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Life forms of plants of natural and anthropogenic landscapes

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Abstract. The relevance of the study is conditioned by the solution of environmental issues to preserve the natural biological diversity of plant life forms in Central Asia and the Balkan Peninsula. The most important task of Uzbek botanists is to investigate all aspects of the structural and dynamic organisation of vegetation cover and changes in plant communities in areas affected by the intense impact of anthropogenic factors. In this regard, the purpose of this study is to conduct a comparative characterisation of plant life forms of natural and anthropogenic landscapes of Central Asia and the Balkan Peninsula. The leading approach to the examination of this problem is spatial-comparative, which allows comprehensively investigating the elements of the system of plant life forms of natural and anthropogenic landscapes. In addition, during the empirical study, the collected field material was analysed by generally

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accepted geobotanical and forestry methods, which consist in describing the topographic position of woody, semi-woody, polycarpic, and monocarpic terrestrial grasses, aquatic plants. The authors used both herbarium and live material from expedition surveys on the Biosphere Reserve and the protected area of the Uvac river gorge by Kazakh, Uzbek, Greek, and Turkish researchers. As a result, a comparative characteristic of the state of modern plant communities of Central Asia and the Balkan Peninsula by the nature and degree of anthropogenic impact was presented. The main life forms of plants of the regions under study were covered; the interrelation of environmental conditions with the process of flora formation was identified and substantiated. The materials of the study are of practical value for ecologists, landscape researchers, geographers, and biologists to use the findings in creating long-term plans for the development of natural landscapes for nature reserves, ecological centres, and nature protection zones. The developed method of comparative characteristics can be used to investigate natural and anthropogenic landscapes of other territories

Keywords: vegetation; transformation; species composition; ecological system; human factor; comparison

INTRODUCTION

With the development of civilisation, the special relationship between nature and society became the impetus for the emergence of landscape studies. As a scientific discipline, landscape science began its existence at the end of the 19th century in the process of complex research on agricultural lands. In the future, the development of landscape ideas in scientific natural science has been transformed and over the past 10 years, the object of research has been man-made landscapes created on a natural basis.

Uzbek researchers G. Abdiniyazova and O. Khozhimatov (Abdiniyazova & Khozhimatov, 2019) investigated anthropogenic landscapes as man-modified nature, which became the basis for the development of terrestrial civilisation. That is, in this case, while preserving its natural version in a slightly edited form, nature was of little interest to the researcher. Landscapes untouched by human activity and their preservation have been the subject of study by environmental organisations over the past few years.

D. Ishankulova *et al*. (2021) based on their studies, concluded that the modern landscape shell consists of natural and anthropogenic components. Natural landscapes, according to D. Ishankulova *et al*. (2021) are not affected by human economic activity. Anthropogenic landscapes – are subject to human exploitation to the extent which allowed them to be restored even after the cessation of economic activity. This happens because, by being included in the natural environment, human makes changes not only in the biota but also in the geological, geomorphological, and hydro-climatic components.

As stated by E. Bryanskaya and D. Sandanov (2021), each specific plant species adapts to the ecological conditions in which it grows. Therefore, the typical life form inherent in a plant in most of its range can be transformed. E. Bryanskaya and D. Sandanov (2021) noted that these changes do not occur in one season. Changing plant life form is a long evolutionary process of the natural adaptability of plants to external factors. This process manifests itself in appearance, that is, the vegetation of alpine meadows near the glacier will differ from the life form of vegetation of Alpine meadows near rock scree.

N. Kulha *et al*. (2020) investigated the types and spatial scales of forest structure changes in different landscapes. Findings of their study support the idea that the structure of boreal old-growth forests changes at discernible spatial scales. Instead of being driven by gap dynamics, the old-growth forests in the studied regions are currently responding to large-scale drivers by an increase in canopy cover.

V. Cheremushkina *et al*. (2020) proved in their study that the diversity of the aerial parts of the axes reflects the adaptation of plants to specific ecological conditions, while maintaining a genetically fixed, general development programme. Their results expand the understanding of the main areas in the evolution of morphs, which has practically not been studied in plants of the Central Asian flora. Using an architectural approach to describing plants, the authors showed that various ecotopic and ecological-coenotic conditions do not affect the nature of the development of life forms of related taxa.

M. Rufino *et al*. (2023) drew attention to such a phenomenon as the seed dispersal syndrome. In the study, the authors evaluate the influence of environmental factors on floristic composition, seed dispersal syndrome and potential for wild fauna refuge. The study emphasises the importance of creating and protecting private conservation areas, such as the RPPN Fazenda Macedônia and corridors among all forest private areas belonging to the CENIBRA company in that landscape.

J. Plue *et al*. (2022) suggested that species may benefit from green infrastructure, i.e., the network of natural and anthropogenic habitat remnants in human-dominated landscapes, if it helps isolated populations in remaining habitat patches to be functionally connected. Inferred functional connectivity explained genetic variation better than structural connectivity, yielding positive effects on genetic variation. The authors' study proposes that green infrastructure can promote functional connectivity, providing that a plant species can survive outside of core habitat patches. As this often excludes habitat specialist species, conservation practice and policy should primarily focus on ancient, managed semi-natural grasslands.

According to F. Liccari *et al.* (2022), fragmentation and isolation of plant species can be reversed by restoring landscape connectivity through effective Ecological Network planning. Interestingly, the study aims at parsing the interacting effect of landscape structure, surrounding habitats and nodes, and structural connectivity on EN plant diversity at two specific scales of investigation i.e., the habitat and the node scale. In general, landscape composition of semi-natural land cover (i.e., hedgerows, watercourses) showed a positive effect on species diversity as opposed to that of the configuration of anthropogenic elements on both scales.

The purpose of the study is to determine the adaptive capabilities of some plant species in complicated climatic conditions developed during evolution by comparing and analysing their development in different ecosystems. The geomorphological zones investigated during the study contain various plant communities that differ in appearance and species composition.

MATERIALS AND METHODS

The method of source analysis was used in the research process to investigate the geographical, biological, landscape, historical, philosophical literature on the chosen topic. With the help of the generalisation method, the authors recorded common features and properties of research by Uzbek, Kazakh, Chinese, American, British, and other researchers. According to the method of analogies, comparative characteristics of plant life forms of natural and anthropogenic landscapes of Central Asia and the Balkan Peninsula were conducted. Having modelled the classification of the main plant life forms of the territories under study, it was possible to identify similarities and differences in indicators of floral richness. The classification of plant life forms of the investigated regions was depicted using the graphical representation of the results method, and Latin and English taxon species were presented according to the summary of plants of the biosphere reserve and the protected area of the Uvac river using method of mathematical statistics.

Among the diagnostic methods, observation, analysis of herbarium materials, and the results of field photography were applied. The samples of areas with natural and anthropogenic landscapes were conducted. For this purpose, the semi-desert and mountainous zones of Central Asia, and the plains and mountainous territories of the Balkan Peninsula were considered. Classification of plant life forms was conducted according to the following forms: woody plants, shrubs, lianas, grasses, succulents. For classification, a description of the topographic position of communities, soil characteristics, and a description of the stand, undergrowth, and grass tier were used. The study of the structural features of the species was conducted both at the live material and at the National Herbarium of Uzbekistan Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan, and at the Herbarium of History Museum of Bosnia and Herzegovina in Sarajevo. The experimental base of the study was the National University of Uzbekistan named after Mirzo Ulugbek.

In the course of the empirical research, the results of long-term studies of structural and dynamic organisations of plant communities formed in territories with a scarce natural irrigation system, and normative and methodological documentation of the physical and geographical conditions of the biosphere reserve and the protected area of the Uvac river gorge were investigated (Ovchinnikova *et al.*, 2020). The biological and biomorphological diversity of plants of the two territories and the degree of resistance of natural landscapes to anthropogenic factors were empirically analysed. Plant life forms were investigated according to the following criteria: appearance of the plant (height, width of foliage), level of lignification of the stem, survival rate of ground shoots, root system. Each of these morphological features was rated 1 point, which was converted into percentages in further processing. One life form can consist of a variety of species and genera. Therewith, one species can form several life forms. In accordance with the above criteria, the plants were determined based on the Centre for Advanced Technologies under the Ministry of Innovative Development of the Republic of Uzbekistan.

RESULTS

Plant life forms are closely related to the rhythm of the development of the ecological situation in the region. The desert and steppe natural zones of Central Asia account for 20 to 25 thousand plant species. Located between China in the northwest and Turkey in the east; Kazakhstan in the north, and the Arabian Peninsula in the south – Central Asia is rich in bluegrass, cabbage, legumes, saxifrage, stonecrop, borage, and lily families in the steppe zone. Mountain vegetation is represented by pine, deciduous-pine forests in combination with herbaceous and shrubby vegetation (Halilaj *et al.*, 2021).

The vegetation of the Balkan Peninsula is represented by a large number of endemic plant species. The coastal zone is mountainous, represented by Mediterranean-type vegetation, and has several levels. The lowest storey – pine and oak forests, shrubs, the middle storey – deciduous forests, deciduous shrubs. The upper border of the mountains at an altitude of 180-2,300 metres – beech, fir, pine. In the central and northeastern parts of the peninsula, the plants are mainly represented by steppe vegetation and agricultural products: wheat, corn, tobacco, grapes (Noroozi *et al.*, 2019).

As a classification of plant life forms, the authors of the study identified the following groups: woody, semi-woody, and herbaceous plants. A group of woody plants is characterised by a crown with branches, on which, as a rule, there is no tillering. Throughout life, aboveground shoots are perennial, the buds are located on all parts of the plant and easily tolerate the winter period.

Semi-woody plants have two parts: the lower perennial woody, aboveground – annuals with elongated shoots. The buds are located relatively low above the soil surface, so, during severe spring and summer frosts, their death is possible. In addition, the authors of the study attributed shrubs to this group: creeping shrubs and climbing shrubs. The bush zone can be both underground and surface. The creeping shrubs have the shape of a tree with perennial lignified shoots that creep along the ground. Due to the fact that the shoots of shrubs have an underground and surface location, the buds can also be located both underground and above it. Stimulation of bud growth occurs as a result of forcible suppression of the growth of the main trunk.

Herbaceous plants – depending on the time of germination of the seed to the adult plant, annual and perennial plants are distinguished. The life span of shoots of annual plants is less than a year, there are no wintering buds in the body. In perennial plants, all aboveground parts of shoots are annuals, and underground ones can last for several years, wintering buds are located on them.

In the course of an empirical study of the life forms of natural landscapes in Central Asia, the species diversity of plants is presented in Figure 1.

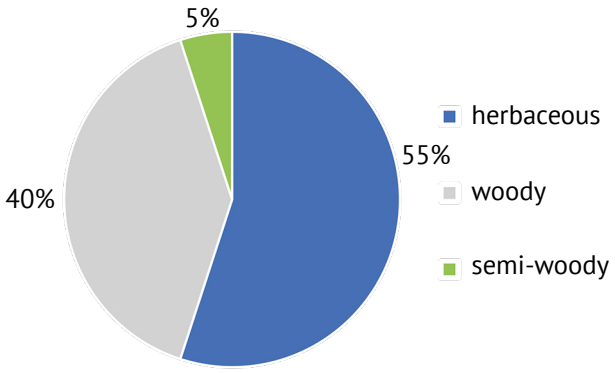

Figure 1. *Classification of plant life forms of natural landscapes of Central Asia*
Source: *compiled by the authors*

The analysis of life forms indicates that the phytocenosis of herbaceous flora is 15 plant species (55%), of which 14 species are short-lived: annuals – 10 species; and biennials – 4 species. The latter have a rod root system. The following representatives are most common: *Fallopia convolvulus (L.) A. L¨ove, Polygonum aviculare L., Berteroa incana (L.) DC., Capsella bursa-pastoris (L.) Medik., Chorispora tenella (Pall.) DC., Sisymbrium loeselii L., Thlaspi arvense L., Viola arvensis Murray, Solanum nigrum L., Carduus crispus L., Conyza canadensis (L.) Cronqist*. Woody plants include 11 species (40%): trees – 6 species, shrubs – 4 species, and semi-shrubs – 1 species. The smallest number of species is semi-woody plants (lianas, perennial herbaceous plants, succulents) – there is 1 species of these representatives (5%).

The life form affects not only the ability of the plant to tolerate unfavourable climate and weather conditions, it determines the place of the plant (its species coenopopulation) in the morphological and functional structure of the phytocenosis. Vegetation analysis of anthropogenic landscapes of Central Asia is presented in Figure 2.

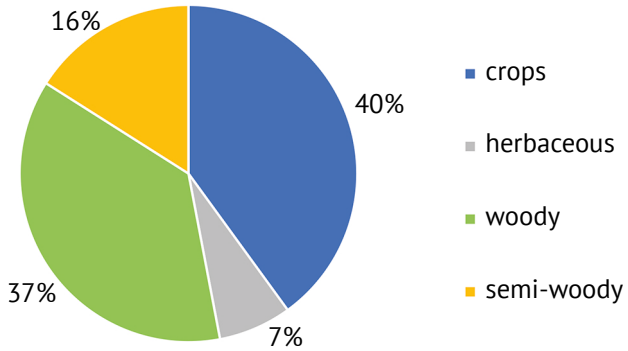

Figure 2. *Classification of plant life forms of anthropogenic landscapes of Central Asia*
Source: *compiled by the authors*

Crops of semi-desert and steppe regions are among the leaders of anthropogenically formed plant groups (40%) (*Acer negundo L., Elaeagnus angustifolia L., Haloxylon ammodendron (C.A.Mey.) Bunge ex Fenzl, Salsola richteri (Moq.) Karel ex Litv., Poa bulbosa L., Salsola gemmascens Pall., Kochia prostrata (L.) Schrad., Salsola Sogdiana Bunge, Kraschennikovia ewersmanniana (Stschegl. ex Lonsinsk.) Grub., Salsola dendroides Pall., Ephedra distachia L. Kraschennikovia ceratoides (L.) Gueldenst., Limonium otolepis (Schrenk) Kuntze, Capparis spinosa L., Glycyrrhiza glabra L., Nitraria sibirica Pall., Peganum harmala L., Heliotropium arguzioides Kar.et Kir., Licium ruthenicum Murr., Artemisia scoparia Waldst. & Kit. Salicornia europea L., Halostachys belangeriana (Moq.) Botsch.*). Herbaceous plants make up a much smaller volume, given the aridity of the earth, they die immediately after flowering even before the onset of summer (7%). Such plants are most vulnerable in the climatic conditions of the forest-steppe zone and mountainous terrain. Woody plants of forest species are preserved in the volume of 37% of the total flora of the anthropogenic landscape, and semi-woody plants make up 16% of its vegetation. Being at a slight distance from the soil surface, their buds are more vulnerable during spring-summer frosts, and the leaves are exposed to a dry period in July–August, so the plants are forced to retain moisture in the stem, while actively shedding foliage.

The classification of plant life forms of the natural landscapes of the Balkan Peninsula is presented in Figure 3.

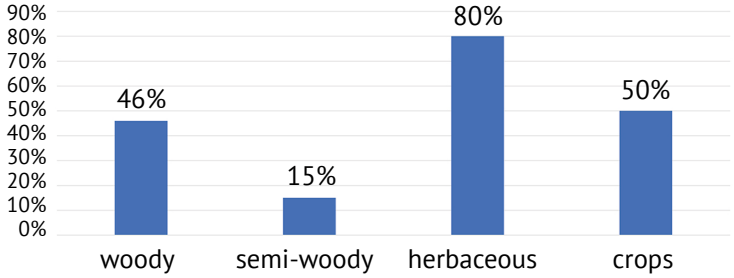

***Figure 3**. Analysis of plant life forms of natural landscapes of the Balkan Peninsula*
***Source:** compiled by the authors*

The mountainous terrain of the peninsula is least susceptible to human intervention. Woody plants are represented by various plants (12 species), which make up 46% of all vegetation on the peninsula. The following species are represented: *Ulmus pumila L., Armeniaca vulgaris Lam., Malus domestica Borkh., Prunus divaricata Ledeb., Robinia pseudoacacia L., Aesculus hippocastanum L., Grossularia uva-crispa (L.) Mill., Ribes aureum Pursh, Parthenocissus quinquefolia (L.) Planch., Symphoricarpos rivularis Suksd.* Semi-woody plants are scattered over the entire area of natural landscapes, and do not form a common canopy. Lianas and vines are located singly and in groups at the level of shrubs, make up 15% of the vegetation. The most common herbaceous plants (64 species, 80%) are herbaceous lianas, ferns, large grasses. Herbaceous plants are mostly perennials. The abundant grasses are explained by the inaccessibility of the Uvac river gorge due to the mountain ranges around and the moderate flow of the riverbed, which allows herbaceous plants to preserve foliage for a long time. Unlike the herbaceous vegetation of Central Asia, which has to shed leaves to conserve moisture. The main representatives are *Allium pervestitum, Rumia crithmifolia, Centaurea taliewii, Dianthus lanceolatus, Astragalus henningii, Astragalus pallescens, Bellevalia lipskyi, Salvia scabiosifolia, Agropyron cimmericum, Agropyron dasyanthum, Elytrigia stipifolia, Crataegus taurica.*

The anthropogenic landscapes of the Balkan Peninsula are represented by plains and lowlands in the northeastern part of the peninsula. It is these territories that are most susceptible to human intervention. The analysis of plant life forms in this region is presented in Figure 4.

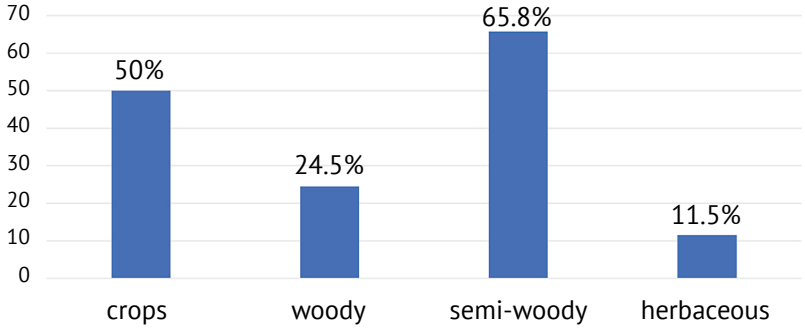

***Figure 4**. Analysis of plant life forms of natural landscapes of the Balkan Peninsula*
***Source:** compiled by the authors*

Woody plants (89 species) – 24.5% (*Pinaceae, Cupressaceae, Taxaceae, Ephedraceae, Robinia pseudoacacia L., Amorpha fruticosa L., Ailanthus altissima (Mill.) Swingle, Machonia aquifolium (Pursh) Nutt., Koelreuteria paniculata Laxm.*). Semi-woody plants: 237 shrubs species (65.8%), 35 semi-shrubs species (9.7%). Herbaceous plants: 42 evergreen species (11.5%), represented by such species as *Arenaria rhodopaea Delip., Astragalus alopecurus Pall., Astracantha aitosensis (Ivan.) Podl., Eranthis bulgaricus (Stef.) Stef., Gypsophila tekirae Stef., Tulipa splendens Delip., Viola parvula Tineo, Pinus brutia Ten., Quercus thracica Stef. et Nedjalkov, Spiraea salicifolia L., Ribes nigrum L., Potentilla fruticosa L., Salix rosmarinifolia L.* tree vines – 12 species (3.3%). A substantial part of the flora is developed by planting plant species in the lowlands and plains (50%). Main representatives: *Asteraceae, Poaceae, Fabaceae, Caryophyllaceae, Rosaceae, Brassicaceae, Scophulariaceae, Apiaceae, Lamiaceae, Liliaceae S. L., Ranunculaceae, Cyperaceae, Boraginaceae*.

After analysing the plant life forms of natural and anthropogenic landscapes of Central Asia and the Balkan Peninsula, the authors of the study conducted a comparative characterisation of the phytocenosis of the territories under study (Fig. 5).

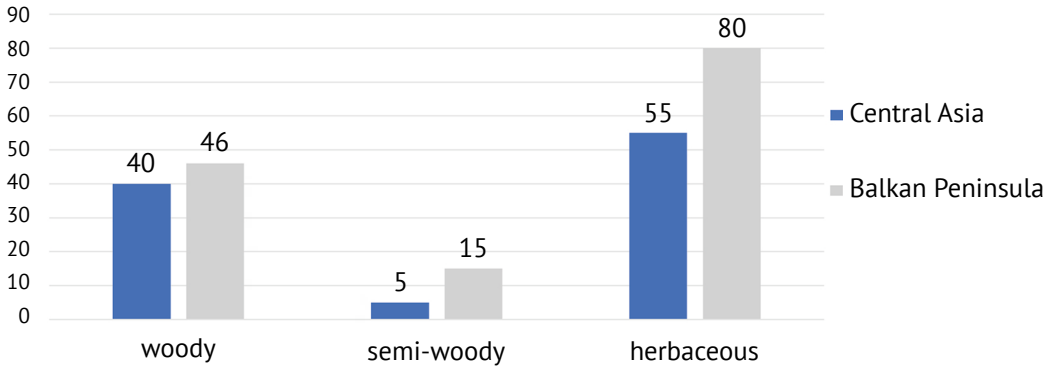

Figure 5. *Comparative characteristics of plant life forms of natural landscapes of Central Asia and the Balkan Peninsula*
Source: *compiled by the authors*

A comparative analysis of plant life forms by the number of species diversity has shown that the largest number of them is recorded on the Balkan Peninsula, especially woody and herbaceous plants. The results of the analysis of the similarity of plant life forms of anthropogenic landscapes of Central Asia and the Balkan Peninsula are presented in Figure 6.

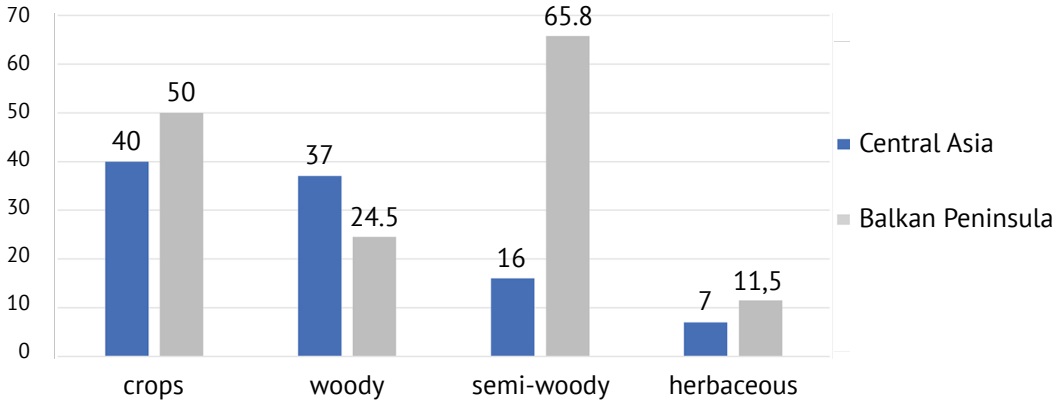

Figure 6. *Comparative characteristics of plant life forms of anthropogenic landscapes of Central Asia and the Balkan Peninsula*

Source: *compiled by the authors*

The number of plant life forms of the Balkan Peninsula prevails over the similar plant communities of Central Asia. However, the species diversity of woody plants is 10% greater in Central Asia. In both landscape zones, perennials predominate in terms of life expectancy, an increase in annual plants is observed from the middle mountain belt and is completely absent in the highlands. Seasonal development on the Balkan Peninsula is dominated by summer-green plants, which is generally understandable since the climate of the peninsula is heterogeneous and changes from west to east from the Mediterranean to the continental climate. For Central Asia, seasonal development is limited to tree stands, lianas, and succulents. Trees and shrubs predominate among the planting plants: olives and citrus fruits (Balkan Peninsula) and cotton (Uzbekistan).

The largest number of variants of plant life forms was observed in the middle band of the mountains in both territories under study. In Central Asia, the upper parts of the mountains are favourable for plants that retain moisture; the flora of the Balkan Islands is devoid of such a need, since the mountains are able to retain moisture coming from the seas.

The following biological properties play an extremely important role for plants: the ability to tolerate unfavourable climate and weather conditions (frosts, heat, drought), the ability to vegetative reproduction and growth, the duration of vegetation, the method of pollination, and the spread of diasporas. They give an idea of the degree of compliance of the species with the conditions of the place of growth and ultimately allow predicting the stability of its existence as part of the flora and vegetation of the investigated territory.

The climate of Central Asia is sharply continental, winters are cold and dry, and summers are very hot. The irrational use of water resources and poor management of industrial enterprises led to the fact that the regions located downstream of the main rivers of Central Asia are in a critical situation with the irrigation system, which can lead to a humanitarian catastrophe. Since plants are dominant in the production of medicinal, feed, and technical industries, the transition to the orderly use of water resources is a nationwide problem. The waters of the rivers used for the irrigation system of plant plantations in some cases do not reach them: they either evaporate or seep into the sands. In this regard, farmers have to reduce agricultural areas, as once fertile fields turn into a poisonous salty desert. The same thing happens with the vegetation of the southern part of the Balkan Peninsula, which is exposed to the salty breeze from the seas, and the mountainous terrain does not allow for sufficient irrigation. However, a large number of rivers on the territory of the Balkan Peninsula allows creating of irrigation systems, which ultimately leads to even greater human intervention in the natural environment. Thus, the natural resources of the regions under study directly depend on natural and ecological, and anthropogenic factors, therefore, the effectiveness of the use of plant resources directly depends on the careful attitude of mankind towards them.

DISCUSSION

Considering that all anthropogenic landscapes are created on a natural basis – in any anthropogenic landscape, even the most man-made, there is necessarily a natural component (subsystem) (Erdős *et al.*, 2019). They are referred to as natural-anthropogenic, such as fires, deforestation, and land ploughed for agricultural land transform ecotones of natural conditions into anthropogenic landscapes.

In Uzbekistan, landscape studies originated and developed mainly based on the investigation of anthropogenic, not natural landscapes. Currently, only those anthropogenic landscapes are recognised that optimally perform the specified socio-economic functions and are environmentally favourable for human life. Geoecological studies were indicative in this regard, which were aimed at identifying valuable resources, their practical use, and a measure of protection and reproduction (Eriksson, 2021). Water has become one such resource for Central Asia and the Balkan Peninsula. Canals to provide the inhabitants of the desert of Central Asia and the plains of the Balkan Peninsula from which irrigation of agricultural plantations directly takes place are being developed. However, due to the imperfection of the irrigation system (most of the canals are not isolated) about 40% of the water evaporates on the way to residential areas (Bengtsson *et al.*, 2019). The flora suffers from this and the vegetation strip may shift to zones with a more optimal temperature for some species. Thus, the deserts of Central Asia will take the place of meadow areas, and those, in turn, will move up to higher parts of the mountains, and forests may disappear completely. The same will happen with the plains and lowlands of the Balkan Peninsula.

Thus, N. Berisha and V. Bytyqi (2021) examined the transition zone between the plain and forest-steppe regions of the central and southern parts of the Balkan Peninsula, focusing on the current state of plant communities. Anthropogenic factors always enhance the differentiation of plant communities of contact environments. The interzonal ecotone diagnoses afforestation of steppe territories within the forest-steppe, and the forest's advance into the steppe zone. Due to the increase in average annual temperatures and the shift of the main part of precipitation to the last stages of vegetation, it is possible to slow down the degradation of forests within the boundaries of the forest-steppe with the activation of the processes of their slow recovery. The development of forest plant communities surrounded by steppe spaces in conditions of removal of anthropogenic influences is also likely. As a result, the process of changing the border of the forest-steppe in the latitudinal direction is possible, which is confirmed by the permanent state of the contact zone of the forest-steppe and the zonal steppe for a specific period of time in the south. As mentioned above, the optimal use of anthropogenic landscapes has a positive effect on the ecological situation in the region. Thus, W. Eide *et al.* (2020) observed a decrease in pasture loads in the area under study over the past ten years. As a result of the emergence of farmlands, steppe plant communities are gradually restored: their storeys are forming, and the projective coverage and species diversity in communities increase.

As noted in the study, some plant life forms have already adapted to survive without water, while in the dry period, semi-woody plants of anthropogenic landscapes of Central Asia are forced to shed foliage to retain moisture in the trunk.

L. Garibaldi *et al.* (2020) also highlight the relationship between water, temperature, and vegetation.

This triad is of great importance for life and economic activity. In regions with hot summers, plants and trees play an important role in cooling the air and providing shade. According to L. Garibaldi *et al*. (2020), the lack of sufficient water supply will lead to an increase in temperature and put pressure on the plants of natural and cultural landscapes. In this regard, the authors give the scientific and practical importance of a regular inventory of vegetation of natural and anthropogenic landscapes and compiling a list of the most adaptable species.

Thus, T. Campagnaro *et al*. (2019) identified economically valuable groups of plants as the object of the study. Having analysed the increase in the demand of the population for medicinal and other raw plants, T. Campagnaro *et al*. (2019) determined the species composition of medicinal plants in Central Asia and identified honey-bearing species. According to the study on the territory of Karakalpakstan, 40% of the wild flora consists of 444 species of medicinal plants, of which 95 species grow on the territory of the Southern Aralkum. In the near future, it is planned to increase such areas to 700,000 hectares. T. Campagnaro *et al*. (2019) drew conclusions that their introduction into production will contribute to meeting the needs of the population in medicinal and food products.

In the doctrine on natural landscapes, N. Kuzmanović *et al*. (2021) consider them as a natural, economic, and social complex. The researcher finds a genetic and functional relationship between climate, soils, vegetation, wildlife, on the one hand, and humans "in all manifestations of their life" – on the other: in their economic activities, methods of cultivation and ploughing of land. N. Kuzmanović *et al*. (2021) give a broad understanding of the landscape as a natural-historical, socio-ecological, and ethnocultural geosystem. The researcher considers the landscape an ethnic legacy of previous generations. With it, the material and spiritual wealth of the nation accumulated over centuries is transferred from epoch to epoch. Therefore, in the system of the most important national values, along with such concepts identifying each people as having a native language, history, culture, religion, the native land – the landscape created by the people is always one of the primaries.

The flora of any territory is a mobile, continuously developing natural system. The combination of species changes over time in its individual ecotopes, depending on the possibility of the existence of individual plant species and environmental factors affecting them in a given area. H. Halilaj *et al*. (2021) defined plant life forms as a floristic complex of species that geographically grow in a given area during evolution and dynamically develop under certain ecological and phytocenotic conditions. H. Halilaj *et al*. (2021) laid the socio-economic and socio-ecological principles of nature management as the basis for the classification of economically modified landscapes. Thus, the researchers determined the degree of anthropogenic transformation of natural landscapes according to the following criteria: the level of preservation or violation of the natural leaving areas; the ability of nature to regulate the deep human impacts (restoration); the functions performed by landscapes in the socio-economic field of human life. In this regard, H. Halilaj *et al*. (2021) classified natural landscapes as conditionally indigenous, not economically used; poorly exploited (successively restored); specially protected natural territories (nature reserves, national and natural parks).

V. Kalinkina *et al*. (2020) proved in their research that the distribution of species and the formation of a certain variant of life forms in them depend on environmental conditions, and on the adaptive potential of plants. V. Kalinkina *et al*. (2020) investigated phytocenosis in three trial areas of the forest area. An increase or decrease in humidity, a change in the degree of illumination and the density of the substrate on the first and third test areas led to a decrease in the total number of seed plant species. On each of the three test areas, rhizomatous species occupy a leading position, however, on the steep isolated slopes of the third test area, their number is noticeably smaller, but the share of involvement in coenosis is higher. Analysis of the shoot structure of herbaceous species showed that there is no consistent dependence of the type of shoot on the place of growth of the individual plant, in each sample area there are approximately equal proportions of all types of different types of shoots (elongated, rosette, and semi-rosette). Ferns are characteristic of undisturbed or slightly disturbed coniferous-deciduous forests, and their sufficient number indicates the stability and long-term development of the community. The presence of only one type of fern in the upper part of the slope indicates that, in general, the conditions here are not very favourable for forest plants in terms of soil moisture and light regime.

CONCLUSIONS

Comparative characteristics of plant life forms in natural and anthropogenic landscapes of Central Asia and the Balkan Peninsula were conducted based on important methodological principles: correct identification of species, determination of invasive plant groups in natural landscapes, and the level of environmental threat in anthropogenic landscapes. The study of the structural and dynamic organisation of plant communities formed on natural or anthropogenic landscapes fully characterises the phytocenosis of Central Asia and the Balkan Peninsula. In this regard, the authors of the study applied the following categories as a classification of plant life forms: woody plants, semi-woody plants (shrubs, lianas, succulents), herbaceous plants, and crops of anthropogenic landscapes.

As a result of the comparative analysis, it was identified that the plant life forms of the natural landscapes of the Balkan Peninsula predominate: woody plants by

6%, semi-woody plants by 10%, and herbaceous plants by 35%. Life forms of anthropogenic landscapes predominate by the criterion of semi-woody plants by 49.8%, herbaceous plants by 4.5%, and crops by 10%, but the species composition of woody plants prevails in Central Asia by 12.5%.

Notably, the flora of the Balkan Peninsula is much richer and more diverse throughout the territory. As already noted in this study, vegetation largely depends on the habitat, the climate in which it grows. The climate of the Balkan Peninsula changes from moderately continental in the north to subtropical-Mediterranean in the south and west, with a huge amount of precipitation and high altitude in the mountains. The climate of Central Asia is sharply continental with arid zones surrounded by mountain ranges that isolate the vegetation of the region from precipitation. Thus, the most destructive factor for the natural biota of Central Asia is drought, while isolation is for the natural landscapes of the Balkan Peninsula. The study of the protected area of the Uvac river led to the conclusion that the endangered plant species are the most vulnerable to alien biodiversity. The phytocenosis of anthropogenic landscapes of Central Asia and the Balkan Peninsula is under pressure from industrial enterprises.

Therefore, to record how the biodiversity of flora reacts to anthropogenic impacts, it is advisable to analyse data from long-term series of the number of plant communities living in territories affected by human activity as further studies.

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CONFLICT OF INTEREST

The authors report no conflict of interest.

REFERENCES

[1] Abdiniyazova, G., & Khozhimatov, O. (2019). The current state of medicinal plants of the South Aral Sea. In *International Conference of Young Scientists "Science and Innovations": A collection of scientific papers* (pp. 25-27). Tashkent: Center of Excellence, Ministry of Innovative Development of the Republic.

[2] Bengtsson, J., Bullock, J., Egoh, B., Everson, C., O'Connor, T., O'Farrell, P., Smith, H., & Lindborg, R. (2019). Grasslands – more important for ecosystem services than you might think. *Ecosphere*, 10(3), 25-28. doi: 10.1002/ecs2.2582.

[3] Berisha, N., & Bytyqi, V. (2021). The correlation between plant endemism and biogeographic factors – a case study from Leqinat Mt. Kosovo. *Flora Mediterranea*, 31, 59-70. doi: 10.7320/FlMedit31.059.

[4] Bryanskaya, E., & Sandanov, D. (2021). Preparation and analysis of data on the distribution of high-mountain endemic plants in North Asia. In *Diversity of Soils and Biota of North and Central Asia: Materials of IV All-Rus. Scientific conference with international Participation* (pp. 82-84) Ulan-Ude: Publishing House of BSC SB RAS.

[5] Campagnaro, T., Sitzia, T., Bridgewater, P., Evans, D., & Ellis, E.C. (2019). Half earth or whole earth: What can Natura 2000 teach us? *Bioscience*, 69, 117-124. doi: 10.1093/biosci/biy153.

[6] Cheremushkina, V., Astashenkov, A., & Saidov, D. (2020). Parallelism in the development of life forms of species of the genus Kudrjaschevia (Lamiaceae): Ontogeny, architectural analysis. *Central Siberian Botanical Garden*, 3(12), 322-333. doi: 10.1134/S1995425520030038.

[7] Eide, W., Ahrné, K., Bjelke, U., Nordström, S., Ottosson, E., Sandström, J., & Sundberg, S. (2020). *Status and trends of species and their habitats – red-listed species in Sweden*. Uppsala: SLU ArtDatabanken.

[8] Erdős, L., Krstonošić, D., Kiss, P., Bátori, Z., Tölgyesi, C., & Škvorc, Z. (2019). Plant composition and diversity at edges in a semi-natural forest-grassland mosaic. *Plant Ecology*, 220(15), 279-292. doi: 10.1007/s11258-019-00913-4.

[9] Eriksson, O. (2021). The importance of traditional agricultural landscapes for preventing species extinctions. *Biodiversity and Conservation*, 30(2), 1341-1357. doi: 10.1007/s10531-021-02145-3.

[10] Garibaldi, L., Oddi, F., Miguez, F., Bartomeus, I., Orr, M., Jobbágy, E., Kremen, C., Schulte, L., Hughes, A., Bagnato, C., Abramson, G., Bridgewater, P., Gomez, C., Díaz, S., Dicks, L., Ellis, E., Goldenberg, M., Huaylla, C., Kuperman, M., Locke, H., Mehrabi, Z., Santibañez, F., & Zhu, C. (2020). Working landscapes need at least 20% native habitat. *Conservation Letters*, 14(2), article number e12773. doi: 10.1111/conl.12773.

[11] Halilaj, H., Kupe, L., Bajrami, A., Icka, P., Mala, X., & Damo, R. (2021). Endemic plants in the flora of Shutman (Sharri Mountain), Kosovo – an analysis of phytogeographical elements and life forms. *Natura Croatica*, 30(1), 1-11. doi: 10.20302/NC.2021.30.1.

[12] Ishankulova, D., Khaydarov, H., & Ochilov, U. (2021). The study of resistant species of woody and shrubby plants under the influence of climate and anthropogenic impacts in the conditions of Uzbekistan. *Diversity of Soils and Biota of Northern and Central Asia*, 25(9), 192-195.

[13] Kalinkina, V., Zhabyko, E., & Khrapko, O. (2020). Life forms and ecological groups of plants in some types of forests on the territory of the Ussuri Nature Reserve. *Bulletin of the Botanical Garden-Institute of the Far Eastern Branch of the russian Academy of Sciences*, 23(2), 1-9.

[14] Kulha, N., Pasanen, L., Holmstrom, L., Grandpre, L., Gauthier, S., Kuuluvainen, T., & Aakala, T. (2020). The structure of boreal old-growth forests changes at multiple spatial scales over decades. *Landscape Ecology*, 35, 843-858. doi: 10.1007/s10980-020-00979-w.
[15] Kuzmanović, N., Lakušić, D., Frajman, B., Stevanoski, I., Conti, F., & Schönswetter, P. (2021). Long neglected diversity in the Accursed Mountains (Western Balkan Peninsula): Ranunculus bertisceus is a genetically and morphologically divergent new species. *Botanical Journal of the Linnean Society*, 18, 757-770. doi: 10.1093/botlinnean/boab001.
[16] Liccari, F., Boscutti, F., Bacaro, G., & Sigura, M. (2022). Connectivity, landscape structure, and plant diversity across agricultural landscapes: Novel insight into effective ecological network planning. *Journal of Environmental Management*, 317, article number 115358. doi: 10.1016/j.jenvman.2022.115358.
[17] Noroozi, J., Talebi, A., Doostmohammadi, M., Manafzadeh, S., Asgarpour, Z., & Schneeweiss, G.M. (2019). Endemic diversity and distribucion of the Iranian vascular flora across phytogeographical regions, biodiversity hotspots and areas of endemism. *Scientific Reports*, 12(9), 9-19. doi: 10.1038/s41598-019-49417-1.
[18] Ovchinnikova, S., Tajetdinova, D., Turdiboev, O., & Tojibaev, K. (2020). Type specimens of names of taxa of the families *Heliotropiaceae* and *Boraginaceae*, stored in the National Herbarium of Uzbekistan of the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan (TASH). *Turczaninowia*, 17(8), 124-135. doi: 10.14258/turczaninowia.23.3.5.
[19] Plue, J., Kimberley, A., Bullock, J.M., Cousins, S.A.O., & Honnay, O. (2022). Green infrastructure can promote plant functional connectivity in a grassland species around fragmented semi-natural grasslands in NW-Europe. *Ecography*, 2022(10), article number e06290. doi: 10.1111/ecog.06290.
[20] Rufino, M.P.M.X., Torres, C.M.M.E., de Melo, F.R., Verly, O.M., & da Silva Costa, W. (2023). Floristic composition and dispersal syndrome: How can environmental factors affect the Cracidae refuge in a secondary Atlantic Forest fragment? *Trees, Forests and People*, 11, article number 100374. doi: 10.1016/j.tfp.2023.100374.

Життєві форми рослин природних та антропогенних ландшафтів

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Анотація. Актуальність даного дослідження зумовлена вирішенням екологічних проблем збереження природного біологічного різноманіття життєвих форм рослин Центральної Азії та Балканського півострова. Найважливішим завданням узбецьких ботаніків є дослідження всіх аспектів структурно-динамічної організації рослинного покриву і змін рослинних угруповань на територіях, що зазнали інтенсивного впливу антропогенних факторів. У зв'язку з цим метою даного дослідження є проведення порівняльної характеристики життєвих форм рослин природних і антропогенних ландшафтів Середньої Азії та Балканського півострова. Провідним підходом до розгляду цієї проблеми є просторово-порівняльний, що дозволяє комплексно вивчити елементи системи життєвих форм рослин природних і антропогенних ландшафтів. Крім того, під час емпіричного дослідження зібраний польовий матеріал проаналізовано загальноприйнятими геоботанічними та лісівничими методами, які полягають в описі топографічного положення деревних, напівдеревних, полікарпічних та монокарпічних наземних трав, водних рослин. Автори використовували як гербарний, так і живий матеріал експедиційних обстежень біосферного заповідника та заповідної території ущелини річки Увац казахськими, узбецькими, грецькими та турецькими дослідниками. У результаті дано порівняльну характеристику стану сучасних рослинних угрупувань Центральної Азії та Балканського півострова за характером і ступенем антропогенного впливу. Висвітлено основні життєві форми рослин досліджуваних регіонів; виявлено та обґрунтовано взаємозв'язок умов середовища з процесом формування флори. Матеріали дослідження мають практичне значення для екологів, ландшафтознавців, географів, біологів і можуть бути використані при створенні перспективних планів розвитку природних ландшафтів заповідників, екологічних центрів, природоохоронних зон. Розроблений метод порівняльної характеристики може бути використаний для дослідження природних та антропогенних ландшафтів інших територій

Ключові слова: рослинність; перетворення; видовий склад; екологічна система; людський фактор; порівняння