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PRODUCTIVITY OF THE MEADOW LANDSCAPES IN THE REGION OF KRAISTE BETWEEN RIVERS KONSKA AND BISTRITSA

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The research observes two main directions. The first level is related with determination and differentiation of the landscape diversity. The second part consists estimation of the productivity of the landscape based on the plant productivity of the meadow landscape unites.

***Keywords*:** landscape, potential, meadow

ПРОДУКТИВНОСТ НА ЛИВАДНИТЕ ЛАНДШАФТИ В РАЙОНА НА КРАИЩЕ МЕЖДУ РЕКИТЕ КОНСКА И БИСТРИЦА

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Резюме: Оценката на потенциала на ландшафтите е ключов параметър при изследването ми и е представителна за продуктивността им. Те са важен елемент за развитие на регионите и реализиране на добри управленски практики. Районът на Краище е един от най-бедните райони в България, въпреки близостта до столицата. Изследването на ландшафтното разнообразие и потенциалната оценка на ландшафтите дават реални възможности за промяна на икономическата ситуация в региона. Изследването отчита две основни направления. Първото ниво е свързано с определяне и диференциране на ландшафтното разнообразие. Втората част се състои в оценка на производителността на ландшафта въз основа на растителната продуктивност на ливадните ландшафти.

***Ключови думи*:** ландшафт, потенциал, ливада

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INTRODUCTION

Landscapes are unique naturally-occurring combinations of natural features occupying a given area. They interact with the physical environment in a way that creates cycling of organic and inorganic matter creating a clearly defined structure through the flow of energy.

All organisms exist in an undisrupted interaction with their environment as they take energy and substances from it and turn these ingredients into biomass. Each organism binds only a fraction of the energy it receives and releases the rest of it to its environment in the form of heat and various end products that are further cycled. The productivity of an ecosystem is measured by the speed with which it accumulates organic matter (biomass). Organic compounds (biomass) are synthesized as a result of the transformation of solar energy into chemical energy or at the expense of chemical energy. Biomass is the weight of organisms expressed as energy (e.g. J/m^2) or dry organic matter (e.g. t/hectare). Green plants account for the largest part of the biomass of ecosystems.

The speed with which biomass is generated by producers (plants) per unit of surface is referred to as primary productivity. The cumulative energy bound in biomass as a result of photosynthesis is known as gross primary production. Some of it is expended by the plants themselves for breathing. The difference between Gross Primary Production and the energy spent on respiration is referred to as Net Primary Production. It is the actual speed of increase of biomass available to heterotrophs (bacteria, fungi and animals).

The speed with which heterotrophic organisms form new biomass is referred to as Secondary Productivity. Unlike plants, heterotrophic organisms are incapable of synthesizing complex energy-rich organic substances from inorganic molecules. They grow and get their energy by feeding on plants or other heterotrophs. Secondary production is in direct correlation with primary.

Landscape productivity research studies the rate with which landscapes generate biomass. Landscapes are functional units where the productivity of any constituent component depends on and influences the productivity of the others.

This research aims to shed light upon the landscape diversity and the productivity rates of modern meadow landscapes in the Kraishte Region stretching between Konska and Bistritsa rivers.

COMPONENT CHARACTERISTICS

The Kraishte Region is known for its rolling topography consisting of countless syncline and anticline forms. They are made of rocks of different age and structure – from Pre-Paleozoic metamorphous rock to Mesozoic limestones and sandstones, and tertiary and quaternary sediments. Some of the mountains located in the region are made of mostly limestones, marl and sandstone (such as Lyubash, Cherna Gora, and Zemenska). Others (such as Ruy, Milevska and Kurvav Kamak mountains) are made of granites and metamorphous rock. The beds of the structural basins below them are lined with accumulative sediments such as gravel, sand and clay.

Kraishte is one of Bulgaria's major morphostructures and lends its name to some of the smaller structures known as Kraishtidi. The main features of the relief as we know it were formed during the early Tertiary and Quaternary periods. The relief in the region is dominated by clearly defined denudation plains, several river terraces and picturesque gorges such as the Erma River Gorge near the town of Tran and the Struma gorges of Krakra, Chardashki, Priboiski, and Zemenski.

The climate in Kraishte is moderate continental although in its southernmost parts it starts to show some transitory features as worm Mediterranean air masses reach them along the valley of the Struma River. In the areas standing over 1500 m above sea level the climate is mountainous (Kurvav Kamak, Ruy, Milevska mountains). Average temperatures in January range between -3° – -6 °C and in July they reach 13–18 °C for the mountain territories. In lowland territories average temperature parameters are -1 °C in January and 19–21 °C for July. Temperature inversions are typical in the structural basins. Annual precipitation in the Kraishte Region varies between 600 and 750 mm increasing with elevation. May and June are the wettest months of the year while February is the driest. Snow cover lasts from 40 to 50 days a year to 3 to 4 months in the higher areas. The prevailing winds blow from the west and northwest.

Rivers in the Kraishte region, with the exception of the Erma River, drain into the Aegean Sea. The Struma River defines one of the borders of the research area. It is the main watercourse in this part of Bulgaria. Some of the larger rivers that originate here include Svetlia, Yavor, and Treklianska. They are fed by rainfall and melting snow (mostly rainfall in the lower areas). Water flow is highest in the spring and lowest in the summer and autumn. In areas of carbonate rock rivers are fed by karst springs. The flow module in areas of higher elevation reaches 15–20 l/s/km². This indicator's lowest value on the other hand has been recorded in the Radomir structural basins (0.5–1.0 l/s/km²). There are a number of artificial lakes in the Kraishte Region the largest of them being Lobosh Artificial Lake (Dam) on the Struma River which forms part of the south eastern border of the area subject to this study. Alluvial accumulations are rich in ground water. Karst springs are concentrated in the foothills of Golo Bardo Mountain and the Zemen Gorge. There are many mineral water springs in the Kraishte, but they fall outside the scope of the area this research has targeted.

The Erma River running through the foothills of the mountain has created some of the more fascinating landscapes in the area of the study. The head springs of the river are located in the mountainous region separating Znepole and the Vlasinska Valley east of the large Vlasinsko Lake along the watershed between Chimernik Mountain to the west and Kurvav Kamuk to the east. Of the 65 kilometers of the river's total length as measured between its head springs and its confluence with the Nishava River only 25 are within the territory of the Republic of Bulgaria. The river's average annual flow measured at the town of Tran is 2,75 m^3/s, but on June 22, 1948 it reached an all-time high of 180 m^3/s. The river freezes over for 20 to 30 days each year.

The main types of soil found in the river valleys and the structural basins of the region are vertisols. They are characterized with deep topsoil layer, mechanically heavy structure (50 to 75 % clay content) and unfavorable physical and mechanical properties. The slopes of the hills and the low-lying mountains are covered with brown mountain (forest) soils and cinnamon soil types. Rendzina soils are found

only in Golo Bardo Mountain. The areas near the beds of the rivers are covered with alluvial soils.

In terms of its phytogeographic characteristics Kraishte belongs to the Illyrian Region of the European Deciduous Forest Belt. In the fields of the structural basins and the foothills of the mountains the indigenous plants have been replaced with cultivated species. The forests are second-growth. Forest formations are made up of deciduous trees dominated by oak, beech, ash, elm, etc. Over the last several decades pine forests have increased their share. The highest zones near the crests of the mountains are covered with grasses.

The fauna of the Kraishte mountainous region is dominated by Palaearctic species. The impact and distribution of Mediterranean species is low as they are mostly found in the southernmost sections of the Zemenska Mountain. The Kraishte is part of the Rila-Rhodope zoogeographical region dominated by representatives of the Middle-European animal province.

In terms of the anthropological pressure exerted on the Kraishte region, its natural environment has suffered significant damage by mining. The development of energy generation and metallurgy in the Pernik Region has led to air, soil, and water pollution. The indigenous plant species in the mountains and the river valleys has been decimated by clear-cutting to create pastures and farm lands. Breeding grazing animals have changed plant cover significantly activating soil erosion. The presence of certain valuable mineral resources in the area spawned industries such as energy generation (Pernik and Bobov dol), cement (formerly in the town of Batanovtsi) and lime (Zemen) production. The large pastures in the area lead to the set-up of large-scale stockbreeding operations. The fields in the valleys, the hilly areas and the foothills of the mountains have favorable hydro-climatic characteristics for growing various different crops such as vegetables, potatoes, corn, tobacco, hops, grapes, and orchards. The relief does not impose difficulties for the development of railroad and road transport. However, due to the region's peripheral location, road transport has been better developed. The mountains and the rivers in the area have good potential for the development of tourist and recreational ventures. Some of the region's better known natural landmarks include the Erma River Gorge near the town of Tran, the Zemen Gorge, and the Skakavitsa Waterfall.

RESEARCH STAGES

The research was conducted in four key stages, as follows:

1. Preliminary familiarization with the region to determine potential key sections.
2. Field work – terrain investigation of 22 landscape points in different places of the research region (Fig. 1 – appendix).
3. Laboratory processing of the data collected in the field.
4. Analysis and summarizing of the results.

RESULTS AND DISCUSSION

LANDSCAPE DIVERSITY

The research and analysis of the landscape diversity of the Kraishte region between the rivers of Konska and Bistritsa follows the landscape differentiation model introduced by Todorov and Zhelezov (2014) and was taxonomically limited to the sub-type level.

In our classification of landscape diversity taxonomic unit of *Landscape Class* was taken as the leading one. The main diagnostic criterion used for its determination was macro-relief (Petrov, 1979; Velchev et al., 1992; Popov, 2001).

The second taxonomic level was *Landscape Type*. Using it, we identified and grouped together territories with similar hydroclimatic conditions (Velchev et al.,1992; Popov, 2001). The leading criterion for identifying landscape types on the map was the characteristics of the climate in terms of temperature and humidity features. We identified the following five types of landscapes within the territory subject to our study:

– Mountainous, moderately warm, Sub-Mediterranean;
– Mountainous, moderately warm, semi-humid;
– Mountainous, moderately warm, humid;
– Tall-mountain meadows;
– Hydromorphous and sub-hydromorphous;

The next taxonomic level is that of *landscape sub-types* as characterized by the character of the plant formations occupying them (per Velchev et al. (1992). The studied area includes:

– Transitional-to-Sub-Mediterranean, low-lying mountain/hollow forests and shibliaks.
– Low-lying mountains, transitional-to-moderate.
– Intermediate mountain forests.

PRODUCTIVITY

Landscape point № 1. Meadow landscapes were studied in Zemen Mountain on a denudation level at 708 m above sea level, situated on an eastern slope to the village of Vranya stena (Fig. 2 – appendix). There are a small percentage of shrub communities. Productivity of grass formations amounts to 1,00 t/ha.

Landscape point № 2. Meadow landscapes were studied near Pestera village in the region with open karst. Productivity of grass formations amounts to 0,80 t/ha.

Landscape point № 3. Meadow landscapes were studied in Milevska mountain near Pobit kamuk village at 1150 m above sea level (Fig. 3 – appendix). Productivity of grass formations amounts to 1,28 t/ha.

Landscape point № 4. Meadow landscapes were studied between villages Kopilovtsi and Shishkovtsi along the valley of river Dragovistitsa. Productivity of grass formations amounts to 3,43 t/ha.

Landscape point № 5. Meadow landscapes were studied along the valley of river Dragovistitsa between villages Drgovistitsa, Sovoliano and Shishkovtsi (Fig. 4 – appendix). Productivity of grass formations amounts to 0,30 t/ha.

Landscape point № 6._Meadow landscapes were studied in Zemen Mountain above the village of Stensko at 625 m above sea level (Fig. 5 – appendix). Productivity of grass formations amounts to 2,12 t/ha.

Landscape point № 7. Meadow landscapes were studied near village Dragovistitsa. Productivity of grass formations amounts to 0,88 t/ha.

Landscape point № 8. Meadow landscapes were studied in Zemenska mountain, south of village Polska Skakavitsa (Fig. 6 – appendix). Productivity of grass formations amounts to 1,28 t/ha.

Landscape point № 9. Meadow landscapes were studied near mouth of river Rayanska. Productivity of grass formations amounts to 2,62 t/ha.

Landscape point № 10. Meadow landscapes were studied near Lobosh dam. Productivity of grass formations amounts to 1,00 t/ha.

Landscape point № 11. Meadow landscapes were studied near Lobosh dam. Productivity of grass formations amounts to 1,72 t/ha.

Landscape point № 12. Meadow landscapes were studied in Rui mountain near village Lomnitsa. Productivity of grass formations amounts to 0,32 t/ha.

Landscape point № 13. Meadow landscapes were studied in Rui mountain above village Zelenigrad at 825 m above sea level (Fig. 7 – appendix). Productivity of grass formations amounts to 1,05 t/ha.

Landscape point № 14. Meadow landscapes were studied in Rui mountain between villages Rani lug and Slishovtsi (Fig. 8 – appendix). Productivity of grass formations amounts to 1,15 t/ha.

Landscape point № 15. Meadow landscapes were studied in Tran structural basins near village Miloslavtsi (Fig. 9 – appendix). Productivity of grass formations amounts to 1,10 t/ha.

Landscape point № 16. Meadow landscapes were studied in Lubash mountain near village Staniovtsi at 880 m above sea level (Fig. 10 – appendix). Productivity of grass formations amounts to 0,80 t/ha.

Landscape point № 17. Meadow landscapes were studied in Lubash mountain near village Staniovtsi (Fig. 11 – appendix). Productivity of grass formations amounts to 1,20 t/ha.

Landscape point № 18. Meadow landscapes were studied in Lubash mountain in the region of village Kosharevo (Fig. 12– appendix). Productivity of grass formations amounts to 0,88 t/ha.

Landscape point № 19. Meadow landscapes were studied in Lubash mountain in the region of village Krivonos (Fig. 13 – appendix). Productivity of grass formations amounts to 1,40 t/ha.

Landscape point № 20. Meadow landscapes were studied in Erulska mountain near village Erul (Fig. 14 – appendix). Productivity of grass formations amounts to 1,27 t/ha.

Landscape point № 21. Meadow landscapes were studied in Cherna gora mountain near village Elov dol (Fig. 15 – appendix). Productivity of grass formations amounts to 0.92 t/ha.

Landscape point № 22. Meadow landscapes were studied in Erulska mountain near Ordaniski monastery at 993 m above sea level (Fig. 16 – appendix). Productivity of grass formations amounts to 0,88 t/ha.

CONCLUSIONS

The meadow landscapes in the Kraishte region between the rivers of Bistritsa and Konska can be described as having average biomass production rates. The highest indicators for productivity of grass formations are indicators of landscape point 4 (3.43 t/ha) – along valley of rive Dragovistitsa, landscape point 6 (2.12 t/ha) – Zemen mountain above village of Stensko, and landscape point 9 (2.62 t/ha) – near mouth of river Rayanska.

The result of the study can be use in the process of development of the regions and regional planning. They can optimize the opportunities of business activities in the region, especially in the area of agricultures.

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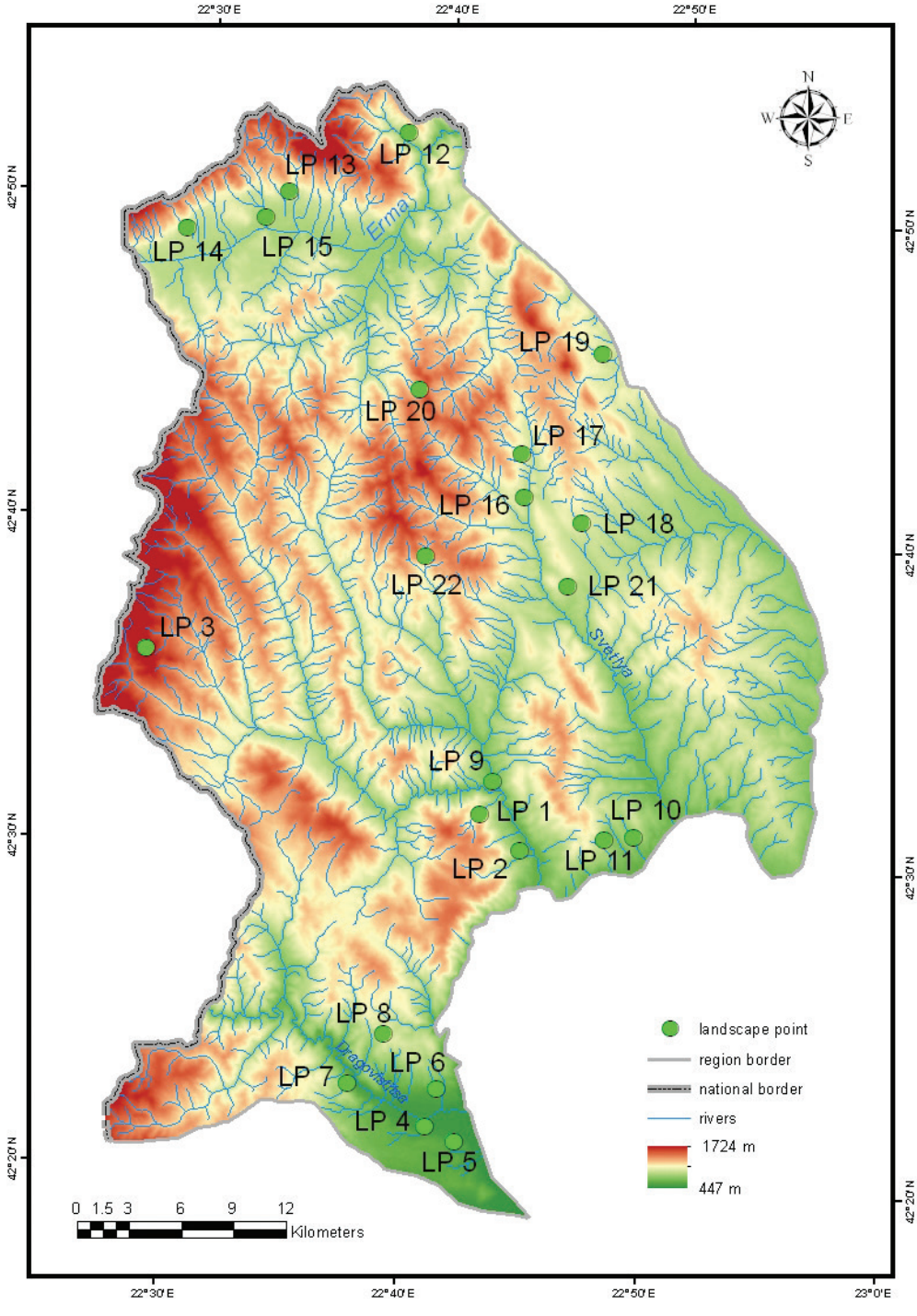

Fig. 1. Map of the Studied Region Showing the Locations of the Landscape Points (LP 1-22)

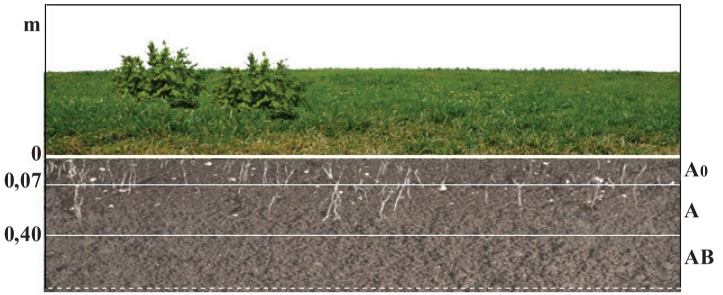

Fig. 2. Meadow landscapes in Zemenska mountain

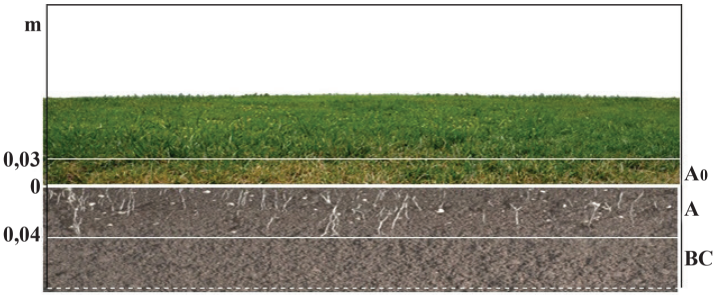

Fig. 3. Meadow landscapes in Milevska mountain

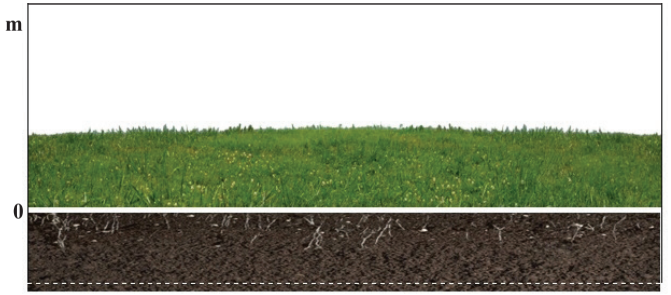

Fig. 4. Meadow landscapes in valley of Dragovistitsa river

Fig. 5. Meadow landscapes in Zemenska mountain

Fig. 6. Meadow landscapes in Zemenska mountain

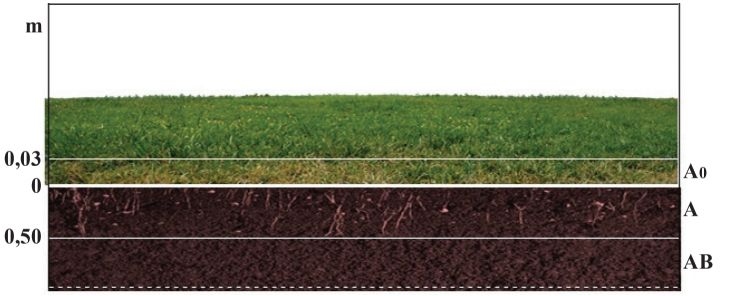

Fig. 7. Meadow landscapes in Rui mountain

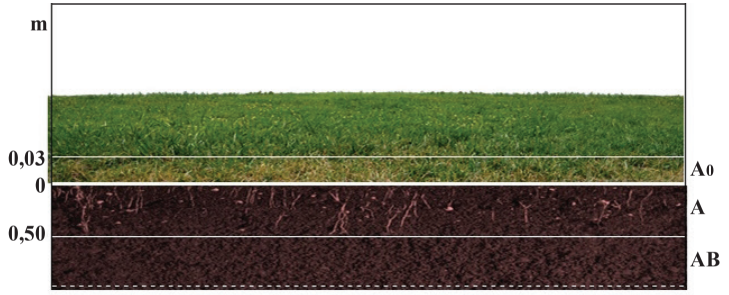

Fig. 8. Meadow landscapes in Rui mountain

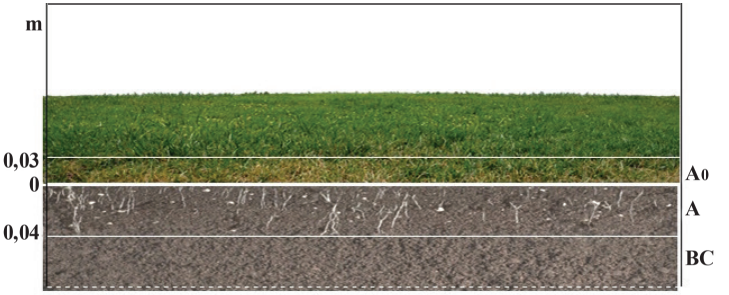

Fig. 9. Meadow landscapes in Tran structural basins

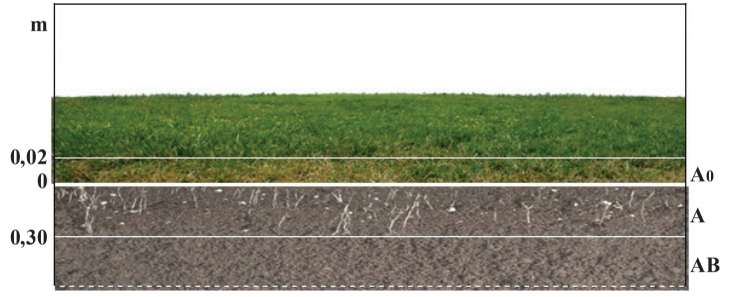

Fig. 10. Meadow landscapes in Lubash mountain

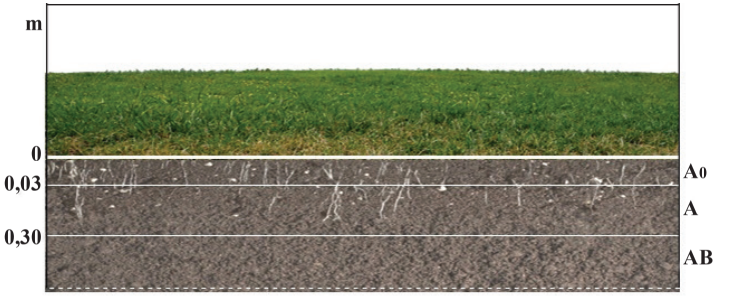

Fig. 11. Meadow landscapes in Lubash mountain

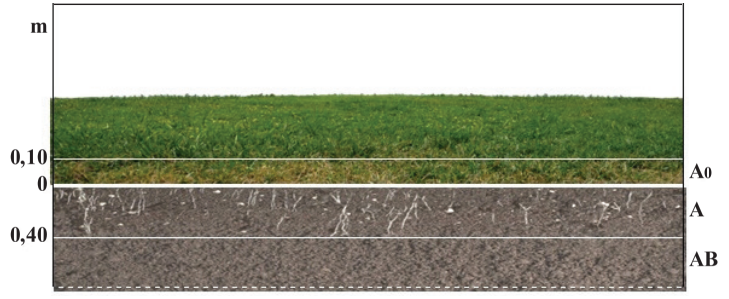

Fig. 12. Meadow landscapes in Lubash mountain

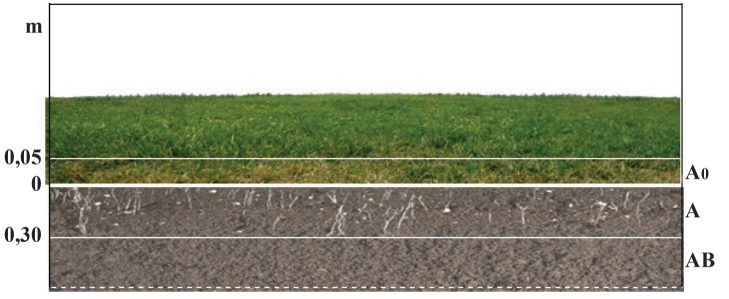

Fig. 13. Meadow landscapes in Lubash mountain

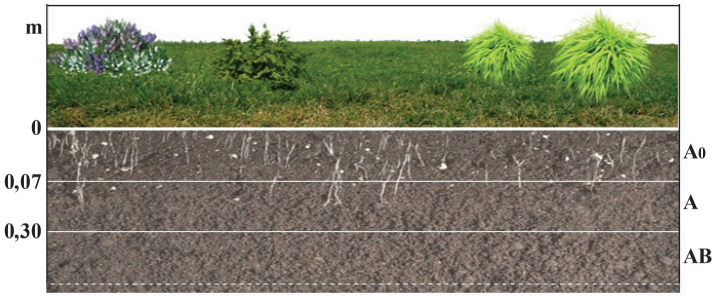

Fig. 14. Meadow landscapes in Erulska mountain

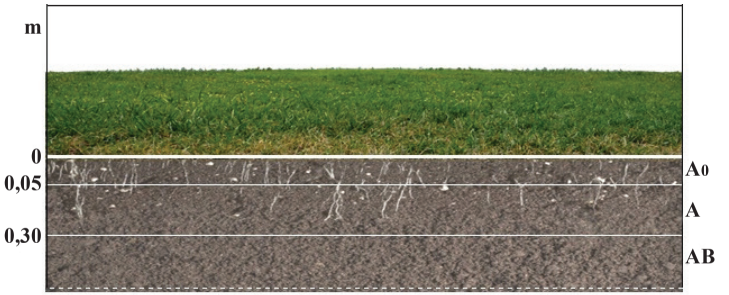

Fig. 15. Meadow landscapes in Cherna gora mountain

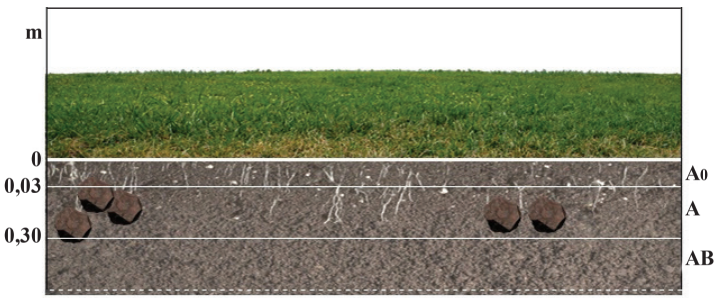

Fig. 16. Meadow landscapes in Erulska mountain