation of the vegetation cover have been determined;
- For the first time, rare plant communities of the southern macroslope were identified;
- For the first time, effective ways to save the vegetation cover of the southern macroslope of the Dzhungarian Alatau have been suggested.

**Scientific novelty and theoretical significance of the research.** The scientific significance lies in the survey of a region with unique biodiversity that is insufficiently studied in geobotanical terms. In connection with the increasing anthropogenic pressure due to irrational nature management, an assessment of the current state of the vegetation cover made it possible to determine the degree of anthropogenic transformation and identify the main threats to botanical diversity. The identification of rare plant communities will allow them to be included in the planned "Green Book" of rare plant communities of the Almaty region. Mapping of the locations of economically valuable species, including wild relatives of cultivated plants became important for the Dzhungarian Alatau.

**The practical significance of the study.** The work can be as a reference tool for carrying out similar studies in other mountainous regions of the country, for developing a scheme of botanical and geographical zoning of the entire mountain range of the Dzhungarian Alatau. The identified rare plant communities and their distribution can serve as a basis for preparing proposals for the conservation and creation of protected areas of different status. Herbarium materials collected as a result of research work have replenished the herbarium fund of the Institute of Botany and Phytointroduction and can be used for scientific purposes by both domestic applicants and foreign botanists. The results of studying the herbarium of the flora of the Dzungarian Alatau are used in teaching general botany in universities.

**The main provisions for the defense:**

- patterns and features of altitudinal zonation within the southern macroslope;
- ecological and physiognomic types of vegetation, their phytocenotic characteristics and altitudinal confinement;
- spatial patterns of vegetation cover on the example of a key site map;
- description of rare plant communities for inclusion in the "Green Book" of the Almaty region;
- recommendations for the preservation of the vegetation cover of the Dzhungarian Alatau southern macroslope.

**The basic results and conclusions of the study**

1. The sequence of altitudinal belts of the southern macroslope of the

Dzhungarian Alatau was revealed: a belt of foothill deserts (600-800 m); steppe belt with sub-belts of deserted steppes (800-1500 m) and meadow steppes (1500-1700 m); forest-meadow (1700-2400 m); a belt of subalpine meadows, steppes and elfin woodlands (2200-2800 m); zone of cryophyte (alpine) meadows and steppes (2800-3500) m).

2. The vegetation cover of the southern macroslope of the Dzhungarian Alatau belongs to 6 types: forest, shrub, meadow, marsh, steppe, and desert. Each type includes ecological and physiognomic categories of vegetation. For each type of vegetation, a phytocenotic characteristic of species diversity and confinement to altitudinal belts are given. The distribution of plants directly depends on the height above sea level, the exposure of the slope, the presence of an additional source of moisture (river network, springs).

3. Dark coniferous forests of the southern macroslope do not form a belt. Spruce forests occupy mainly steep northern slopes in the eastern part of the macroslope (Koyandytau, Tyshkantau, etc.); moss, herb-moss and moss-forb-shrub spruce forests are widespread. Shrub thickets form subalpine juniper dwarf trees, communities of halophytic shrubs of foothills, mesophytic shrubs of river valleys, petrophytic shrubs of the steppe belt. Meadow vegetation occupies a wide altitude range from foothill deserts to subalpine and alpine belts. Alpine meadows (2800-3300 m) are scattered fragmentarily among stony slopes, talus, rocks and along the tops of mountain ranges, they are found in combination with steppes and juniper dwarfs. Mid-mountain meadows are distributed along the northern slopes, sometimes in combination with spruce and shrubs. Floodplain meadows (real and swampy) are noted in low mountains along river valleys. The steppe type of vegetation extends from 800 m above sea level to the alpine

belt. The sub-belt of true steppes is not expressed, it is fragmentary, which is associated with the aridity of the southern macroslope and the plowing of the foothill plains.

4. The vegetation of the southern macroslope of the Dzhungarian Alatau is anthropogenically transformed. The main factors of transformation are plowing in the foothills, changes in river flow, canals, grazing, haymaking, recreation, road digression. The degree of impairment is average. In some places, there are highly transformed areas (plowing of steppe slopes and river valleys (Usek). Steep slopes are slightly disturbed.

5. The vegetation map of the key site "Tyshkantau - Borokhudzir" of the southern macroslope of the Dzhungarian Alatau (S. 1: 250 000) reveals highland vegetation (nival vegetation, vegetation of the alpine belt with a predominance of cryophytic meadows and steppes, vegetation of the subalpine belt with a predominance of high-mountain meadow steppes, grass-forb meadows and the participation of subalpine spruce forests); vegetation of the middle mountains (vegetation of the middle mountains with a predominance of meadow and shrub steppes and the participation of spruce forests); vegetation of low mountains (vegetation of low mountains with a predominance of desertified steppes and shrubs); vegetation of foothills (vegetation of foothill deserts, vegetation of mountain river valleys and intermountain valleys); anthropogenic vegetation.

6. On the southern macroslope of the Dzhungarian Alatau, 104 key sites were identified with the participation of wild relatives of cultivated plants / economically valuable species. There are 10 main groups (fodder, decorative, medicinal, melliferous, tanning, vitamin, essential oil, food, weed and poisonous) of economically valuable plants. Depending on the economic value, fodder (27%) and decorative (17%) plants prevail.

7. On the southern macroslope, there are 17 rare plant communities recommended for inclusion in the "Green Book" of the Almaty region. Among them there are 16 communities with the participation of rare species listed in the Red Book of the Republic of Kazakhstan. In addition, belt-zonal communities are rare - dark coniferous forests of Shrenk spruce and Siberian fir; intrazonal - gallery floodplain forests with Tien Shan birch.

8. Preservation of the vegetation cover of the southern macroslope of the Dzhungarian Alatau is considered as an indicator of the main ecological efficiency. We propose the following measures as effective key indicators of biodiversity conservation:

- prevention of fires on the vegetation cover of high-altitude zones;
- supervision over illegal cutting of shrubs and semi-shrubs;
- periodic change of places of livestock grazing on natural pastures;
- decrease in the amount of hay making on steppe pastures and hayfields;
- protection of valuable resource species of flora and creation of conditions for the preservation of resource potential;
- collection and storage of seeds of rare and economically valuable species as measures to preserve biodiversity.

**Personal contribution of the author to the work.** In the course of the research work presented in 8 articles and 4 theses, given in the main content and results of the dissertation, the author took part in expeditions to collect field material, including: collecting herbarium, determining altitudinal-zonal patterns, determining GPS

coordinates, the construction of an ecological-phytocenotic classification. In the course of processing the field and literary material, the candidate analyzed the data to construct an ecological-phytocenotic classification, developed a map and a legend to it and identified rare plant communities.

**Coherence of the work with the program of the scientific research.**

The dissertation work was carried out within the framework of the program "Botanical diversity of wild relatives of cultivated plants in Kazakhstan as a source of enrichment and preservation of the gene pool of agrobiodiversity for the implementation of the food program" (2013-2015). (State registration No. 0113RK00940)

**Approbation of the work**

The results and main provisions of the dissertation were presented and discussed:

- "Steppes of Northern Eurasia" Materials of the VII international symposium (Russia, Orenburg, 2015);
- Proceedings International Conference "Applied ecology: problems, innovations" (Georgia, Tbilisi, 2015);
- International scientific and practical conference of students and young scientists "World of Farabi" (Almaty, Kazakhstan, 2014-2016).

**Publications.** The main content and results of the dissertation were published in 12 scientific papers. One article was published in journals included in the Scopus database, 5 articles in republican scientific journals from the list of the Committee for Control in Education and Science of the Republic of Kazakhstan, 2 articles and 4 theses in the collection of international scientific conferences.

**Structure of the dissertation.** The structure of the dissertation consists of references, designations and abbreviations; introduction; 4 chapters; conclusion and bibliography of 189 titles. The volume of work is 144 pages, including 12 tables, 28 figures and 3 appendices.