CONSIDERATIONS REGARDING THE GEOMORPHOLOGY OF BANATULUI MOUNTAINS

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Abstract. *Banat is a region from South-West Romania that is geomorphologically characterised by the repartition of form reliefs. The form reliefs from this area succeed each other in levels starting from East to West as such: low plain, high plain, hills and mountains. This region is characterised by low mountains that were formed by the presence of karst. From a geologic point of view, Banatului Mountains belong to the largest and most compact surface of chalky, carbonic rocks from Romania, Reşiţa-Moldova Nouă area. Data from plot descriptions present in forest management plans can be used in studying a territory's geomorphology as they present detailed particularities for certain surfaces occupied by stands. The purpose of this present paper is to study the geomorphology of Banatului Mountains with the help of data from forest management plans realized for forests located in this region. The data that were taken into consideration were: altitude, relief category, field configuration, slope and exposition. The total surface occupied by national forests from Banatului Mountains is of 482.387 ha. Amongst them, the majority are situated at altitudes between 500 and 600 meters. The slope (with a significant percentage of undefined slopes) is the main form relief from Banatului Mountains. Field configuration in the forest area is mainly sinuous, occupying 6% of this area, while kneading fields occupy only 1%. Field inclination presents an increased growth from plain fields up to those with a 30^g slope. The most accentuated slopes are registered by Baile Herculane (70^g), Sasca Montana, Bozvici, Resita and Baile Herculane (60^g). A reduced percentage was observed for fields with very low slopes (2%) or very high (5%), while fields with slopes between 20^g and 40^g have recorded significant percentages (80%). The entire Banatului Mountains chain is characterized by a relatively uniform repartition of stands based on the exposition, with a lower percentage of fields with East and West expositions.*

Keywords*: altitude, field slope, field configuration, exposition, Banatului Mountains*

INTRODUCTION

Banat region is located in the south-west part of Romania. From a geomorphologic point of view, this area is characterised by the repartition of relief forms. As such, the following relief forms can be found from East to West in a succession of levels: low plain, high plain, hills and mountains (SITLIVY, et al., 2014; DUNCA, 2017). Low mountains are characteristic for this region. These relief forms are caused by karst presence and represented by the following mountain units: Semenic Mountains (1446 m altitude), Locvei Mountains (727 m altitude), Dognecea Mountains (617 m altitude), Aninei Mountains (1160 m altitude), Poiana Ruscă Mountains and Almajului Mountains (1224 m altitude) (IURKIEWICZ, et al., 2005; TIMÁR, et al., 2008; MUREŞAN and IANĂŞ, 2012). The vertical and horizontal distribution of the elements is determined by the relief's distribution in the above-mentioned levels (ŢĂRĂU, et al., 2015). From a geologic point of view, Banatului Mountains belong to the most compact surface of chalky, carbonic rocks from Romania, Reşiţa-Moldova Nouă area (ARTUGYAN, 2013; Artugyan and Urdea, 2014; ARTUGYAN, 2017). The climate from this area is temperate-continental, characterised by warm and dry summers and cold winters. The annual average temperature is gathered between 6-10^0 C, while the annual average precipitation is of 600-1000 mm (Aldescu, 2008; BELIĆ, et al., 2011; KELS, et al., 2014; Dunca, 2018; Hoancea, et al., 2018;). The mountain areas from this region are characterised by

an annual average temperature of 5-6^{0}C and annual average precipitations of 800-900 mm (Sidor and Popa, 2015).

The low mountains from this region are characterised by a petrographic structure and varied relief forms from eruptive rocks (Arinis Mountains), crystalline (Locvei Mountains) or crystalline mixed with granite (Dognecea Mountains). The main soils are dystric cambisols and rarely eutric cambisols with a fragmentary appearance of regosols and lithosols (IANOȘ, 2002). These soils are rich in humus (CRIȘAN et al., 2017; SPÂRCHEZ et al., 2017), nutritive elements (DINCĂ et al. 2019; ENESCU et al., 2019; TÂRZIU et al., 2002), microorganisms (ONEȚ et al., 2019), are well supplied with water (DINCĂ et al., 2018) and are generally favourable to forest vegetation (BLAGA et al., 2019; CÂNTAR et al., 2019; CHISĂLIȚĂ et al., 2015).

The purpose of this paper is to characterise Banatului Mountains from a geomorphologic point of view (Figure 1.)

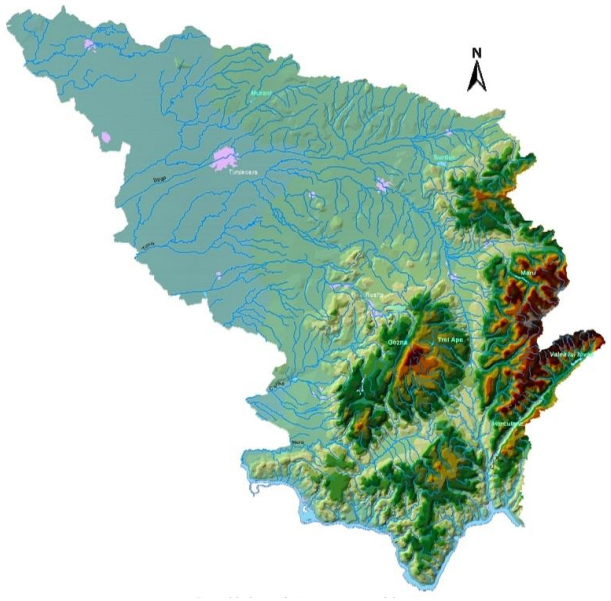

Figure 1. Banatului Geomorphology
(http://www.rowater.ro/dabanat/Planuri%20bazinale/descriere%20bazin.pdf)

MATERIAL AND METHODS

Forest management plans area sort of Bible for silviculture practitioners as they describe all forests (constituted in production subunits) from a certain territory. Besides their biometric characteristics, they include an inventory of the environment characteristics from the studied area, including the field's geomorphology.

Based on this fact, the present study has used all data regarding Banatului Mountains geomorphology from forest management plans realized during 1991-2007 for 24 forest districts (*** AMENAJAMENTE).

The extremely generous database (46.601 stand elements) ensures a very good representation of the obtained data.

The following characteristics were analyzed (by using features offered by Excel): altitude, relief category, field configuration, slope and exposition.

Three sub-areas were created and analysed within the exposition and besides the analysis realized for the entire Banatului Mountains area:

- Poiana Rusca Mountains (with a general NE-SV repartition);
- Dognecea, Aninei, Semenicului, Almajului Mountains (with a general N-S repartition);
- Locvei Mountains (with a general E-V repartition), (fig. 2).

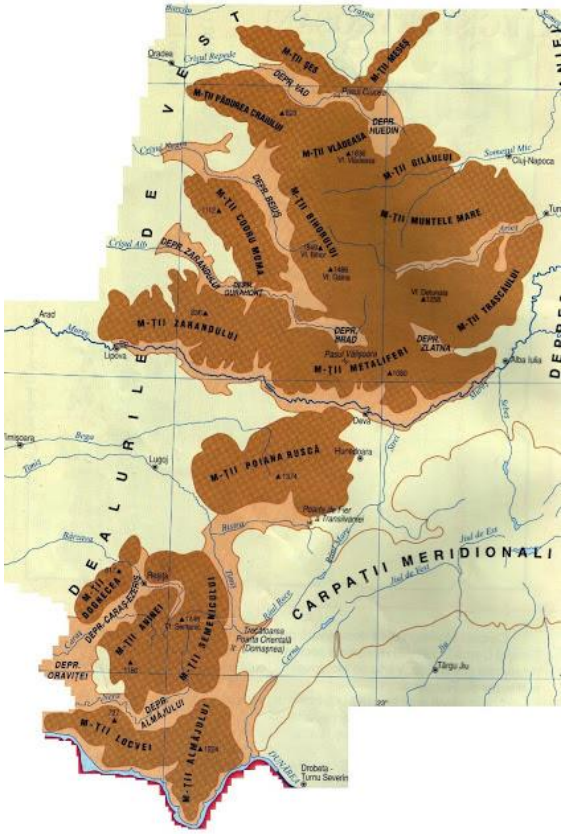

Figure 2. The orientation of the Occidental Carpathians, including Banatului Mountains (http://geografiebranesti.blogspot.com)

RESULTS AND DISCUSSIONS

Altitude

The total surface occupied by state forests in Banatului Mountains is of 482.387 ha. Amongst them, the majority of stands are situated at altitudes between 500 and 600 m. (Figure 3). The altitude average from Banatului Mountains is of 595 m, with the lowest altitudes recorded at Berzeasca (80 m) and the highest at Rusca Montana (1770 m).

Compared with the Southern Carpathians, where the average altitude is of 1120 m (DINCĂ and BRATU, 2019), Banatului Mountains is somewhere at the half.

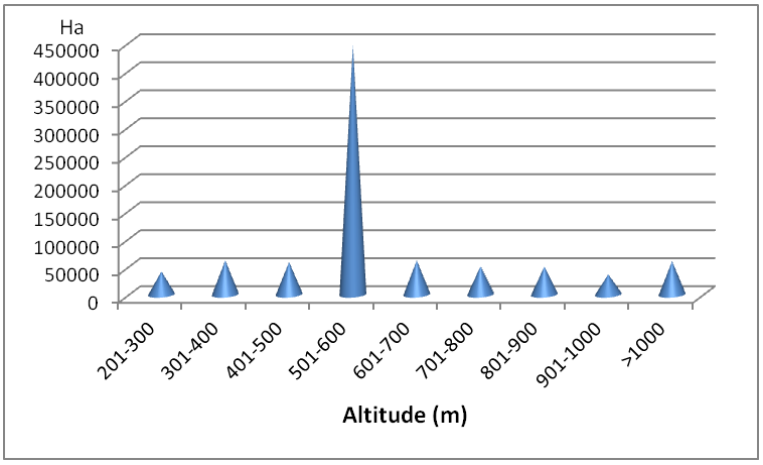

Figure 3. Altitudes from Banatului Mountains

Slope is the main dominant relief form from Banatului Mountains (with a high percentage of undefined slopes and almost equal percentages between inferior, middle or superior slopes, with a slight predominance of superior slopes), table1.

Table 1

Relief forms from the Southern Carpathians

Relief form	Surface (ha)	Surface (%)
Meadow	750	-
Slope	352067	73
Inferior slope	41417	8
Average slope	31621	7
Superior slope	52804	11
Plateau	2948	1

Field configuration in Banatului Mountains forest is mainly sinuous, with plain fields occupying 6%, while kneading fields only 1% (Figure 4.).

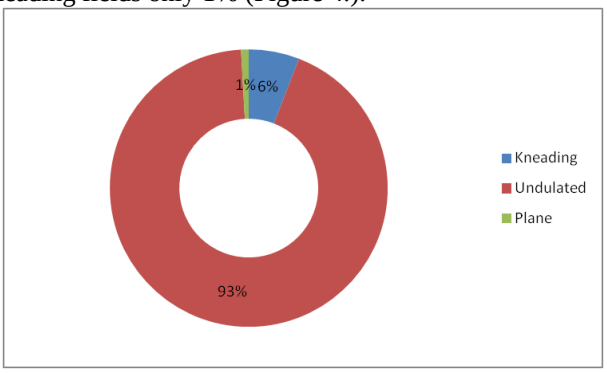

Figure 4. Field configuration in the Southern Carpathians

Field slope

The slopes of fields occupied by forests from Banatului Mountains are rendered in Figure number 5. A Gauss curve can be seen, with a continuous growth from plain fields up to 30^g slope fields and a similar decrease from this value to the highest slopes.

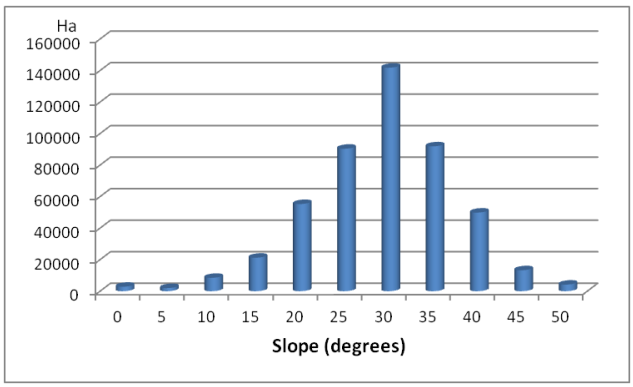

Figure 5. Field inclination in Banatului Mountains

The most accentuated slopes are recorded at Baile Herculane (70^g), Sasca Montana, Bozvici, Resita and Baile Herculane (60^g). Even though the fields have more accentuated slopes in Banatului Mountains when compared with the Southern Carpathians, their percentage in the total surface is lower: fields with slopes higher than 40^g amount to 5% in Banatului Mountains, while they reach 12% in the Southern Carpathians (DINCĂ and BRATU, 2019).

The distribution of fields on categories is rendered in Table number 2:

Table 2.

Slope categories from Banatului Mountains

Surface (ha)	Slope (^{g})				
	0-10	11-20	21-30	31-40	>40
	9708	62641	189927	196972	23135

As such, a reduced percentage of fields with very small slopes (2%) and very high slopes (5%) can be observed, together with a significant percentage of fields with slopes gathered between 20^g and 40^g (80%).

The exposition

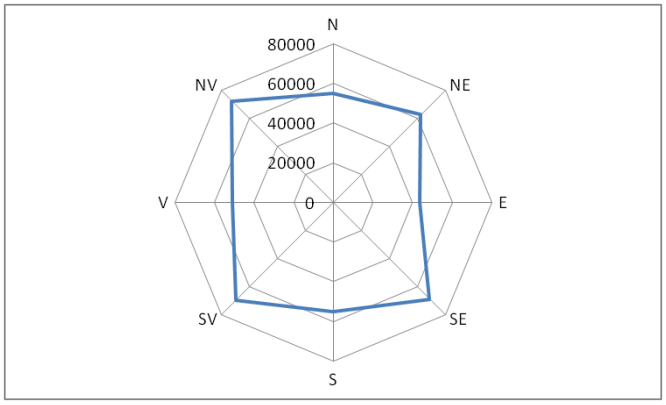

Figure 6. Field exposition in Banatului Mountains (total)

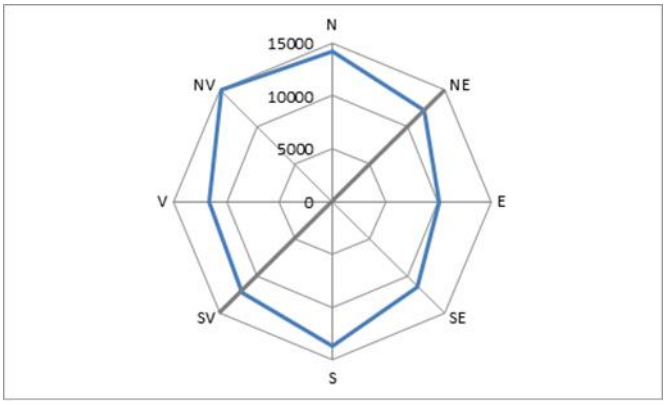

Figure 7. Field exposition in Poiana Rusca Mountains

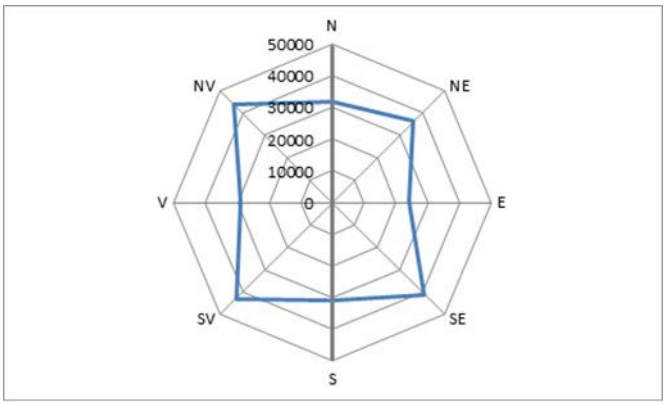

Figure 8. Field exposition in Dognecea, Aninei, Semenicului, Almajului Mountains

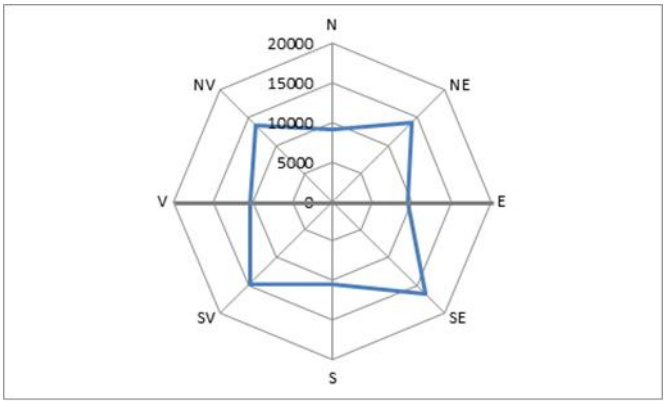

Figure 9. Field exposition in Locvei Mountains

A relatively uniform distribution of stands based on exposition can be observed for the entire Banatului Mountains chain (Figure 6), with a lower percentage of east and west exposition fields.

Similar distributions are also recorded for Dognecea, Aninei, Semenicului and Almajului Mountains (Figure 8) and for Locvei Mountains (Figure 9). On the other hand, Poiana Rusca Mountains (that are situated somehow outside the compact Banatului Mountains massif) display a slightly different exposition repartition (Figure 7), being more elongated on the north-south direction.

The following aspects have resulted by comparing the distribution of expositions on the above-mentioned mountain massifs with their general direction (the thick line from Figures 6-9):

- for Poiana Rusca Mountains, with a general NE-SV orientation, the expositions of all afforested plots does not correspond with this direction as they are relatively uniform distributed on the cardinal directions;
- for Dognecea, Aninei, Semenicului and Almajului Mountains, with a general N-S exposition, the distribution of areas covered by forests generally respects this direction, followed by NE-SV and NV-SE that are more widespread than the E-V direction;
- for Locvei Mountains, with a constant E-V orientation, the exposition is superior and constant in this direction, compared with the N-S one.

CONCLUSIONS

The data from plot descriptions supplied by forest management plans (altitude, relief category, field configuration, slope and exposition) can be used for realizing a general characterization of a field's geomorphology.

The main relief form from Banatului Mountains is the slope, while stands are distributed evenly based on the exposition. The majority of stands from this area are situated at altitudes between 500-600 m and on slopes between 20^g-40^g (80%). The stands from the entire Banatului Mountain chain are distributed relatively even, based on the exposition, with a lower percentage of fields with an east and west exposition. From a general point of view (in the case of mountain massifs disposed on the N-S and E-V directions), the expositions of forest areas are preponderantly disposed on the same direction. However, there are some cases (mountains from the NE-SV direction) that do not follow this rule.

BIBLIOGRAPHY

ALDESCU, G. C. , 2008 - The necessity of flood risk maps on Timiş River. In IOP Conference Series: Earth and Environmental Science, 4(1).

ARTUGYAN, L., 2013 - A review of karst terrains studies in Romania and Banat Mountains and future approaches. Review of Historical Geography and Toponomastics, VIII (15-16): 69-81.

ARTUGYAN, L., URDEA, P., 2014 - Groundwater drainage monitoring and karst terrain analysis using Spontaneous Potential (SP) in Anina Mining Area (Banat Mountains, Romania). Preliminary study. Karst without Boundaries, 11-15.

ARTUGYAN, L., 2017 - Geomorphosites assessment in karst terrains: Anina karst region (Banat Mountains, Romania). Geoheritage, 9(2): 153-162.

BELIĆ, M., NEŠIĆ, L., ĆIRIĆ, V., VASIN, J., MILOŠEV, D., & ŠEREMEŠIĆ, S., 2011- Characteristics and classification of gleyic soils of Banat. Ratarstvo i povrtarstvo, 48(2): 375-382.

BLAGA, T., DINCA, L., PLEȘCA, I.M., 2019: - How can smart alder forests (*Alnus glutinosa* (L.) Gaertn.) from the Southern Carpathians be indentified and managed. Scientific papers series „Management, Economic Engineering in Agriculture and Rural Development", 19(4): 29-35.

CÂNTAR, I.C., DINCĂ, L., CHISĂLIȚĂ, I., CRIȘAN, V., KACHOVA, V., 2019 - Identifying the oldest stands from the Southern Carpathians together with their main characteristics. Proceedings of the Multidisciplinary Conference on Sustainable development, Filodiritto International Proceedings, pp. 186-193.

CHISĂLIȚĂ, I., DINCĂ, L.C., SPÂRCHEZ, G., CRĂCIUNESCU, A., VIȘOIU D., 2015 - The influence of some stagnoluvosols characteristics on the productivity of *Quercus cerris* and *Qurecus frainetto* stands from OS Făget, DS Timiș. Research Journal of Agricultural Science, 47 (3): 23-28.

COTEȚ, P., 1967 - Problèmes de géomorphologie historique en Roumanie: La pénéplanation des Carpates Occidentales et Méridionales. Annales de Géographie 76, 417: 552-570.

CRIȘAN, V., DINCĂ, L, 2017 - The predominant forest soils from Timiș Forest Administration County. JOURNAL of Horticulture, Forestry and Biotechnology, 21(3): 137-141.

DE MARTONNE, E., 1902 - Lucrări geografice despre România, Ed. Academiei RS România, pp. 175.

DINCA, L., BADEA, O., GUIMAN, G., BRAGA, C., CRISAN, V., GREAVU, V., MURARIU, G., GEORGESCU, L., 2018 - Monitoring of soil moisture in Long-Term Ecological Research (LTER) sites of Romanian Carpathians. Annals of Forest Research, 61(2): 171-188

DINCĂ, L., BRATU, I., 2019 - Geomorfologia Carpaților Meridionali pe baza datelor din amenajamentele silvice. Revista de Silvicultură și Cinegetică, 44: 35-37.

DINCA, L., CHISALITA, I., CANTAR I.C., 2019 - Chemical properties of forest soils from Romania's West Plain. Revista de Chimie, 70(7): 2371-2374.

DUNCA, A. M., 2017 - The history of hydraulic structures realized in Banat hydrographical area (Romania). Transactions on Hydrotechnics, Scientific Bulletin of Politehnica University of Timișoara, 61(75, 1): 53-60.

DUNCA, A. M., 2018 - Monitoring Long-Term Air Temperature Regime in Banat (Romania). Annals of Valahia University of Targoviste, Geographical Series, 18(1): 74-83.

ENESCU, C.M., DINCĂ, L., TIMOFTE, A.I., 2019 - Main characteristics of forest soils across Getic Piedmont (South-Western Romania) - Scientific Papers. Series A. Agronomy, 62(1): 42-48.

HOANCEA, L., SIMON, M., RAIN, P., COPĂCEAN, L., COJOCARIU, L., 2018 - Influence of environmental factors on the beginning of grazing on grasslands from ATU Oravița, in correlation with pastoral traditions. Research Journal of Agricultural Science, 50(4): 391-398.

IANOȘ, G., 2002 - General considerations on the soil cover of Banat, Romania. Geographica Pannonica, (6): 13-16.

IURKIEWICZ, A., HOROI, V., POPA, R. M., DRĂGUȘIN, V., VLAICU, M., MOCUȚA, M., - 2005 Groundwater vulnerability assessment in a karstic area (Banat Mountains, Romania)–Support for water management in protected areas. In Proceedings of the International Conference

and Field Seminar "Water Resources and Environmental Problems in Karst–Cvijić. 127-132.

KELS, H., PROTZE, J., SITLIVY, V., HILGERS, A., ZANDER, A., ANGHELINU, M., ... LEHMKUHL, F., 2014 - Genesis of loess-like sediments and soils at the foothills of the Banat Mountains, Romania–Examples from the Paleolithic sites Românești and Coşava. Quaternary International, 351: 213-230.

MUREȘAN, Ș., IANĂȘ, D., 2012 - Representation Of The Banat Mountains In The Cartographic Documents Of The 18 Th Century. Review of Historical Geography and Toponomastics, VII (13-14): 145-154.

ONET, A., DINCĂ, L.C., GRENNI P., LASLO, V., TEUSDEA, A.C., VASILE, D.L., ENESCU, R.E., CRISAN, V.E., 2019 - Biological indicators for evaluating soil quality improvement in a soil degraded by erosion processes. Journal of Soils and Sediments, 19(5): 2393-2404.

SIDOR, C. G., POPA, I., 2015 - Influenţa parametrilor meteorologici lunari şi periodici asupra creşterii radiale a bradului, pinului silvestru şi laricelui din Banat. Bucovina Forestieră, 15(1): 55-63.

SITLIVY, V., CHABAI, V., ANGHELINU, M., UTHMEIER, T., KELS, H., NIȚĂ, L., ... & ȚUȚU, C. 2014 - Preliminary reassessment of the Aurignacian in Banat (South-western Romania). Quaternary International, 351: 193-212.

SPÂRCHEZ, G., DINCĂ, L., MARIN, G., DINCĂ, M., ENESCU, R.E., 2017 - Variation of eutric cambisols' chemical properties based on altitudinal and geomorphological zoning. Environmental Engineering and Management Journal, 16(12): 2911-2918.

TÂRZIU, D.R., SPÂRCHEZ, G., DINCĂ, L., 2002 - Solurile României, Editura Pentru Viaţă, Braşov, pp. 98.

TIMÁR, G., SZÉKELY, B., MOLNÁR, G., FERENCZ, C., KERN, A., GALAMBOS, C., ... ZENTAI, L., - 2008 Combination of historical maps and satellite images of the Banat region—re-appearance of an old wetland area. Global and Planetary Change, 62(1-2): 29-38.

ȚĂRĂU, D., ROGOBETE, G., DAVID, G., DICU, D., 2015 - Ecopedological resources from Banat and their suitability for the main agricultural crops and tree species. Research Journal of Agricultural Science, 47(3): 239-245.

*** Amenajamentele Silvice Ale Ocoalelor: Dobra (1997), Hunedoara (1993), Ana Lugojana (1999), Oțelul Roșu (2000), Rusca Montană (1991), Caransebeș (1995), Teregova (1992), Mehadia (19993), Băile Herculane (2001), Bocșa Română (2004), Păltiniș (1998), Reșița (2001), Văliug (1992), Oravița (2008), Anina (2007), Nera (2004), Deva (1991), Ilia (1998), Cosava (2002), Berzeasca (1995), Bocsa Montana (2003), Bozovici (2004), Moldova Noua (2006), Sasca Montana (2007).