

The Biological Structure of the Modern Dendroflora of Western Tanirtau

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Abstract: In terms of its plant richness, the Tien Shan occupies a special place among the mountain systems of Central Asia. According to many scientists, the Tien Shan is conditionally divided into three parts - western, central (inner) and northern. In the geographical nomenclature, onomastics and toponomics of modern sovereign Kazakhstan, the original name Tanirtau is used instead of the term Tien-Shan. Western Tanirtau is the most floristically rich mountain ecosystem in Kazakhstan, where the bioclimatic zones from deserts to glaciers are represented in all their diversity. The generic coefficient of the flora of Western Tanirtau is the highest in Kazakhstan and reaches 4.12, which indicates a high degree of autonomy and originality of the flora of Western Tanirtau.

There are no special reports on the dendroflora of Western Tanirtau at this time. The essence of the floristic analysis given in this paper is the biological analysis of the dendroflora of Western Tanirtau.

The species composition of tree and shrub plants collected and recorded in all natural, anthropogenic-urbanized ecosystems of Western Tanirtau were the objects of study.

Research objectives: to identify the life forms of the dendroflora of Western Tanirtau; to determine the rhythm of flowering and fruiting of tree and shrub plants in the region.

Keywords: Dendroflora, Western Tanirtau (Tien Shan), Flora, Biological Structure, Kazakhstan, Family, Genus, Species.

1. Introduction

Biological analysis of the flora is carried out on the life forms of plants. The life form of plants, in some authors-ecobiomorph, is the external form of plants - as a reaction, the attitude of the plant organism to the influence of a complex of environmental factors in space and time [1,2,3].

The study of the dendroflora of Western Tanirtau was conducted from 2008 to 2020. The study was conducted in the region of the Kazakh part of Western Tanirtau in the south of Kazakhstan. The collection and processing of materials was carried out according to the method of A. K. Skvortsov. All types of tree and shrub plants observed on all high-altitude mountain belts, including ridges, gorges, and anthropogenic-urbanized ecosystems, were recorded.

The analysis of the flora is based on a program of floristic research of various degrees of activity [4].

Completely new data were added to the data on the dendroflora of Western Tanirtau due to the study and analysis of the urban flora of Shymkent [5].

Nevertheless, these studies did not thoroughly study the dendroflora of Western Tanirtau within Kazakhstan. This served as the basis for determining the current state of the natural ecosystem and the taxonomic structure of the dendroflora.

2. Study Area

The object of the study is the species composition of tree and shrub plants collected and recorded in all natural, anthropogenic and urbanized ecosystems of Western Tanirtau.

According to V. N. Pavlov [6], within the natural boundaries of Western Tanirtau, 9 districts are naturally and clearly distinguished by their complex natural and climatic characteristics: I-Aksu - Jabagli; II-Talas - Uzunakhmat; III-Badam - Kelesky; IV-Verkhne - Chirchik; V-Parkent; VI - Santalash - Chatkal; VII-Aflatun - Karasu; VIII-Kuramin; IX - South - Baikal.

The Kazakh part of the Western Tanirtau is represented within the Aksu-Zhabagli, Talas-Uzunakhmat (partially) and Badam-Keles districts. Therefore, in the floristic analysis of the dendroflora of Western Tanirtau, we conducted a study only in these 3 districts (Figure 1).

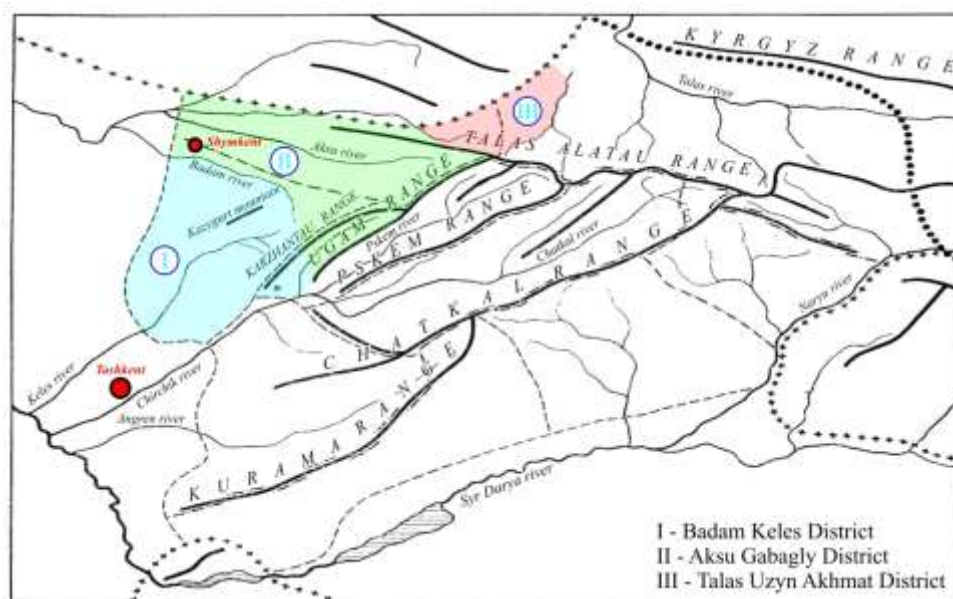


Figure 1-Map-scheme of Western Tairntau

3. Method and Materials

The study of the dendroflora of Western Tairntau was carried out in different seasons during numerous field trips conducted in the period from 2008 to 2020. The study was based on a summary of the dendroflora of Western Tairntau [7]. The collection and processing of the material for this work was carried out according to the generally accepted method of A. K. Skvortsov [8].

All types of tree and shrub plants observed on all high-altitude mountain belts, including ridges, gorges and agrocenoses, and anthropophytions, were recorded.

The study was carried out in the region of the Kazakh part of Western Tairntau in the south of Kazakhstan (68° s. w., 42° w. d.), where the flora extends over a vast area, about 13200-13800 km²(highlighted areas I, II and III in Figure 1).

The biological structure of the modern dendroflora of the region is based on the ecological-system approach, the theoretical aspects of which in Kazakhstan over the past 20-30 years are widely reflected in the works [9-12]. When determining the materials collected during the expedition on the territory of Western Tairntau, as well as viewing previously collected material stored in the Herbarium of the Institute of Botany and Phytointroduction of the Ministry of Education and Science of the Republic of Kazakhstan, the Institute of the Gene Pool of Flora and Fauna of the Academy of Sciences of the Republic of Uzbekistan, 396 taxa of dendroflora were identified.

4. Results and Discussion of Results

The dendroflora of the studied region, like all other dendroflora, is represented by the divisions of woody and semi-woody plants according to T. I. Serebryakova [1]. (Table 1).

Table 1. The ratio of departments and types of life forms of the dendroflora of Western Tairntau (according to T. I. Serebryakova [1]).

| Departments | Types | Number of types | % from the total number of species | Types of natural ecosystems | Types of anthropophytion |
|-------------------|---------------|-----------------|------------------------------------|-----------------------------|--------------------------|
| A. Woody plants | 1 Trees | 167 | 42,17 | 45 | 122 |
| | 2 Shrubs | 159 | 40,15 | 81 | 78 |
| | 3 Shrubs | 12 | 3,03 | 12 | 0 |
| | 4 Lianas | 14 | 5,53 | 5 | 9 |
| Total: | | 352 | 88,88 | 143 | 209 |
| Б. Полудревес-ные | 5 Semi-shrubs | 19 | 4,79 | 19 | 0 |

| | | | | | |
|-----------|---------------|------------|------------|------------|------------|
| растения | 6 Semi-shrubs | 25 | 6,31 | 23 | 2 |
| Total: | | 44 | 11,11 | 42 | 2 |
| In total: | | 396 | 100 | 185 | 211 |

And now we will briefly focus on the characteristics of the types of life forms separately.

Trees. "Trees have the most fully expressed capacity for intensive and long-term growth of shoots; as a result, trees reach the largest size among higher plants. By placing their crowns high above the ground, they take up maximum space. A distinctive feature of any erect tree is the formation of a single trunk, the biologically main axis, always striving to maintain a more or less vertical direction of growth and growing shoots (both in length and in thickness).

Branching, if it is pronounced, in a tree is usually acrotonic, i.e. the strongest branches develop closer to the top of the trunk and its branches, and in the lower parts of the trunk, the side branches either do not develop at all, or develop poorly and quickly die off. This is how the crown is formed in the upper part of the trunk [13].

The trunk of a tree lives as long as the whole tree. Dormant buds at the base of the trunk give sister trunks only if the main trunk is cut down and damaged in another way (root growth) [13-16].

The richness of diversity, their geographical and climatic patterns of this life form are very interesting. Thus, statistical calculations show that the highest percentage of trees is in the flora of humid tropical forests (up to 88% – in the Amazon of Brazil). In the area of taiga forests of the temperate cold zone, although trees dominate the landscape, they are represented by only 1-2 or a few species, which make up a negligible percentage of the total number of species. In the flora of the temperate forest zone of Europe, trees make up no more than 10-12% of the total number of species [13].

Shrubs. In shrubs, the main shoot behaves like a small tree, but quite early, on the 3rd, 5th, 10th year of life, new stems begin to grow from dormant buds at the base of the stem, often surpassing the mother one and gradually replacing each other.

In general, the life span of a shrub can be very long, several hundred years, but each of the trunks lives on average 10-40 years [13].

Shrubs. These are miniature shrubs with the same main method of branching, but they are more stunted and the life span of individual skeletal axes is less, 5-10 years. They are common in the tundra, high in the mountains... [13].

Semi-shrubs and semi-shrubs are formed on the principle of a shrub, but have a shorter life span of skeletal axes (5-8 years) and in addition, every year after flowering, they lose the entire upper part of their annual flowering shoots, sometimes up to ¾ or more of the total height of the shoots. The remaining woody perennial system of " stumps " bears the buds of renewal, located above the ground [13].

The ecological and geographical feature of semi-shrubs and semi-shrubs is that they are particularly characteristic of arid and extra-arid ecosystems of deserts and mountain steppes [13].

Lianas. Woody and semi-woody lianas are characterized by the fact that their stems do not carry supporting functions, they are formed by leaning on other objects or on the supporting stems of other plants. According to I. G. Serebryakova [13], lianas are elements of tropical forests.

The spectrum of life forms given in Table 1 shows once again the forest essence of the dendroflora of West-Tanirtau. This is indicated by the numerical advantage of trees and shrubs, as well as the presence of a noticeable number of lianas. The quantitative superiority of cultivated plants with the life form of a tree, shrub and liana indicates the prospects for enriching dendroflora not only from the humid, mesophilic forest ecosystems of temperate Eurasia and the Holarctis as a whole, but also from the tropical forests of the Southeast and East Asia with a monsoon climate. On the other hand, the clear numerical advantage of trees, shrubs and lianas among the species of natural ecosystems, in turn, gives grounds for asserting the historical links of the dendroflora of Western Tanirtau with those of tropical and subtropical forests in past geological epochs.

One of the obvious biological signs is deservedly considered the rhythm of development or the vital rhythm of plants. Usually, in floral works, the biological rhythm is estimated by the timing of flowering and fruiting. A review and analysis of the facts on the time of flowering of dendroflora species in Western Tanirtau shows that dendroflora species bloom from the earliest spring to late autumn, from the end of February - early March to the end of October. For ease of calculation and to determine and evaluate the dependence of the rhythm of development on a complex of environmental factors (temperature, humidity, insolation, wind rose, etc.), we distinguish 7 groups of the rhythm of flowering. It is necessary to immediately make a reservation that the allocation of these groups is to a certain extent conditional.

Group 1-Early spring. This includes species that bloom in March and in the first half of April. There are species that bloom in February. Ecologically, this group can be characterized as humid-moderate-cool, because the soils are not yet warmed up, the sum of positive temperatures is not yet high.

2-group-Spring. Here are collected species that bloom from the end of March to the beginning of May, usually massively blooming in April and in the first half of May. This group can be described as ecologically humid-moderately warm, since the soils are already warmed up, the sum of positive temperatures is higher than in early spring, and the temperature difference at night and during the day is reduced.

Group 3-Late-early-summer. These are species that bloom from the end of April to the first half of June, usually massively blooming in May. Ecologically, this group can be characterized as humid, subhumid-warm.

4-group-Flight. These are species that bloom in June, July, usually massively blooming in the second half of June and in the first decade of July. Ecologically, this group can be characterized as subhumid-subarid-moderately hot and hot.

5-group-Late-autumn. These are species that bloom in August - September. Environmental characteristics-subhumid-subarid-hot-moderate-hot.

6-group-Remontantnaya. Species blooming throughout the growing season. There are 2 subgroups-1) spring-autumn and 2) summer-autumn.

The distribution of dendroflora species in Western Tanirtau is given in Table 2.

Table 2. The ratio of the groups of the flowering rhythm in the dendroflora West Tanirtau

| n/a | Flowering rhythm groups | Number of types | % of the total number of species | Note |
|-----|--|-----------------|----------------------------------|------|
| 1 | Early Spring | 18 | 4,54 | |
| 2 | Spring weather | 83 | 20,95 | |
| 3 | Late spring-early summer | 197 | 49,74 | |
| 4 | Summer School | 63 | 15,90 | |
| 5 | Late summer-autumn | 12 | 3,03 | |
| 6 | Repair shop | 5 | 1,26 | |
| 7 | The rhythm of flowering was not revealed | 18 | 4,54 | |
| | | 396 | 100% | |

The data in Table 2 shows that three-quarters of the dendrophora species in the study region bloom and fade by mid-June, i.e., by the beginning of summer. Every second type of dendroflora blooms in the late spring-early summer season, when there is enough heat and moisture. Every fourth and fifth species blooms in the spring, when the sum of positive temperatures is not yet so high and the soil is warmed up positive temperatures are not yet so high and the soil is not warmed up so much. The blooming of the vast majority of dendrophora species in the first half of the growing season suggests that the dendroflora of Western Tanirtau belongs to the flora of the temperate Holarctic. However, the advantage of the late spring-early summer group indicates that the dendroflora of Western Tanirtau belongs to the ancient Mediterranean mountain flora with a humid-subhumid-warm climate. This statement is also reinforced by the presence of the summer group of the flowering rhythm and its rather high role in the dendroflora. On the other hand, the significant proportion of the summer group and the presence of late summer-autumn and remontant groups may be an indicator of the influence of southern subtropical and tropical flora on the dendroflora of the region. After all, it is for their representatives that late flowering and arrhythmia of flowering are characteristic. These revealed patterns in the rhythm of development of dendroflora species are also confirmed by the analysis of the rhythm of fruiting of species (Table 3).

Table 3. The ratio of groups of the rhythm of fruiting (fruit maturation) in the dendroflora of Western Tanirtau

| n/a | Flowering rhythm groups | Number of types | % of the total number of species | Note |
|-----|--------------------------|-----------------|----------------------------------|------|
| 1 | Early Spring | 3 | 0,75 | |
| 2 | Spring weather | 17 | 4,29 | |
| 3 | Late spring-early summer | 28 | 7,07 | |

| | | | |
|---|--------------------------------|-----|-------|
| 4 | Summer School | 169 | 42,67 |
| 5 | Late summer – early autumn | 81 | 20,45 |
| 6 | Autumn | 63 | 15,90 |
| 7 | Late autumn | 9 | 2,27 |
| 8 | Repair shop | 5 | 1,26 |
| 9 | The fruiting rhythm is not set | 21 | 5,30 |

5. Conclusions

During the analysis of materials collected on the territory of Western Tairtau and viewing previously collected materials, 396 dendroflora taxa belonging to 130 genera and 50 families were identified. The proposed material is an actual reflection of the current state of the dendroflora of Western Tairtau within Kazakhstan and for the first time the life forms of woody and shrubby plants were determined at the current level of taxonomy and nomenclature. For the first time, the most complete list of the dendroflora of Western Tairtau is given, which includes 396 species of woody and shrubby plants. The rhythms of flowering and fruiting of the dendroflora of the studied area were revealed.

The proposed material is an actual reflection of the current state of the dendroflora of Western Tairtau within Kazakhstan.

The data presented in the article are recommended for use in the preparation of the Kazakhstan National Strategy for the Conservation and Balanced Use of Biological Diversity, and are under discussion for inclusion in the "Plant Determinant of the Republic of Kazakhstan". The complete list of species is recommended for use in the compilation of the Plant Identification Index of the surroundings of the city of Shymkent, as well as in the theoretical analysis of the flora of Western Tairtau. In addition, we offer the results of the study for use in the development of resource and environmental measures in the region.

6. Literature

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