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EXPERIENCE OF ECOLOGICAL-LANDSCAPE ORGANIZATION OF THE ALPINE-SUBALPINE HIGHLANDS OF CHERNOHORA IN THE BORDERS OF THE TRANSCARPATHIAN REGION (UKRAINE)

Abstract. The article briefly presents the experience of carrying out the research of the ecological and landscape organization of the territory of the alpine-subalpine highlands of Chornohora and application of the landscape approach in optimizing the pastoralism and tourism system. Considerable attention is paid to specifying the goals and objectives of conducting a similar ecological-landscape organization of highlands, peculiarities of theoretical and methodological landscape principles, and the step-by-step study of the high mountain natural territorial complexes.

The general features of the morphological structure of the key site «Sheshul-Petros» and its interrelation with the pastoralism and tourism are described. The main result of the research is the developed recommendations of optimization of land use system, which are developed on a landscape basis.

Keywords: alpine-subalpine highlands, natural territorial complexes, landscape structure, pastures, optimization, Chornohora.

Topicality of research. The ecological stability of the landscape depends directly on the amount of natural lands that are the bearers of stability and secondary functionality. The issue of ecologization of land exploitation is important in land management and an increasing factor in the development of projects for the organization of the territory of any intended purpose.

The valuable natural resource of the Transcarpathian region is the natural territorial complexes (NTC) of the alpine-subalpine highlands that are confined to the highest mountains of the Ukrainian Carpathians (in particular, Chornohora). From the point of view of genetic landscape science of the highlands of the Chornohora, there are three types of altitude terrains – denudational alpine and subalpine high-mountain, ancient-glacial-exarational subalpine high-mountain and nival-erosion subalpine high-mountain, which are composed of smaller morphological units – striyas, tracts, facies [11].

Over the past decade, the structure of agricultural land of the Rakhiv district has a tendency to reduce the number of lands of high-mountain pastures as a result of overgrown forest [11]. Therefore, it is expedient to establish the territory of the «very high» according to the genetic accessory. Therefore, it is advisable to distinguish the natural highlands by genetic origin and to conditionally distinguish them from artificially formed pastures of the mid-mountain tier. That is, the relevance of the research is due to the problem of preserving valuable NTC and the ecological stabilization of the pastoralism on the highlands of Chornohora, and the most optimal way to understand the functioning of the territory and ecologically safe operation is a comprehensive study on a landscape basis.

Characteristics of the Study Area. According to the physical-geographical zoning A. Melnyk, the Chornohora landscape is a part of the Svydovets-Chornohirskiy district of the Vysokogirno-Polonynskoyi region [11]. In the northwest of the Chorna Tisza river, Chornohora separates from the Svydovets landscape, while in the southeast of the Chornyi Cheremosh river it is the border with Skupivsky and Pniv landscapes. From the southwest to Chornohora is the Stogivsky landscape of the Stig-Playsky region, and in the north and north-east of Chornohora it borders the system of intermountain depressions represented by the Yasinyansky, Vorokhta-Il'tsevsky and Verkhovinsky landscapes [11].

Chornohora mountain range is the main system-forming element of the group of ancient glacial-high-mountain landscapes of the Ukrainian Carpathians [19]. It is characterized by maximum altitudes of 1900–2000 m a.s.l. Among the peaks that capture the ridge line of the main ridge of the massif, the absolute height of only six exceeds 2 000 m a.s.l. – Petros (2 020 m), Hoverla (2 061 m), Rebra (2 001 m), Gutyn-Tomnatic (2 016 m), Brebeneskul (2 037 m) and Pip-Ivan (2 022 m) (figure 1).

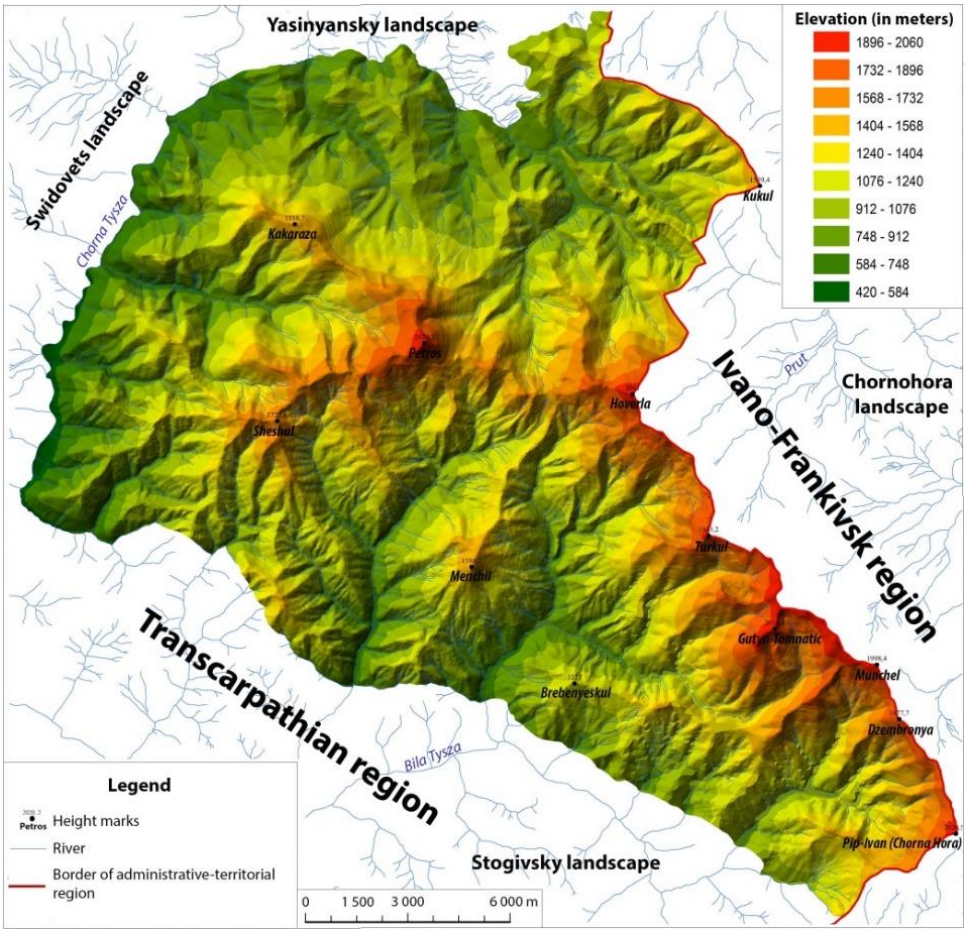

Figure 1 – Digital terrain model of the Chornohora landscape within Transcarpathian region

Chornohora is located in the eastern part of the Rakhiv administrative and territorial area within the Transcarpathian region and occupies 18,2 % (344,548 km^2) of its area. Its highest gypsum level is covered by the high-mountain landscape tier, the presence of which has influenced the development of the pastoralism in Chornohora and the Ukrainian Carpathians in general, and has long been a hallmark of the Hutsul region. Within the limits of Chornohora, the alpine-subalpine highlands are represented by two fragments that extend from the north-west to the southeast. The first fragment is located in the area of Petros and occupies an area of 14,9 km^2. In our study it was used as a model area, since most of it is part of the Carpathian Biosphere Reserve (CBR), but there is intensive management of the pastoralism and recreational activity. The second part of the high mountains of Chornohora is confined to the main ridge, which stretches 25–30 km in the south-easterly direction from Hoverla to the city of Pip-Ivan (Chorna Hora).

Setting objectives. The natural territorial complexes of the alpine-subalpine highlands of Chornohora are characterized by a variety and a peculiar combination, which is fixed by the landscape pattern. They are widely used in the pastoralism and recreation, which is often accompanied by the development of negative physical and geographical processes that aggravate the ecological stability of high-mountain geocomplexes: soil-vegetation cover degradation, shrub drying, erosion, dredging, etc. To optimize the farming complex and reduce the negative impact on highlands natural territorial complexes, we have

conducted a series of field and cameral (laboratory) research. The authors aim to convey some experience in conducting similar ecological and landscape projects for the optimization of the subalpine and alpine highlands of the Ukrainian Carpathian massifs on the example of Chornohora using a landscape approach.

Analysis of recent research and publications. Special surveys of ecological and landscape organization issues and the optimization of the land use system of the subalpine and alpine highlands of the Chornohora landscape with the use of the landscape approach weren`t carried out previously. However, E. Egan [1] and V. Klapchuk [7] studied the issues of owning a mountain farm in Chornohora, while K. Malinowski [9], M. Troll and I. Sitko [23, 26], I. Koynova and I. Rozhko [8] investigated the effects of its influence on the ecological status of geocomplexes and vegetation dynamics. The land structure of regional physical-geographical units and individual natural territorial complexes of the Ukrainian Carpathians, including the Chornohora landscape, was conducted by A. Melnyk [11]. Some authors of this article have also analyzed the current state of economic use, the problems of the use of high-mountainous natural territorial complexes, and the land structure of the highlands of the Chornohora landscape [22].

Materials and Methods. Significant use of tracts of highlands as natural pasture lands requires monitoring of their ecological status, degree of modification and opportunities for further use. Therefore, the main task of conducting the ecological and landscape organization of the alpine-subalpine highlands of Chornohora was to establish the basic principles of optimization of the land use system of highlands as a management of the pastoralism based on the laws of the landscape organization of the territory. During the elaboration of the project of the ecological and landscape organization of the alpine-subalpine highlands of Chornohora was preceded by a series of intermediate tasks:

the concept of «highlands» from a landscape point of view and principles of its selection are substantiated [12];

the factors of formation of the landscape structure of the Chornohora highlands using GIS-technologies were analyzed, the digital terrain model (DTM) was developed and the corresponding sectoral maps were drawn up [4, 5];

a field landscape survey of the study area was conducted, in the process of which the peculiarities of the operation of geocomplexes and its consequences were determined, the peculiarities of the location and functioning of the objects of the pastoralism were analyzed, etc. [22];

landscapes were mapped to key areas with corresponding legends to them, established patterns of morphological structure and its relation to the system of economic use [13, 14];

the problems and prospects of the use of high altitude NTC were explored, as well as the ways of optimization of the system pastoralism and recreation within the highlands of Chornohora as recommendations [6, 22].

By purpose, the lands of Ukraine are divided into nine categories. In accordance with the scientific developments of the Institute of Land Management of the Ukrainian Academy of Agrarian Sciences of Agrarian Sciences (UAAS), they can be grouped into three groups of lands for the impact on the environment [21]:

agrolandscapes (agricultural lands);

the environment stabilizing (lands of the forest and water fund, nature conservation and other nature conservation purposes, recreational purposes, land of health-improving purposes, land of historical and cultural purpose);

residential (lands of residential and public buildings, industrial land, transport, communication, energy, defense and other purposes).

In the 80's of the 20th century the Institute of Land Management of the Ukrainian Academy of Agrarian Sciences of Ukraine (UAAS) has justified the optimal relationship between the above mentioned land groups. For the lowland part of Ukraine, the following ratio is considered optimal: agrolandscapes land – 45–50 %, environment stabilizing – 30–35 %, residential – 15–20 %. Instead, for mountain areas these figures are 20–35 %, 50–60% and 15–20 % respectively [21].

Based on the developments of the Institute of Land Management of the Ukrainian Academy of Agricultural Sciences, V. Peresolyak, V. Savchak and R. Peresolyak [20, 21] concluded a methodology for ecological and landscape organization of the territory on landscape bases, the essence of which is to scientifically substantiate and solve the general problem of ecologization of land use by optimizing the

ratio and mutual territorial placement of agricultural and natural lands. Were developed methodical recommendations which have a number of features:

the ecologically necessary ratio of lands of the agrolandscape, environment, stabilizing and residential group, which is based on the methodology, is calculated on the administrative-territorial entities;

it is developed mainly for ecological optimization of agricultural lands;

selection criteria and the main proposed parameters of the outline of the elemental landscape-ecological territorial units (ELETU), as the main structural unit, are calculated more to the level (plain) territories that are likely to be widely used as agricultural land and can`t capture a very complicated landscape structure of highlands territories, etc.

Taking into account the above, and paying attention to the fact that more than 70 % of the territory of the alpine-subalpine highlands of Chornohora within the Transcarpathian region belongs to the nature reserve fund of the Ukraine with the highest heritage (the Carpathian Biosphere Reserve), which, according to the development of the Institute of Land Management UAAS, automatically relate to the environment stabilizing group, we believe that the use of this technique isn`t feasible. Therefore, in our opinion, the development of the project of the ecological-landscape organization of the alpine-subalpine highlands of Chornohora, as well as the highlands of any massif in the Ukrainian Carpathians, should be based on a detailed study of the morphological structure and properties of each type of geocomplex, an analysis of the current state and capabilities of their use, degree of anthropogenic modification and further development of recommendations for rational use on a landscape basis.

When studying the ecological-landscape organization of highlands an important step is to establish the features of the landscape structure and landscape diversity, which in the future should be taken into account in the development of functional zoning, as existing (the Carpathian Biosphere Reserve), and when creating new objects of the nature reserve fund. Projects of the ecological and landscape organization of highlands should decide the direction of development of recreational and tourist activities, establish the expediency in exploiting tourist routes, its ecological status, etc. Identification and metrization of unique NTC and valuable natural objects is the guarantor of the development of nature conservation and recreation in general.

An algorithm for studying the landscape structure. Emphasizing the peculiarity and complexity of the morphological structure of the highlands of Chornohora, as the object of our study, as well as the complex of applied aspects, the theoretical and methodological basis of the research served the position and methods of field landscape mapping of mountain landscape studies developed by G. Miller [16, 17].

Studying of the landscape structure of the subalpine and alpine highlands of Chornohora within the Transcarpathian region, conducted at the key site of «Sheshul-Petros», took place in three stages: preparatory (pre-field), field and cameral (laboratory). At the preparatory stage, a map-hypothesis was created on the key plot, the initial data for the conclusion of which the existing landscape maps and schemes [11, 15, 16, 18], branch maps (geological, geomorphological, maps of the Quaternary deposits) were used [10, 27, 28], materials of soil survey [25], high-precision aerial photographs [24], etc. For a complete analysis of the key area relief, a topographic scale of 1 : 25 000 was vectored and a digital model of relief (DMR) was created, which formed the basis for constructing thematic maps: steepness and slope exposures. When developing the map of the crookedness of the earth's surface, the gradation of G. Miller [16, 17] was used, namely: less than 3° – very flat; 3-6° – flat; 6–9° – slightly sloping; 9–12° – sloping, 12–15° – very sloping; 15–30° – steep; 30–45° – very steep; more than 45° – cliff.

During the field stage, we conducted field mapping of the NTC in the key section «Sheshul-Petros» according to G. Miller's method [16, 17], objects of which were geocomplexes of all levels of the morphological structure: strias, altitude terrains, sectors, and especially – tracts. Several reconnaissance routes were carried out to fully study the landscape structure of the study area and field complex investigations of facies in blank forms at the most representative facies points were performed (figure 2).

During the cameral (laboratory) phase of the study of the landscape structure of the alpine-subalpine highlands of Chornohora, on the example of the key site «Sheshul-Petros», the results of their own field mapping were worked out and the materials obtained during the conduct of complex landscaping studies of facies, the laying of a landscape map on a key plot at a scale of 1 : 25 000 and legends to her. In order to systematize the legend, the landscape maps of G. Miller [15, 16], A. Melnyk [11] and others were used.

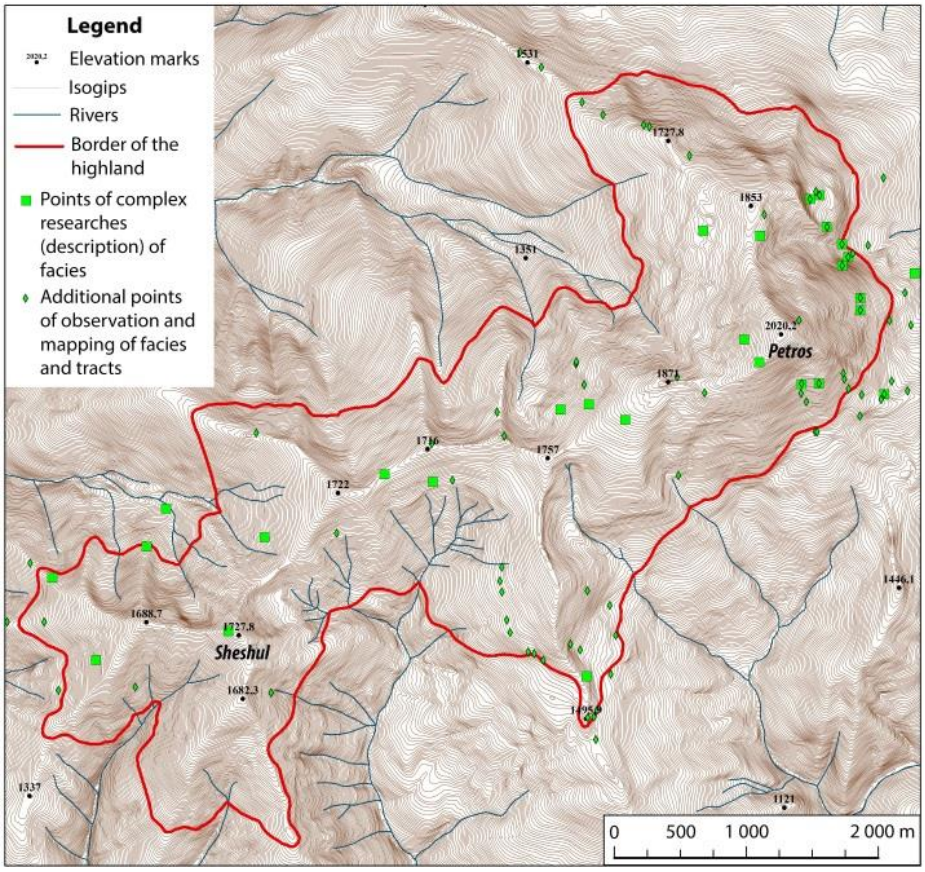

Figure 2 – Points of complex study of tracts and facies at key site «Sheshul-Petros»

Outcomes and discussions. In the morphological structure of the NTC key section «Sheshul-Petros», the alpine-subalpine highlands of the Chornohora are confined to two landscape sectors: the southwest windward, strongly moistened, parallel-drained macro-slope and northeastern, leewardly strongly moistened macro-slope [17]. In the landscape, the highlands within the sector of the southwestern macro-slope are represented by two altitude terrains: slightly convex denudated surfaces of very cold and wet alpine-subalpine high-mountain and concave old-glacial surfaces of very cold and wet subalpine high-mountain. They are expressed by three landscape strias and are consistent with the direction of fall of the geological stratum of the bedrock. The morphological structure of the highlands within the northeastern sector is also represented by two altitude terrains: slightly convex denudated surfaces of very cold and wet alpine-subalpine high-mountain and concave old-glacial surfaces of very cold and wet subalpine high-mountain. But theirs morphological structure is expressed by three strias, which are located mainly on the roof of monoclinic of geological strata. This caused a significant slope of the tract, the development of rockfalls, screes and others negative physical-geographical processes. Fifty seven types of tracts have been identified within the entire study area [13].

More gentle slopes of the southwestern sector, which receive more solar heat and precipitation for growing vegetation, which also contributes to the regeneration of dominant meadow vegetation, as the main forage base of the high-mountain plains, are widely used as pasture land in the pastoralism. This contributed to a significant degradation of the vegetation and significant destruction of the subalpine shrubs.

The territory of the alpine-subalpine highlands of the Chornohora within the limits of the Transcarpathian region is used in the pastoralism, recreational and nature conservation activities. As the pastoralism and unregulated recreation have the greatest negative impact on the high-mountain geocomplexes, we have analyzed in detail the state and peculiarities of their functioning. The model site was selected by the north-western part of the highlands of Chornohora, which has been undergoing considerable anthropogenic pressure since ancient times.

It was established that pastoralism uses high-mountain geocomplexes mainly as pasture lands. Analysis of the morphological structure of highlands made it possible to establish the patterns of organization of natural complexes that express the properties and ecological state of pastures. It is revealed that the largest high-mountain plains in the outskirts of the key area of «Sheshul-Petros», which use the curried type of cattle grazing, are: Menchul, Konets, Sheshul, Garmaneska, Golovcheska, Stupy and Shumneska.

Also, we analyzed the recreational and tourist routes within the key site, which belong to two types: the first one is ground roads, the second one is the tourist trails, which are mainly used in hiking tourism. Their length and nature of the stretch, as well as confinement to the natural complexes are determined. The dependence of the development of degression on tourist routes on the features of geocomplexes is determined, which expresses its resistance to loads [2]. Particular attention was paid to the development of modern negative processes associated with them [3]. It was revealed that the ground roads are characterized by relative stability, which is more connected with the features of the geological structure, while the development of trail paths on the tourist routes to Petros, which pass through different combinations of tracts, depends on the features of geocomplexes, their steepness and vegetation cover and so on.

Recommendations. On the basis of the conducted research in order to optimize the management of the mountainous economy and the development of recreational activities within the alpine-subalpine highlands of Chornohora, we make the following suggestions:

the cessation of the destruction of the structure of alpine-subalpine phytocoenosis of high mountain geocomplexes in Chornohora can be achieved thanks to the strict delimitation of forests from pastures and the observance of special rules of management in them;

now it is expedient to divert the load of the pastoralism to geocomplexes. This can be achieved by dividing the capacity of individual high-mountain plains to attract infrastructure (sheds, residential buildings) of non-functional plains, thus achieving the optimal number of livestock population;

when the forest cover is restored, the tracts of the mid-mountains in the vicinity of abandoned plains it is necessary to by clear meadows away from single young trees, because from an economic point of view, these pastures are the main basis for the development of the economy in the region. Otherwise, after the restoration of the forest cover due to its isolation, it will be economically unprofitable to transport the wood in the future;

for the maximum effect of dispersion of pastoralism it is expedient to conduct a study of the present state and anthropogenic modification of natural complexes of highlands. After all, in view of the nature-conservation purpose of most of the highlands, it isn`t appropriate to involve valuable geocomplexes or territories with primary vegetation in operation;

an important step for improving the ecological status is the development of green tourism within the mountainous part of Chornohora;

regulation of the number of tourists is required on popular routes and their general concentration, to completely prohibit the use of motor vehicles within the territory of the nature reserve fund and, in part, the territory of another intended purpose within the highlands;

it is advisable to combine recreational activities with traditional pastoralism, limiting livestock, attracting tourists to visit the high-mountain plains, and thereby promote other recreational facilities and tourist routes.

Conclusion. This paper describes an algorithm of conducting a research of the ecological-landscape organization of the territory of the alpine-subalpine highlands of the Chornohora massif within the Transcarpathian region, which was gradually implemented on the basis of a representative key site «Sheshul-Petros». For conducting such studies, the determinants of value are theoretical and methodological principles of genetic landscape studies, which reveal the peculiarities of the landscape approach to the study of the problems and features of economic activity in the alpine-subalpine highlands of Chornohora.

General results of our research the following conclusions, which are a staple of analysis:

since the strongest interrelationships, and therefore, the highest stability, are characteristic of genetically related geocomplexes, the identification and study of highlands natural complexes from the standpoint of their genetic affiliation for the purposes of land management is a priority;

highlands natural territorial complexes confined to the complexes of mesoforms of the relief formed under the influence of the leading factor of morphogenesis (peneplenization, erosion-denudation processes, glacial exarational and accumulation). Besides the characteristic set of physical and geographical

processes, they also vary in the hydro-climatic and soil-vegetation features. From the landscape point of view, they are the basis for the allocation of morphogenetic altitude terrains;

the heterogeneity of the geological structure of the highlands of Chornohora in the boundaries of altitude terrains in the morphological structure is best captured by the landscape strias, and the morphometry of the forms of relief, soil and vegetation, etc. features should be taken into account when allocating geocomplexes of the level of the tract;

the main task for the development of similar projects of the ecological-landscape organization of the alpine-subalpine highlands is to identify the main cells and specific geocomplexes that undergo periodic loading and determine their current state;

the highlands of Chornohora are used in the pastoralism mainly as pasture. Most affected are NTC, which are within a radius of 1–2 km to the high-mountain plains, the placement of which tends to the upper boundary of the forest.

For the solution of practical tasks of land management, geocomplexes of the level of the tracts are of great importance. The development of projects of the ecological-landscape organization of the alpine-subalpine highlands of Chornohora and other massifs of the Ukrainian Carpathians should be based on a detailed study of the morphological structure and properties of each type of geo-complex, analysis of the current state and possibilities of their further use. Therefore, development of recommendations on rational use on a landscape basis helps reduce the negative impact on valuable highlands geocomplexes of Chornohora and the Ukrainian Carpathians in general.

Identification and metrication of unique NTC and valuable natural objects is a guarantor of the development of nature conservation and recreation in general. Projects of the ecological-landscape organization of highlands should decide the direction of development of recreational and tourist activity, establish the expediency of exploiting tourist routes, its ecological status, etc. The urgent task for the future in the development of the ecological-landscape organization highlands is the establishment of landscape diversity, which should be taken into account in the development of functional zoning, as already existing, and when creating new objects of the nature reserve fund.

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ЗАКАРПАТЬЕ ОБЛЫСЫ ШЕГІНДЕ (УКРАИНА) ЧЕРНОГОРАНЫҢ АЛЬПІЛІК-СУБАЛЬПІЛІК БИІК ТАУЛАРЫНЫҢ ЭКОЛОГО-ЛАНДШАФТТЫҚ ҰЙЫМДАСТЫРЫЛУЫН ЖҮРГІЗУДІҢ ТӘЖІРИБЕСІ

Аннотация. Мақалада қысқаша Черногораның альпілік-субальпілік биік тауы аумағында эколого-ландшафттық ұйымдастыру зерттеуін жүргізудің тәжірибесі және полонина шаруашылығы жүйесі мен туризмді оңтайландыруда ландшафттық тәсілді қолдану көрсетілген. Биік таулардың эколого-ландшафттық ұйымдастырылуы іспеттес, теоретико-әдістемелік ландшафттық принциптерге және дәл биік таулы табиғи аумақтық кешендерді зерттеудің кезеңділігін жүргізу кезінде мақсаттар мен міндеттердің нақтылығына маңызды көңіл бөлінген.

«Шешул-Петрос» түйінді телімінің морфологиялық құрылымының жалпы белгілері және оның полонина шаруашылығы және туризммен өзара байланысы сипатталды. Зерттеудің басты нәтижесі болып ландшафттық негізде жасалған жерді пайдалануды оңтайландыру жүйесін ұйымдастыруды құру табылады.

Түйін сөздер: альпілік-субальпілік биік таулар, табиғи аумақтық кешен, ландшафттық құрылым, жайылым шаруашылығы, оңтайландыру, Черногора.

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ОПЫТ ПРОВЕДЕНИЯ ЭКОЛОГО-ЛАНДШАФТНОЙ ОРГАНИЗАЦИИ АЛЬПИЙСКО-СУБАЛЬПИЙСКОГО ВЫСОКОГОРЬЯ ЧЕРНОГОРЫ В ЗАКАРПАТСКОЙ ОБЛАСТИ (УКРАИНА)

Аннотация. Кратко представлен опыт исследования эколого-ландшафтной организации территории альпийско-субальпийского высокогорья Черногоры и применения ландшафтного подхода при оптимизации системы полонинского хозяйства и туризма. Значительное внимание уделено конкретизации целей и задач при проведении подобной эколого-ландшафтной организации высокогорья, особенностям теоретико-методологических ландшафтных принципов и поэтапности исследования именно высокогорных природных территориальных комплексов. Описаны общие черты морфологической структуры ключевого участка Шешул-Петрос и ее взаимосвязь с полонинским хозяйством и туризмом. Главным результатом исследований стали рекомендации по оптимизации системы землепользования, разработанные на ландшафтной основе.

Ключевые слова: альпийско-субальпийское высокогорье, природный территориальный комплекс, ландшафтная структура, пастбищное хозяйство, оптимизация, Черногора.

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