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ENVIRONMENTAL ANALYSIS OF GORGE REMIZOVKA TRANS-ILI ALATAU

This article presents the results of the study, obtained during the ecological analysis of the gorge Remizovka of the Trans-Ili Alatau. Due to the fact that the flora is a defining component of ecosystems and is subject to changes over time, it serves as an indicator of the changes that are occurring, and its current state is the result of phenomena that occurred earlier under the influence of natural and anthropogenic factors. In this regard, the inventory and analysis of the flora of any region were, and will always be relevant. One of the global challenges of our time is the study of problems and the conservation of biological diversity. Gorge Remizovka is previously poorly known, therefore the purpose of our work was to conduct an ecological analysis of the flora of this region.

Flora was studied using both traditional methods of field geobotanical research and new methodological methods.

The distribution of plant species in the life-forms of Remizovka has shown that perennials (623 species or 69.69%), annuals (143 species or 15.99%) and shrubs (55 species or 6.15%) are predominant. The smallest part of the species refers to biennials (46 species or 5.14%), semishrubs (9 species or 1.01%) trees (8 species or 0.89%), and a small number of semi-shrubs (6 species or 0.67%), shrubs (2 species or 0.22%) and lianas (2 species or 0.22%).

As a result of the ecological analysis of the flora of Remizovka gorge, which is based on the classification of groups with respect to soil moisture, it was found that most of them are mezoxerophytes (423 species or 47.32%), xerophytes (194 species, 21.70% mesophytes (175 species, 19.57%), xeromesophytes (92 species or 10.29%). The smallest part of the flora of the region consists of gigromesophytes (7 species, 0.78%) and meso-hygrophytes (3 species, 0.34%).

Key words: Gorge Remizovka, ecological analysis, life forms, ecological groups.

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Іле Алатауының Ремизовка шатқалына экологиялық анализ

Бұл мақалада Іле Алатауының Ремизовка шатқалындағы экологиялық талдау кезінде алынған зерттеудің нәтижелері келтірілген. Флоралар экожүйені құрам бөліктерін анықтауға байланысты және ұзақ уақыт бойы өзгерістер индикаторы ретінде қызмет етеді және оның қазіргі жағдайы табиғи және антропогендік факторлардың әсерінен бұрын орын алған оқиғалардың нәтижесі болып табылады. Осыған байланысты кез келген аймақтың флорасын инвентаризациялау және талдау әрдайым маңызды. Біздің заманымыздың жаһандық проблемаларының бірі биологиялық әртүрлілікті сақтау және мәселелерді зерттеу болып табылады. Ремизовка шатқалы бұрын-соңды

аз зерттелген, сондықтан біздің жұмысымыздың мақсаты осы аймақтың флорасына экологиялық сараптау жүргізу болып табылады.

Далалық геоботаникалық зерттеу әдістері және жаңа әдіснамалар арқылы флора зерттелді. Тіршілік формасына байланысты Ремизовка өсімдіктер көпжылдық (623 түр немесе 69,69%), біржылдық (143 түр немесе 15,99%) және бұталар (55 түр немесе 6,15%) болып бөлінді. Ең аз саны екіжылдықтар (46 түр немесе 5,14%), бұталар (9 түрі немесе 1,01%) ағаштар (8 түрі немесе 0,89%) жартылайбұталар саны (6 түр немесе 0,67%), бұталар (2 түр немесе 0,22%) және лианалар (2 түр немесе 0,22%).

Нәтижесінде Ремизовка шатқалының флораларына экологиялық талдау арқылы топтардың классификациясы топырақ ылғалдылығына байланысты. Сондай-ақ, көпшілік бөлігін мезоксерофиттер (423 түр немесе 47,32%), ксерофиттер (21,70%-ын 194 түр), мезофиттер (175 түрі, 19,57%), ксеромезофиттер (92 түрі немесе 10,29%) құрайды. Флораның ең аз бөлігі гигромезофиттер (7 нысаны, 0,78%) және мезогигрофиттер (3 түрі, 0,34%) құрайды.

Түйін сөздер: Ремизовка шатқалы, экологиялық анализ, тіршілік формасы, экологиялық топтар.

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Экологический анализ ущелья Ремизовки Заилийского Алатау

В данной статье представлены результаты исследования, полученные в ходе проведения экологического анализа ущелья Ремизовки Заилийского Алатау. В связи с тем, что флора является определяющей составной частью экосистем и подвергается изменениям с течением времени, она служит показателем происходящих изменений, а её современное состояние является результатом явлений, происходивших ранее под влиянием природных и антропогенных факторов. В связи с этим инвентаризация и анализ флоры любого региона были, есть и будут всегда актуальными. Одной из глобальных задач современности является изучение проблем и сохранение биологического разнообразия. Ущелье Ремизовка является ранее малоизученным, поэтому целью нашей работы было провести экологический анализ флоры данного региона.

Флора изучалась с использованием традиционных методов полевых геоботанических исследований.

Распределение видов растений Ремизовки по жизненным формам показало, что преобладающими являются многолетники (623 вида, или 69,69%), однолетники (143 вида, или 15,99%) и кустарники (55 видов, или 6,15%). Наименьшая часть видов относится к двулетникам (46 видов, или 5,14%), полукустарникам (9 видов, или 1,01%) деревьям (8 видов, или 0,89%), и, незначительное количество составляют полукустарнички (6 видов, или 0,67%), кустарнички (2 вида, или 0,22%) и лианы (2 вида, или 0,22%).

В результате экологического анализа флоры ущелья Ремизовки, в основу которого принята классификация групп по отношению к влажности почв, выявлено, что большую часть составляют мезоксерофиты (423 вида, или 47,32 %), ксерофиты (194 вида, что составляет 21,70 %), мезофиты (175 видов, 19,57 %), ксеромезофиты (92 вида, или 10,29 %). Меньшую часть флоры региона составляют гигромезофиты (7 видов, 0,78 %) и мезогигрофиты (3 вида, 0,34%).

Ключевые слова: Ущелье Ремизовка, экологический анализ, жизненные формы, экологические группы.

Introduction

Flora as a natural history formation, is a defining component of ecosystems, subject to changes over time. The refore, the flora of the research region serves as an indicator of the current changes, and its current state is the result of phenomena that occurred earlier under the influence of natural and anthropogenic factors. In this regard, the inventory

and analysis of the flora of any region were, are and will always be relevant. The problem of studying and preserving biological diversity is a global task of the present day.

One of the characteristic features of the current stage of development of society is the strengthening of anthropogenic impact on the environment. This process is accompanied by synergistic effects and leads to a deterioration in the quality of the natural

environment, which in the long term leads to a reduction in biodiversity (Lebedeva 2002: 432, Nesterova 2017: 289-296).

Kazakhstan, as a party to the Convention on the Conservation of Biological Diversity, has its obligations to conserve biological diversity. In accordance with the UN Convention on Biodiversity, the first stage for conservation is the inventory (Convention: 1992). Therefore, in modern conditions of the inventory of flora and natural plant resources, both at the regional and national levels, along with generalization and replenishment with new information on useful properties, is the foundation for the development of a scientifically grounded algorithm for the rational use of plant resources (Romanova 1993: 304).

The vegetative world of Kazakhstan, including the Remizovka gorge of the Trans-Ili Alatau, is characterized by a rich gene pool and unique reserves of useful plants, primarily wild-growing species with medicinal properties, a significant part of which is promising for research into the chemical composition and biologically active substances, which are science-intensive and competitive production, which enjoys an increasing demand in the world market (Grudzinskaya 2012: 139).

The Trans-Ili Alatau including the Remizovka gorge, is the central ridge of the mountain system of the Northern Tien Shan, and the flora of the Trans-Ili Alatau is one of the richest floras, reflecting with minor exceptions the flora of the entire Northern Tien Shan (Beketova 2017: 290-298, Kokoreva 1996: 38, Inelova 2017: 49).

A characteristic feature of the territory of the Remizovka gorge of the Trans-Ili Alatau is the saturation of the flora and the uniqueness of the structure of the vegetation cover. The structure of the cover is dominated by complexes of plant communities (Nesterova 2016: 50-53, Ogar. 2016: 36-42). The composition of plant communities and their distribution in space are determined by habitat conditions. The main factors determining the distribution of vegetation in space are the conditions of moistening, salinity and mechanical composition of soils, and groundwater, as well as geomorphological conditions (Sadyrova 2017: 299-308).

A whole galaxy of scientists has for many years studied the flora and vegetation of the Northern Tien Shan, including the Trans-Ili Alatau.

Due to the fact that the Remizovka gorge is poorly understood and there is insufficient information about the region, research on the natural diversity and structure of communities at the ecological,

floristic, geobotanical and other levels is extremely important (Proskuryakov 2012: 228).

Materials and methods

A list of the field expedition research routes for studying the flora of the gorge Remizovka for 2017-2018 is developed.

The material of the studies was the herbarium material of the Department of Biodiversity and Bioresources of the Kazakh National University named after al-Farabi, as well as own collections of species composition, conducted during the period of 2017-2018.

The classical methods of floristic, geobotanical research are used. The main method of investigation was route-reconnaissance.

Several expeditions were carried out in the gorge of Remizovka, Trans-Ili Alatau (Figure 1), including spring, summer and autumn periods. As a result, more than 500 herbarium sheets of higher vascular plants were collected. The processing, identification and comparison of plants were carried out using a morphological-geographical method.

When determining herbarium specimens, the floras of the USSR, Flora of Kazakhstan, the Determinant of Plants of Central Asia, Illustrated Plant Determiner of Kazakhstan, as well as work and the determination of families and genera were used as sources for sources with the help of the Flora of Kazakhstan M. C. Baitenova (Goloskokov 1969: 289-231, Baitenov 2001: 245-251).

The location of species and supratemporal categories in the abstract of the flora and the floral spectrum are made according to the system of A.L. Takhtadzhyan (Takhtadzhyan 1987: 439). The spelling of Latin names, the nomenclatural changes in taxa were reconciled in accordance with S.K. Cherepanov (Cherepanov 1981: 509).

Results and discussion

Based on the literary data «Flora of Kazakhstan», «Illustrated determinant of plants of Kazakhstan» and own research in the flora of the Remizovka gorge, 894 species belonging to 380 genera from 81 families were identified. Analysis of the largest families of the Remizovka gorge flora allowed the identification of 10 largest families in the largest number of species (Asteraceae, Poaceae, Fabaceae, Rocaseae, Ranunculaceae, Lamiaceae, Caryophyllaceae, Brassicaceae, Apiaceae, Scrophulariaceae). (Barkley 2000: 253-258, Bruce 2005: 15-29, Hudaberdi 2000: 52-61). The listed

10 families include 586 species or 65.55% of the total species composition of the flora of the studied region. The largest genera are Astragalus (18

species or 2.01%), Artemisia (18 species or 2.01%), Erigeron (15 species or 1.68%), Potentilla (11 species or 1.23%).

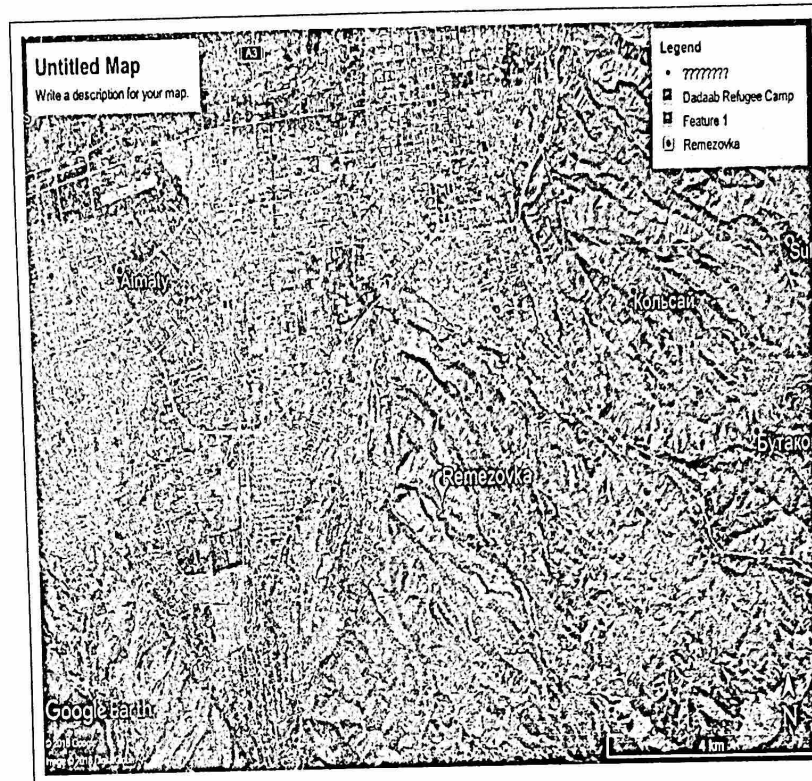


Figure 1 – Map of the Remizovka Gorge

Plants grow and develop under the influence of a complex complex of simultaneously acting on them factors that cause adaptive reactions. The struggle for moisture was the main stimulus for the evolution of the plant world, as evidenced by the history of the formation of modern floras of various regions of the globe (since the Cretaceous period) (Goryshen 2005: 686). So, in relation to water, the

following ecological groups stand out: hydrophytes, hygrophytes, mesophytes, xerophytes (Lotova 2007: 295-306).

Since the flora of the research area is constantly changing and depends on the water regime, 6 groups were identified in the study area: mesohydrophytes, hygromesophytes, mesophytes, mesoxerophytes, xeromesophytes and xerophytes (Table 1).

Table 1 – Distribution of the flora species of the Remizovka gorge in confinement to habitat types

Ecological type	Type of site of growth	Number of species	% of the total number of species
Mesoxerophytes	With periodic inadequate moistening	423	47,32
Xerophytes	With strong moisture shortcoming	194	21,70
Mesohydrophytes	With sufficient moisture	175	19,57
Xeromesophytes	With periodic aridity	92	10,29
Hygromesophytes	Periodically over much waterlogging	7	0,78

As a result of the ecological analysis of the Remizovka gorge flora, which is based on the classification of groups with respect to soil moisture, it was found that most of them are mezoxerophytes (423 species or 47.32%). These plants are adapted to conditions somewhat less than the average for moisture reserves in the soil, intermediate between xeromesophytes and xerophytes (Serebryakov 1962a: 377, Archibold 1995: 510). Mesoxerophytes are characteristic of sandy and clayey mountainous areas, as well as tugai. This is *Ceratocephala testiculata* (Crantz) Bess. *Papaver pavoninum* Schrenk and others.

The second place is occupied by xerophytes (194 species, 21.70%), plant species adapted to live in conditions with periodically insufficient moisture or with a permanent lack of moisture. They are adapted to life in conditions of low water supply (Serebryakov 1962a: 377). Xerophytes are plants of dry habitats capable of suffering a significant lack of moisture – soil and atmospheric drought. This group includes species of mountain territories, dry steppes. They have various adaptations to the conditions of lack of moisture: a strongly developed root system, a water-conducting system (ie, leaves have a dense vein arrangement), strongly reduced leaf blades, have thick cover tissues (thick-walled, multilayered epidermis with outgrowths and hairs that form thick «felt» pubescence) (Michael 2001: 156.). Xerophytes include *Ephedra equisetina* Bunge and others.

The third ecological type is mesophytes (175 species or 19.57%) – species adapted to life in conditions of medium water supply (average moisture of soils and air). Plants of this ecological group are characteristic for floodplains of rivers and tugai. These are species such as *Equisetum hyemale* L., *Clematis songarica* Bunge, *C. glauca* Willd., *Thalictrum alpinum* L., *Th. simplex* L. and others. The same group includes ephemerals and ephemeroids (Serebryakov 1978v: 431-461), which form the spring flora.

Fourth place is occupied by xeromesophytes. This is an intermediate ecological type between proper mesophytes and mezoxerophytes in the flora of the Trans-Ili Alatau. There are 92 species in the flora of the region, or 10.29%. These plants are adapted to conditions with moisture reserves in the soil slightly below average. Xeromesophytes, species with a periodically arid habitat – *Delphinium camptocarpum* Fich. et C.A.Mey., *Hypocoum parviflorum* Kar. et Kir., *H. trilobum* Trautv. and others.

The least part of the flora of the region is composed of gigromesophytes (7 species or 0.78%) and meso-

hygrophytes (3 species or 0.34%). Gigromesophytes, periodically over-powerful overmoistening species – *Potentilla supina* L., *Veronica anagallis – aquatica* L., *Cyperus glomeratus* L. and others.

Thus, the conducted ecological analysis of the flora of the region showed us all the diversity of ecological types. The dominance of mezoxerophytes, xerophytes and mesophytes indicates the inner-continental position of the Remizovka gorge.

As a result of the studies, the life forms of the Remizovka gorge flora were analyzed. Under the life form is meant the totality of adult individuals of this species under certain growing conditions, possessing a peculiar general appearance (habitus), including overground and underground organs (underground shoots and root system) (Vasiliev 1988: 447-450, Du Rietz 1931: 95). An analysis of the life forms of the Remizovka species is shown in Figure 2. Among the plants growing on this territory there are perennials, biennials, annuals, half-shrubs, shrubs, shrubs, shrubs, trees, and lianas. The distribution of the species of the Remizovka gorge in lifeforms has shown that perennials (623 species or 69.69%), annuals (143 species or 15.99%) and shrubs (55 species or 6.15%) are predominant. The smallest part of the species refers to biennials (46 species or 5.14%), semishrubs (9 species or 1.01%) trees (8 species or 0.89%), and a small number of semi-shrubs (6 species or 0.67 %), shrubs (2 species or 0.22%) and lianas (2 species or 0.22%).

The analysis of life forms according to I.G. Serebryakov (Serebryakov 1952b: 390), Serebryakov 1962a: 377) showed that the basis of the flora of the Remizovka gorge of the Trans-Ili Alatau is grassy polycarpica of 669 species, accounting for 74.83% of the total, monocarpic species represented by 143 species or 16%, shrubs are represented by 55 species or 6.15%, half-shrubs and semishrubs have 1.68% (15 species), the number of trees is 8 species, which is 0.89%, the smallest number of species is represented by saprophytic and parasitic grasses perennials and shrubs and, including 2 species or 0.22% (Table 2).

Thus, the analysis of the life forms of the Remizovka gorge flora showed the whole variety of life forms with a predominance of herbaceous polycarpics and monocarpic grasses.

However, many researchers believe that the system of distribution of species according to life forms according to I.G. Serebryakov does not cover the complete biological characteristics of the flora (Serebryakov 1978v: 431-461), and the system of «biological types» K. Raunkire is an indicator of the fitness of the species of a particular flora to

carry an unfavorable period, since it is based on the location of the kidneys of renewal with respect to the surface soil. In this regard, we resulted in

the distribution of species among the «biological types» of K. Raunkire for the flora of the region under study (Table 3).

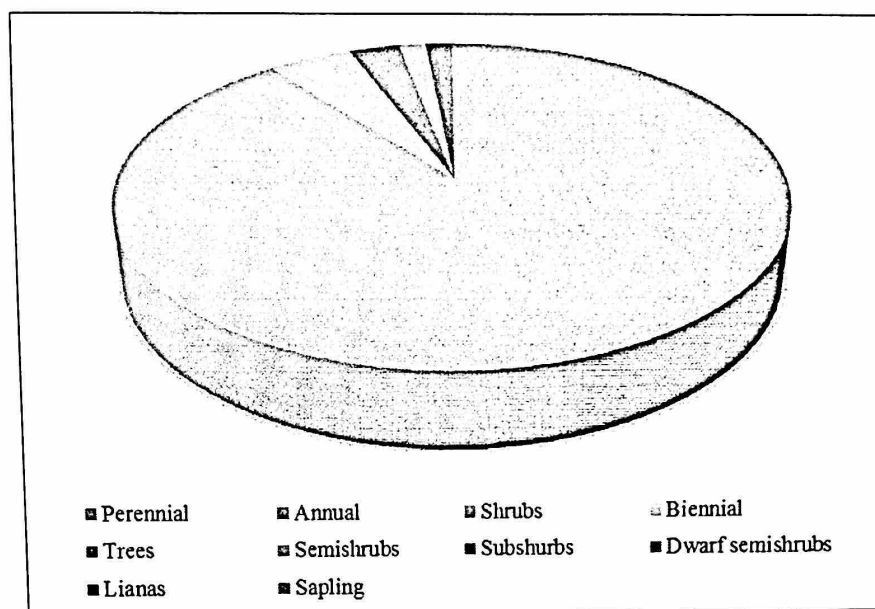


Figure 2 – Life forms of the Remizovka species

Table 2 – Distribution of species of the Remizovka flora according to I.G. Serebryakov

Life form	Number of species	% of the total number of species
I. Trees (tree)	8	0,89
II. shrubs	55	6,15
III. subshurb	2	0,22
IV. Semishrubs and dwarf semishrub	15	1,68
V. Grass polycarpics	669	74,83
VI. Saprophytic and parasitic herbaceous perennials	2	0,22
VII. Monocarpic grass	143	16
Total:	894	100

The distribution of the species of the Remizovka gorge in life forms, according to the classification of K. Raunkier (Raunkier 1934: 632), showed that the overwhelming majority are hemicryptophytes (570 species, which is 63.76% of the total), followed by terophytes (130 species or 14.54%), cryptophytes (112 species or 12.53%), phanerophytes (65 species or 7.27%), chamefits (17 or 1.90%).

Table 3 – Distribution of the flora species of the Remizovka gorge by the «biological types» of K. Raunkire

«Biological types» of Raunkire	Number of species	% of the total number of species
Phanerophytes	65	7,27
Chamefits	17	1,90
Hemicryptophytes	570	63,76
Cryptophytes	112	12,53
Terophytes	130	14,54
Total	894	100

Conclusion

On the basis of the conducted researches and the analysis of results of the received data the following conclusions are made:

Based on the analysis of the literature data, the research of the herbarium fund of the Institute of Botany and Phyto-Introduction of the Chinese Academy of Sciences and its own research into the collection and study of plants in the Remizovka gorge of the Trans-Ili Alatau, a preliminary annotated list of flora including 894 species belonging to 380 genera and 81 families.

6 ecological groups of plants are distinguished, among which the leading place is occupied by mezoxerophytes (423 species), which is typical for this territory. Nevertheless, a significant proportion of the opposite ecological groups – xerophytes and

mesophytes – testify to the inland position of the Remizovka gorge of the Trans-Ili Alatau.

Analysis of the life forms of the Remizovka gorge of the Trans-Ili Alatau showed the whole diversity of life forms with a predominance of herbaceous polycarpic and monocarpic grasses, which is a typical sign of the flora of a given territory. According to K. Raunkire's system, the overwhelming number of species belongs to groups of hemicryptophytes (570 species or 63.76%) and terophytes (130 species or 14.54%).

Due to the fact that the flora is a defining component of ecosystems and is subject to changes over time, it serves as an indicator of the changes that are occurring, and its current state is the result of phenomena that occurred earlier under the influence of natural and anthropogenic factors. Thus, it is necessary to develop monitoring and forecasting of the situation in order to improve it.

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