EXPLOITATION OF THREE-DIMENSIONAL MODELS IN GRASSLAND ANALYSIS. CASE STUDY

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Abstract. *The appearance and typology of the grasslands, in the hilly and mountainous areas, are in accordance with the characteristics of the relief (slope, exhibition), the climatic conditions and with the properties of the soils. In this context, the plants in the grassland habitats have undergone changes and have adapted to the subzones with particular conditions. The variability of the environmental conditions requires the detailed analysis of the grasslands by holistic methods, which should "combine" all the factors of the physical environment at any point on the investigated surface. The aim of the research was to extract relevant information in pratological studies, by processing three-dimensional models generated from altimetric models and topo-cadastral data. For the analysis of the grassland considered a case study, satellite images and topo-cadastral data were used. The processing and general mapping was done with ArcGIS 10.2.1 software (ArcMap and ArcScene) and Google Earth Pro. Essential data were considered: altimetric values, both point and in the form of continuous images (raster), slope of the terrain (length and slope), slope orientation; all these elements have a direct and indirect influence on the vegetation of the grassland. The research results show that the analyzed grassland from ATU Goruia, has an area of 296 ha, is arranged on two slopes on altitudinal levels, has different values of the slope depending on the terrain configuration and is demarcated by the forest line. The transversal profile, on an interval of 2.72 km, of the highest peak shows that at an altitude of 660 m a plateau is created, the minimum value being 394 m altitude on the slope with shaded exposures (average slope is 21.4%) and 434 m altitude on the slope with sunny exposures (average slope is 19.0%). The analyzed grassland has three ridges, on one side of the slope dominates the exposure N, N-V and the other side of the slope is characterized by an exposure E and S-E. Biomass production and species diversity, as a specific expression of the respective ecotope, significantly reflect the relief character.*

Keywords: *grasslands, three-dimensional models, geospatial data, spatial analysis*

INTRODUCTION

In Romania, grasslands represent about 20% of the country's surface and represent an invaluable economic and national heritage reserve. In order to avoid the depressive curves in the vegetal biomass of the grasslands, the most complex, interdisciplinary studies with new information in the field are necessary.

The fragmented relief occupied by the grasslands (in the hill and mountain area), determines on altitude changes in the action of stationary factors, creating specific interdependencies in topoclimates, soil characteristics (HERNANDO, ROMANA, 2015) and in the physiognomy and composition of vegetation (GAVILÁN, 2005; LIU ET AL. 2019). The increase of the altitude, from the plain to the mountain, brings important changes in the thermal and pluviometric regime (ŞMULEAC ET AL. 2020) which in turn determines the known altitudinal zonality of the grasslands (KOVÁCS-LÁNG ET.AL. 2000, FANA ET AL. 2009). The exposure of the slopes influences the temperature, determining a specific climate warmer, sunnier on the southern slopes, where a more thermophilic and cooler vegetation develops with a mesophilic vegetation on the northern slopes (COJOCARIU, 2005). This is also due to the different water regime on the two slopes.

In the hilly area and on the plateaus, the exhibition also determines the use of the land; thus vineyards, orchards and in general agricultural crops are developed mainly on the southern exposure while on the northern exposure the forests and natural grasslands dominate (ROGOBETE, ȚĂRĂU, 2015).

The slope influences the vegetation of the grassland (LIEFFERS, LARKIN-LIEFFERS, 2011) especially by the soil water regime (XUE ET AL. 2017) and by the degree of erosion (ANGHEL, TODICĂM, 2008; COSTEA, 2012; IONUȘ ET.AL. 2013). Grasslands on higher slopes give lower biomass production on the northern exposure, compared to those on the southern exposure and due to the decrease of the thermal regime (AUSLANDER ET AL. 2003), which in the mountains is a first factor in limiting the grasslands production and species biodiversity.

The biomass of the grassland is the result of some interrelationships between the physical, chemical and biological factors in the soil (BLAIR ET AL. 2014) and the vegetal carpet that can be stimulated, more or less, by anthropogenic interventions such as fertilization (MOISUC ET.AL. 1997), overseeding, correct adjustment of the animal load (MOISUC ET.AL. 1994; MARUȘCA, 2016). This is the only way to explain why different production results are obtained in the same regime of climatic and edaphic factors. Changes in the seasons where there is an annual change in a factor, such as plant nutrition, lead to an increase in the amount of green mass of grasslands.

In this context, the appearance and typology of grasslands, in hilly and mountainous areas, are in accordance with the characteristics of the relief (altitude, slope, exposure), climatic conditions and soil properties (COMAN ET AL. 2019). In this context, the plants in the grassland habitats have undergone changes and have adapted to the subzones with particular conditions (DURĂU ET AL. 2010; SAMFIRA ET AL. 2012).

The variability of the environmental conditions requires the detailed analysis of the grasslands (O'MARA, 2012) by holistic methods, which "combine" all the factors of the environment at any point on the investigated surface (TASSER ET AL. 2003; DIXON ET AL. 2014).

The aim of the research was to extract relevant information in pratological studies, by processing three-dimensional models generated from altimetric models and topo-cadastral data.

MATERIALS AND METHODS

The study area is located on the administrative territory of Goruia, Caraș-Severin County (Figure 1).

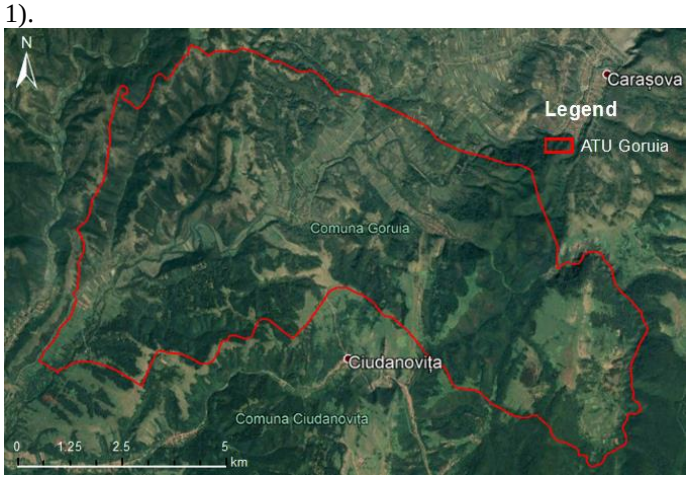

Fig. 1 Location of the study area (processing according to ANCPI)

For the analysis of the grassland considered a case study, the Digital Elevation Model (DEM) was used (Figure 2), satellite images and topo-cadastral data.

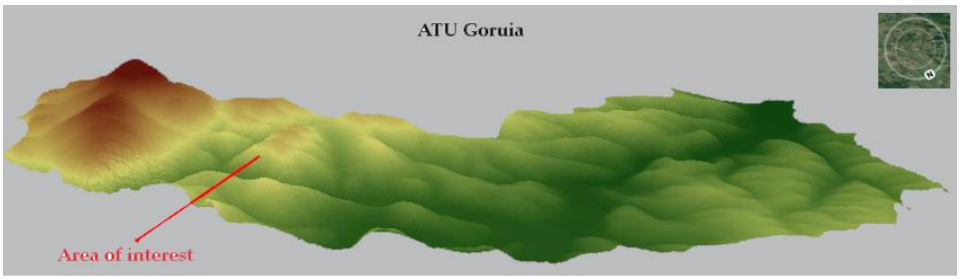

Fig. 2 Study area - 3D model (processing after European Environment Agency (EEA), 2017: Digital Elevation Model)

The processing and generation of cartographic materials was done with ArcGIS 10.2.1 software (ArcMap and ArcScene) and Google Earth Pro. Essential data were considered: altimetric values, both punctual and in the form of continuous images (raster), slope of the terrain (length and inclination of slopes), slope orientation, morphometry and morphology of the relief (with direct implications on water runoff and accumulation); all these elements have a direct and indirect influence on the vegetation of the grasslands.

As auxiliary data, were extracted: longitudinal and transversal profiles, data related to the topography of the area and neighborhoods of the grassland surface, limiting factors and risk processes, etc.

RESULTS AND DISCUSSION

In this study we analyzed the disposition of a meadow of 296 ha from ATU Goruia, on both slopes, respectively by geomatic methods we determined: altitude, exposure and slope.

A first operation, obligatory in remote pratological studies is the identification and delimitation of grassland surfaces, by modern means already established (SIMON ET.AL. 2017).

For the analysis of the grasslands considered a case study, satellite images and topo-cadastral data were used. Map processing and generation was done with ArcGIS 10.2.1 software (ArcMap and ArcScene) and Google Earth Pro.

The analyzed grassland (Figure 3, Figure 4), delimited by the forest line, is arranged on two slopes, on different altitudinal steps. Altitude, through direct factors, has an influence on many aspects of plant growth and development in grasslands.

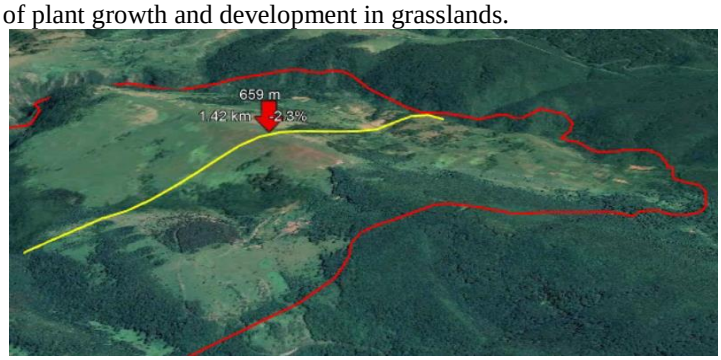

Fig. 3 Morphometric analysis of the grassland surface in ATU Goruia

The transversal profile in the analyzed grassland shows that the maximum altitude is at 659 m, where a plateau is formed, the minimum value being 394 m on the slope with shaded exposures and 434 m on the slope with sunny exposures, on an interval of 2.72 km.

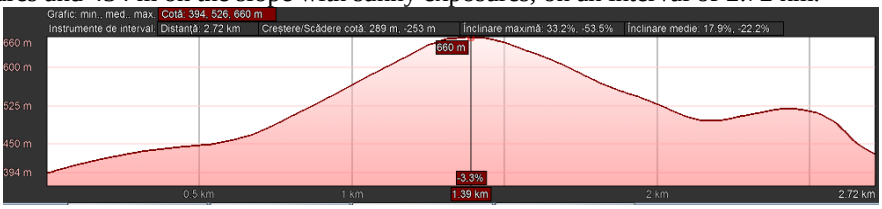

Fig. 4 Transverse profile (V - E) in the grassland surface

AUSLANDER ET AL. (2003) report that the microclimatic conditions on the slopes vary dramatically, affecting the biology of organisms at all levels and that the south-facing slopes can receive solar radiation six times higher than those facing north.

The presentation of the grassland from ATU Goruia on the slope with sunny exposures, on a length of 1.31 km, is presented and analyzed in figure 5 and figure 6.

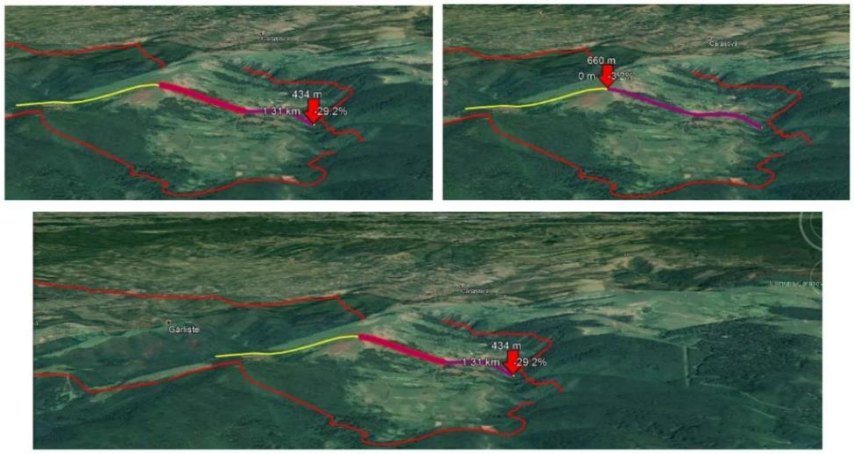

Fig. 5 Analysis of the grassland from ATU Goruia on the slope with sunny exposures

From figure 6, it is found that on the slope with sunny exposures the slope of the land suddenly decreases between the altitude of 660 and 500 m where a plateau area is created, then there is again an increase of 1.8% to an altitude of 521 m (area plateau) and then a steep descent of the slope to 432 m altitude, where the meadow meets the forest. The maximum slope is 32.0% and the average value is 21.4%.

Fig. 6 Graphical representation of the slope with sunny exposures

The presentation of the grassland from ATU Goruia on the slope with shaded exhibitions, on a length of 1.39 km, is presented and analyzed in Figure 7 and Figure 8.

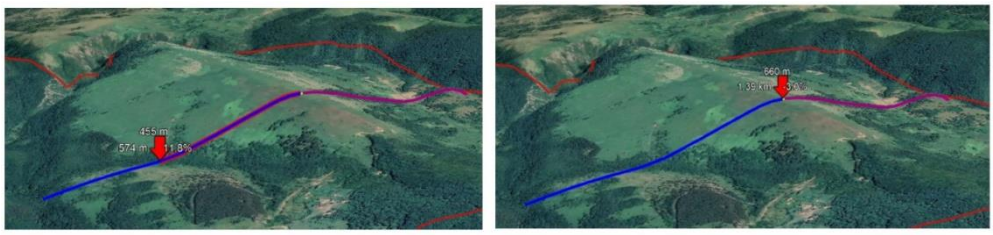

Fig. 7 Analysis of the grassland from ATU Goruia on the slope with shaded exposures

Figure 8 shows that on the slope with shaded exposures the slope of the land decreases suddenly to an altitude of 455 m, after which there is a gentle decrease to an altitude of 396 m where the meadow meets the forest boundary. The maximum slope is 35.8%, the minimum is 3.3% and the average value is 19.0%.

Fig. 8 Graphical representation of the slope with shaded exposures

GONG ET AL. (2008), in turn, point out that the northern slopes showed higher productivity and species diversity compared to the southern slopes.

In the Mountainous Banat, on the northern slopes a typical mesophilic vegetation develops, represented by *Agrostis tenuis* and *Festuca rubra* (SAMOILĂ ET AL. 1979).

The map of the exhibition of the slopes on the entire grassland surface, from ATU Goruia, is presented in Figure 9. The analyzed grassland has a large surface and three peaks; the highest being the peak of 660 m, on which the transversal profile was analyzed.

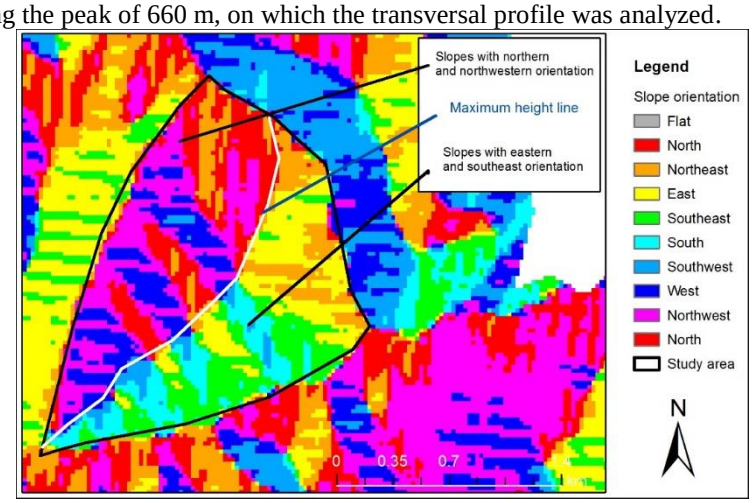

Fig. 9 Slope exposure map

Figure 9 shows that in the middle the grassland is crossed by a line of maximum height that separates the two slopes. As the terrain is uneven and has ridges, on one side of the slope

dominates the exposure N, N-V and the other side of the slope is characterized by an exposure E and S-E. The relief, through its exposure, creates much differentiated topoclimates.

CONCLUSIONS

The analyzed grassland, from ATU Goruia, has an area of 296 ha, is arranged on two slopes on altitudinal steps, has three peaks and is demarcated by the forest line. The transversal profile, on an interval of 2.72 km, of the highest peak shows that at an altitude of 660 m a plateau is created, the minimum value being 394 m altitude on the slope with shaded exhibitions and 434 m altitude on the slope with exhibitions sunny.

On the slope with sunny exposures, on a length of 1.31 km, the slope of the land follows the configuration of the land, the maximum inclination being 32.0%, and the average value is 21.4%.

On the slope with shaded exposures, the slope of the land decreases suddenly to an altitude of 455 m, after which there is a gentle decrease to an altitude of 396 m, here being the demarcation line of the land. The maximum value of the slope is 35.8%.

The analyzed grassland has three ridges, on one side of the slope dominates the exposure N, N-V, and the other side of the slope is characterized by an exposure E and S-E.

Biomass production and species diversity, as a specific expression of the respective ecotope, significantly reflect the character of the relief.

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