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ASSESSING THE ACCESSIBILITY OF RELIEF FOR TOURISM ACTIVITIES. CASE STUDY - COZIA MASSIF (SOUTHERN CARPATHIANS, ROMANIA)

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Abstract: Relief, through altitude, specific landforms and processes, through the morphology of valleys and interfluves, influences the practice of different types of tourism in a given area. It can be considered a factor of favorability or restrictiveness for the development of tourist activities. Restriction is mainly given by the degree of accessibility of the landforms through its morphometric and morphographic parameters. In this context, this study aims to assessing the accessibility of landforms by analyzing a series of factors (declivity, land cover, road network), determining the accessibility by sectors of the tourist routes, highlighting the parameters with the greatest importance in calculating accessibility, determining the degree of difficulty of tourist trails, as well as the identification of areas where low accessibility generates specific forms of tourism (alpinism and climbing). The study area is represented by Cozia Massif, located in the South of the Southern Carpathians and enrolled almost entirely in the area of Cozia National Park. The accessibility of the massif was determined by the analysis of three factors (declivity, land cover and transport infrastructure) which constituted the main input data of the applied model. Intersection of parameters has led to the establishment of accessibility ranges for both the entire mountainous area and, in particular, for the tourist routes. The results showed that in a proportion of 43.41%, the massif has average accessibility, which offers the possibility of developing various types of mountain tourism. The transport routes

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inside the massif amount to about 162 km, of which 56 km are marked tourist trails. They mostly have high and medium accessibility (31.38% and 41.77% respectively).

Key words: relief, tourism, accessibility, tourist route, Cozia Massif, Southern Carpathians, Romania

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INTRODUCTION

The relief is the main component of the geographic environment that contributes to the tourist potential of the mountainous area, through the multitude of landforms with high attractiveness, which can be constituted in tourist attractions or tourism-generating resources (Cocean, 2011). The types of tourism practiced in a certain mountainous area, as well as the location of the tourist infrastructure, depend on the morphometric and morphographic parameters of the landforms, which gives it the role of physical support (Muntele & Iaţu 2006). The relief is important for touring activities and the overall viewing possibilities of the landscape due to the belvedere points it offers, or by the landscape background function when it is not the main attraction (Cocean, 2011; Gozner, 2014). Landforms can be considered a limiting factor for tourism activity due to morphometric and morphographic characteristics that may restrict access to some tourist attractions, as well as the presence of present-day geomorphological processes (Comănescu et al., 2010; Gavrilă, 2012). Accessibility has been the subject of study in many scientific fields, being defined differently according to the purpose of the evaluation. Together with the physical accessibility that is the subject of this paper, there are other types of accessibility used in different disciplines (mental, social, organizational, financial, virtual). They include in the analysis both the proximity of sites and the possibility to benefit from certain services (sanitary, educational, transport, financial, commercial, tourist, recreational) and individual characteristics (personal experiences and needs, ability to understand and use the facilities of a space) (Kıvanç, 2011; Kwan, 1998; Makri, 2002).

Physical accessibility refers to the degree of difficulty in achieving spatial objectives that may be institutions in the urban areas or landforms with tourist importance in mountainous areas (Clius, 2012). In general, physical accessibility is given by the distance to the point of interest, the length of time spent traveling, the variety of transport, the ability to benefit from certain services (attributes of the place), but also the constraints, abilities and personal experiences (characteristics of the individual) (Neutens et al., 2007; Dong et al., 2006; Kwan, 1998; Miller, 2003; Kwan, 2004). Therefore, two accessibility approaches are seen - "accessibility of place and of the individual" (Kwan, 1998) – selected according to the objectives of the scientific approach. This approach focuses on spatial accessibility analysis, independent of the attributes of individuals, highlighting the difficulty with which certain points or objectives can be achieved by different people.

In the literature have been numerous attempts to define the concept of physical accessibility. Clarck (1979) defines accessibility in natural areas as a recreational opportunity. Accessibility can be considered, according to the US Department of the Environment (1996), the possibility of reaching a spatial objective without significant efforts. In the sense of Joly (1999), accessibility is a geographic concept with a significant role in transport planning to facilitate access to different points. Chen (2000) treats accessibility as an important index of the ease of movement of persons in a given territory. Kwan (2003) considers accessibility as being the possibility to reach a certain place in optimal conditions of safety, comfort, complexity and speed of travel, to achieve a

goal. Accessibility therefore depends on the degree of difficulty to reach a point, imposed by the distance and time taken to the objective, the risks associated with the movement and the characteristics of the transport infrastructure. Accessibility analysis is a necessity as it is a very important factor in the development of territorial strategies and planning (Makri, 2002; Juliao, 1999; Halden et al., 2000; Radke & Mu, 2000). These planning policies aim at "better distribution of population and activities in the territory", which is why accessibility "expressed in time, distance or cost" should be assessed in the early stages of this approach (Juliao, 1999). Accessibility is therefore an essential factor in planning different socio-economic but also recreational activities, also in view of its important role in managing protected areas (Boers & Sottrell, 2007; Miccadei et al., 2014).

Accessibility assessment does not only result from the need to inform tourists about the possibility of achieving the proposed objectives but also of protected area managers. Travel route informations are useful for managing recreational resources, monitoring, assessing and arranging routes in order to reduce the impact of tourism activities on them (Tomczyk, 2011; Pickering, 2007; Brown, 2011; Önal et al., 2007; Mullick, 1993; Tóth et al., 2010). Concerns about contextualizing and modeling the accessibility of relief are also present in Romanian literature (Gheorghe, 2009; Comănescu et al., 2010, Cocean, 2011; Clius et al., 2012; Bulai, 2013; Alixăndroae, 2014). These works address the issues of tourism in general and mountain tourism in particular, and the role of natural or anthropogenic factors in the qualitative or quantitative assessment of accessibility. In the mountainous area accessibility is influenced by a number of factors imposed by the local characteristics of the landforms (morphometry, morphography, morphodynamics), the quality of the infrastructure and the type of means of transport, but also by the land cover. This study has as a general objective the assessing of the accessibility of Cozia Massif and the determination of the degree of difficulty of the tourist trails as a whole and by sectors.

STUDY AREA

The study area is represented by Cozia Massif, located in the Eastern part of the Southern Carpathians, in the south of Făgăraş Mountains (Popescu & Călin, 1987) and included almost entirely in the area of Cozia National Park (Figure1). It was declared a protected area II IUCN category - National Park in 1990 by Government Decision no. 7/1990 and confirmed in 2000 (Law no. 5 / 2000). Since 2007, it has been declared a site of community importance (ROSCI0046 Cozia) and special protection area (ROSPA 0025 Cozia-Buila Vânturariţa), being integrated into Natura 2000 network. The aim of Cozia National Park is to protect and conserve landforms and representative habitats at national level and to maintain biological diversity at regional level.

From a geological point of view, Cozia Massif is a crystalline horst composed of gneisses and par-gneisses. Peripheral sedimentary formations are sandstone, limestone, marl, breccia, conglomerate, sands that make up Faciesul de Gosău, Brezoi Formation, Turnu Sandstone, Căciulata layers, Călimăneşti Conglomerate (Geological map, 1:50.000, sheet Călimănesti L-35-97-B). Fault systems have caused the massif uplift by 800-1000 m in relation to the surrounding area, thus obtaining the appearance of a "rocky monolith" that impresses through massiveness and steepness. The lithological, tectonic and climatic conditions in which the massif was modeled gave rise to a stepped relief, converging to the highest point of the massif (Ciuha Mare Peak - 1668m), with sharpened interfluves, needles, rocky towers and steep slopes with heights of hundreds of meters (Popescu & Călin, 1987). The touristic potential of the massif is given by ruiniform landforms (towers, chimneys, natural arches, bench, sewer, sharp edges), steep walls, waterfalls, stone gates, caves and the presence of Cozia Gorge. The elements of the geographic environment of

Cozia Massif offer the possibility of practicing a wide range of tourist activities: mountain hikes and climbing, weekend tourism, curative tourism (in Calimanesti spa resort located at the base of the massif) and religious tourism. The most important tourist spots related to the relief inside the massif are Cozia Peak or Ciuha Mare (1668m), Durduc Peak or Crucea Ciobanului (1568m), Bulzu Peak (1665m), Şoimului Peak (1281m), Pietrele Vulturilor, Colţii Foarfecii, Turnul lui Teofil, Poarta de Piatră, Gardului Waterfall, Urşilor Cave etc., many of which are considered geomorphosites.

The access infrastructure is predominantly represented by tourist routes and forest roads that have a concentric development, starting from the access points located at the base of the massif to the central part, where is located Cozia Chalet (1573m).

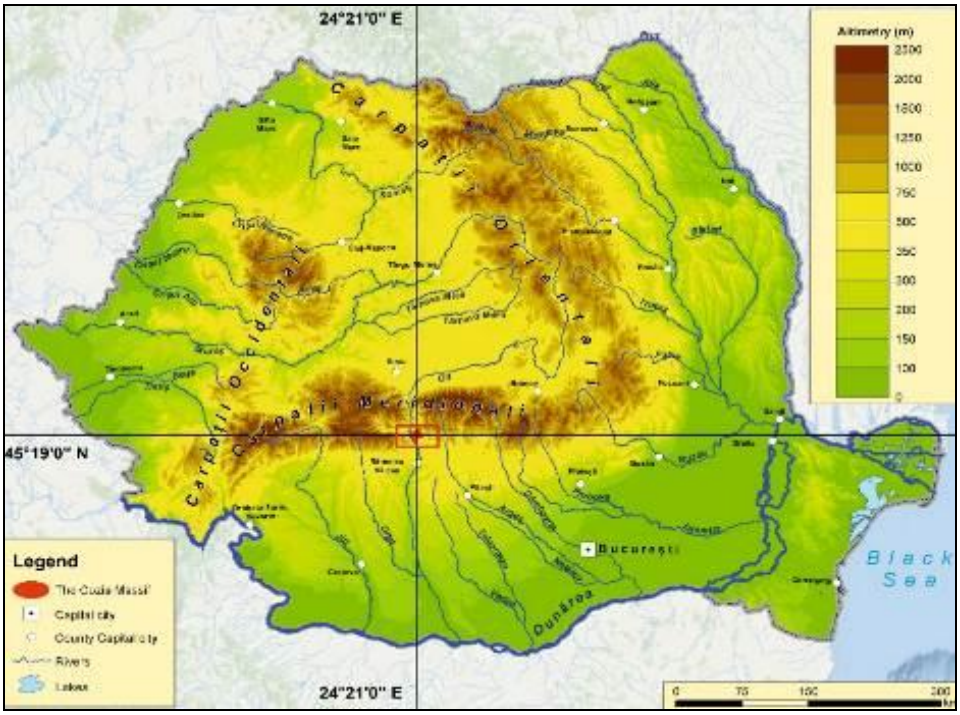

Figure 1. The geographical position of study area (Source: www.geo-spatial.org)

METHODOLOGY

Assessing the accessibility of landform for tourism activities required the creation of a database of topographic information, land cover and transport infrastructure. For this analysis, slope is the most important element of the relief and resulted from the Digital Elevation Model (DEM), which was obtained on the topographic map at 1: 25,000 scale. Data on land cover and transport was extracted from orthophotoplans from 2012. This database was supplemented with field-based information from the Garmin 64st GPS, which mainly focused on tourism routes (high-risk sectors, belvedere points) (Figure2).

The first step was to determine accessibility based on slope values and land cover. These parameters were classified into 5 classes and received scores proportional to accessibility levels. The most accessible slopes (1) record values of 0-100, and the most difficult to access, values above 400 (5). The land cover has been reclassified according to the type of vegetation that requires a certain degree of visibility and accessibility for

tourists. Grassy vegetation (meadows, grasslands, etc.) was considered the most accessible (1), while rocks represent the areas with the lowest accessibility (5) (Table 1). Subsequently, the two resulting rasters were processed (multiplied) by the Weighted Overlay method. Because the parameters did not have equal influence on accessibility, a differential weighting was taken into account (slopes - 60%, land cover - 40%).

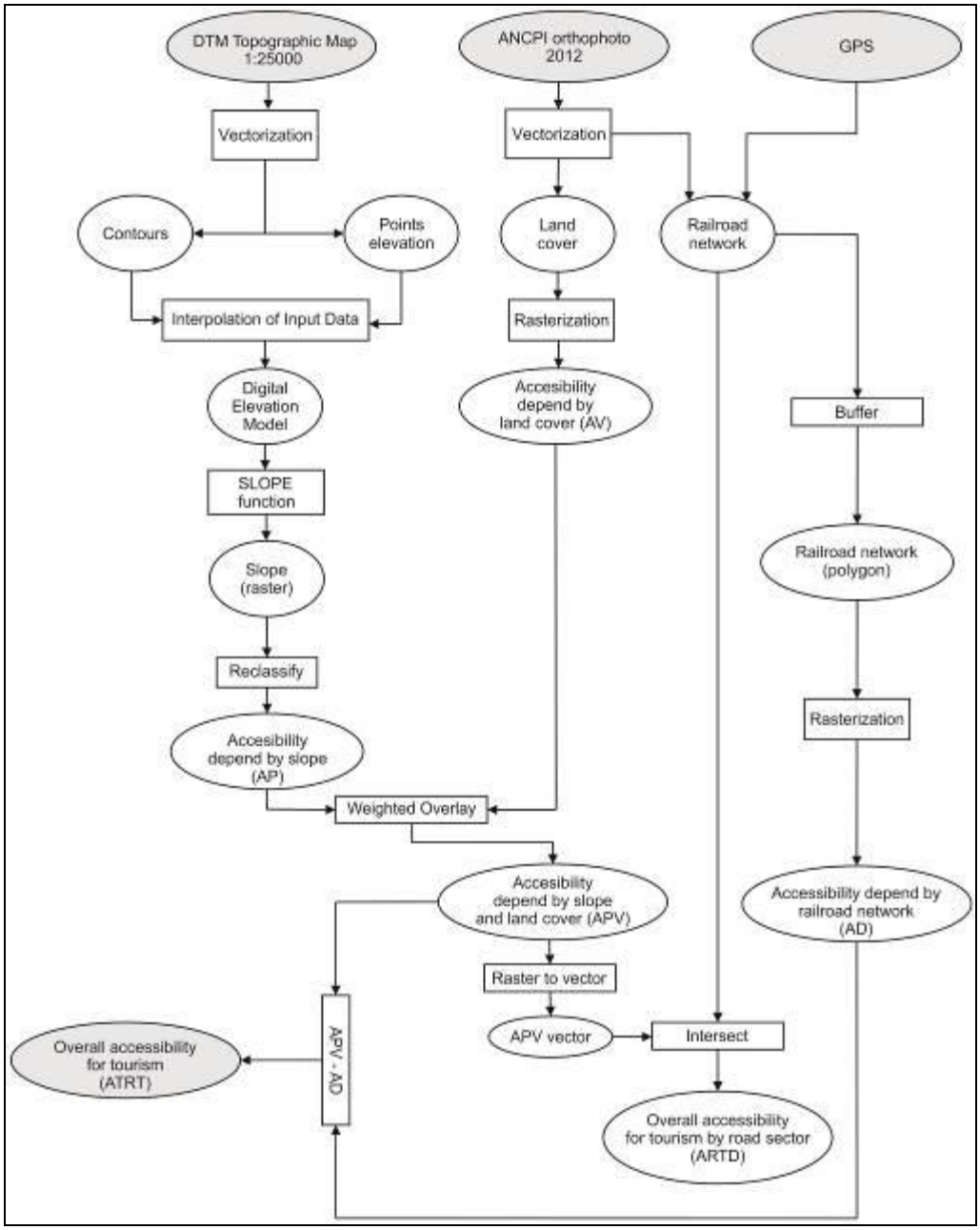

Figure 2. The methodological approach

In the next step, accessibility of relief was calculated, including in the analysis data about the type of infrastructure and means of transport. The method involves converting paths from vector format to raster using the Buffer function. The size of the area of influence of the transport network was determined by the accessibility and importance of the roads (Table 2). In order to be included in the analysis, these data were rasterized, resulting in a grid with two values: 0 for areas without infrastructure and 1 for spaces crossed by communication paths. Subsequently, the difference between the accessibility achieved in the first stage and the raster resulting from the road data processing: *ATRT* = *APV* - *AD*, where *ATRT* is total accessibility for tourism, *APV* - accessibility depending by slopes and land cover and *AD* - accessibility depending on transport infrastructure. Thus, the sectors crossed by the means of transport have increased accessibility by one unit.

Table 1. Parameters used to determine landform degree of accessibility

Parameter / Score	**1**	**2**	**3**	**4**	**5**
Slopes (P-grade)	0 – 10	10 – 20	20 - 30	30 - 40	>40
Use (U)	Grassy Vegetation	Deciduous forests Mixtures of forests	Coniferous forests	Swamp areas	Rocks
ACCESSIBILITY	**Very high**	**High**	**Average**	**Reduced**	**Very reduced**

Table 2. Parameters used to determine accessibility by road network

Parameter / Buffer (m)	**50**	**40**	**10**	**5**	**0**
Roads (D)	European National County	Local Forestry	Tourist paths	Other paths	No roads
ACCESSIBILITY	**1**				**0**

Accessibility on road sectors required transformation of relief accessibility depending by slopes and use of raster format in vector format, then its intersection (Intersect) with the road network. The results consisted of obtaining roads by sectors, each sector having a value in accordance with the degree of accessibility (1 - very high, 2 - high, 3 - medium, 4 - low, 5 - very low). Finally, the lengths of the road segments corresponding to each accessibility class were calculated. In order to highlight the influence of the parameters mentioned in the equation of landform accessibility for tourism activities, scatter plot graphics were made in order to determine the correlation of these variables. Another method of analyzing the accessibility of mountain roads is represented by the profile on representative trails providing information on the morphometric parameters (segment slope, average slope of the route, level difference, total length of ascending and descending sectors), land cover, sectors with high risk of injury, total route length, total walking time and intermediate times. This was done using the Global Mapper software that used the terrain numerical model obtained by vectorizing the contour lines on the topographic map 1: 25,000, as well as the data recorded by a GPS device (Garmin 64st) while driving. The profile was processed in Corel Draw graphics program. This approach has the advantage of assessing the difficulty of tourist routes based on a larger number of items considered, but also the possibility of establishing relationship between the elements included in the analysis.

RESULTS

The accessibility obtained on the basis of slope and land cover (Figure 3) reveals the differences between the central part of the massif and the periphery, also evidenced by the geomorphological regionalization of the massif. The crystalline horst of Cozia (Hann 1990), with altitudes over 1000 m, constitutes the central and northern part of the massif and has

lower accessibility values compared to the sedimentary unit located on its southern periphery, characterized by prolonged interfluves with low slopes and altitudes not exceeding 1000 m. In proportion of 45.15%, the area considered in the study shows average accessibility (code 3) corresponding to 20-30° slope areas covered with deciduous forests and mixture.

Areas with **high and very high accessibility (code 2 and 1 respectively)** represent 24.14% of the total area of the massif and characterize rounded interfluves with a slope less than 10 ° and slopes below 20 °, under hardwoods and mix or meadows. This type of accessibility predominates in the Southern and South-Eastern part of Cozia Massif, in the upper part of the hills Păușa, Căliman, Suliţa, Groşilor, Dealul cu Coacăză, at the ridge of Haidor and Pleşa and in the Cocinelor and Mocirlele interfluves. Large and very large accessibility values can be found in the upper part of Muchia Trăznită, Culmea Vârful Omul and in Muchia Turneanu on smaller surfaces. The high accessibility of these areas is demonstrated by the fact that most of the tourist routes were arranged along them.

Low accessibility (code 4, 28%) occupies areas situated especially on the Northern slope of the massif, very steep, elevated along Brezoi Fault. They characterize the slopes with 30-40 °, covered by coniferous and mixture forests, from Culmea Șirul de Pietre, Claia de Piatră, Muchia Vlădesei, Căprăriile, Boldanului, Urzicii, Armăsarului, Cârligul Mare and the slopes of Cozia Peak (1668m), Ciuha Mică (1629m) and Rotunda (1592m).

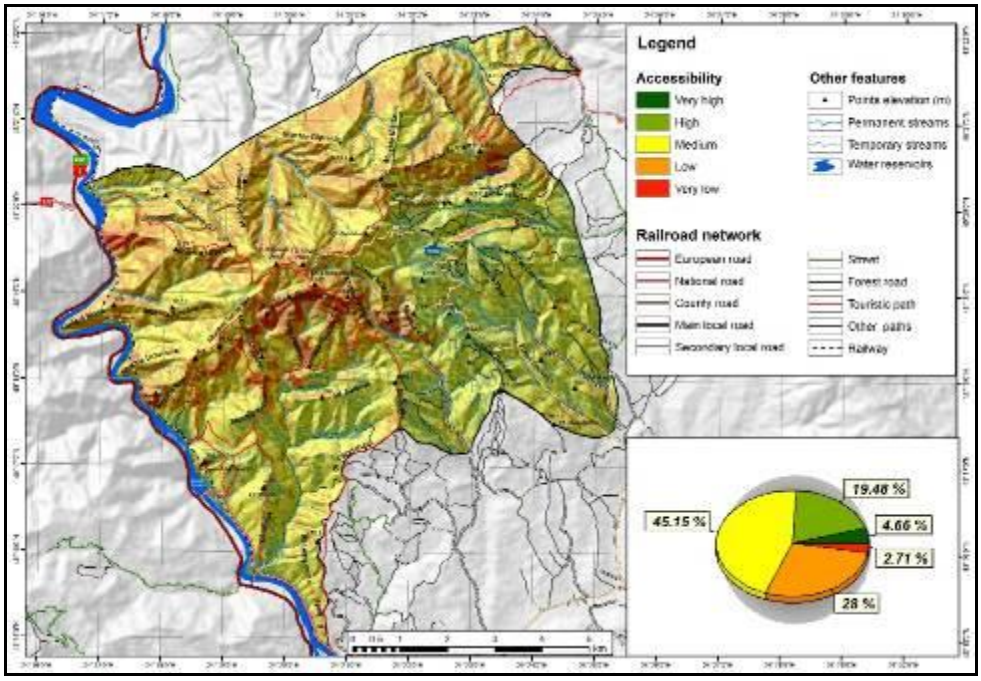

Figure 3. The accessibility depending by slope and land cover

The areas very low accessible or even inaccessible (code 5, 2.71%) for tourists who practice mountain hiking overlap with rocky cliffs with slopes above 40 ° from the edges of Turneanu, Scorţaru, Roşiei, Fruntea Oii, Colţii Foarfecii, Pereţii Gardului, Pietrele Roşiei and Vulturilor, the abrupts of Bulz, Durduc, Soim, Salbatic and Tower of Theophilus. These are made up of gneisses that behave differently at temperature oscillations, which form a ruiniform relief, very attractive from a touristic point of view. The imposing slopes of Cozia have attracted interest and extreme sports

lovers (climbing). Therefore, very low accessibility of the cliffs can be regarded in this case as a tourism generator. Climbing opportunities are offered especially by the walls of Bulzului, Gardului, Foarfecii, Pietrele Vulturilor and Scocul Ursului (Popescu & Călin, 1987). Inclusion in the analysis of the transport network (Figure 4) has led to the increase of areas with high and very high accessibility from 24.14% to 26.53%, namely by 2.4%. This indicates that areas with large slopes, covered by forest vegetation or cliffs with low accessibility, have become more accessible due to the arrangement of tourist routes. These situations are present along all mountain trails. For example, Bulz and Durduc slopes in the sector crossed by tourist routes 1 and 4 have gained high accessibility values due to the installation of cables designed to limit the risk of injury.

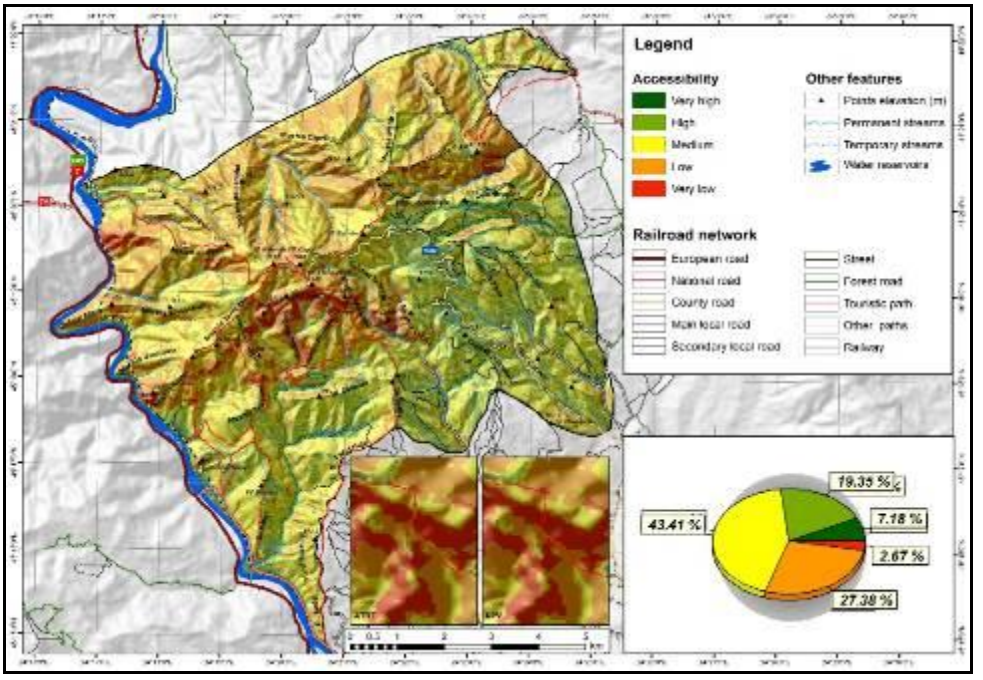

Figure 4. The total accessibility of relief for tourism activities

The transport network allows access to the most important tourist attractions, thus being necessary to inform the tourists about the difficulty of the routes. The transport infrastructure inside Cozia Massif is represented by marked and unmarked tourist routes, by forest, communal and county roads. They have a total length of about 162 km, follow the valleys and interfluves and converge to the central part of the massif where Cozia Chalet is located. In this respect, road accessibility was assessed for each route (Figure 5). Of the total length of the transport routes, about 100 km (62.25%) have high and very high accessibility, about 50 km (30.27%) average accessibility, and the remaining about 12 km (7.49%) low and very low accessibility. The marked tourist trails amount to 56 km and show predominantly average accessibility (42.2%) and high (32.6%). The degree of trails difficulty determined by the landforms accessibility analysis varies according to the weight of accessibility classes in the total length of the tourist trails. Hence, routes with high and very high accessibility on about 50% of the length and very low accessibility below 1% of the total length are characterized by a low degree of difficulty and are represented by routes 1, 3 and 4. The most difficult routes from the point of view of

landforms accessibility are those that present on about half of the total length, very low and low accessibility (routes 9 and 10) (Table 3). Low access areas cross rocky and very steep areas, such as Bulz and Durduc steeps, the slopes of Singuraticul Peak and Muchia Scorţaru.

Table 3. The relief accesibility on the road sector calculated for marked tourist trails

Route no. 1 - Păuşa - Stânişoara - Cozia						
Accessibility	1	2	3	4	5	Total
Length (km)	1,23	3,2	3,12	1,68	0,09	9,33
%	13,24	34,35	33,47	17,96	0,98	100
Route no. 2 - Turnu - Cozia						
Accessibility	1	2	3	4	5	Total
Length (km)	0,63	1,18	4,31	1,32	0,11	7,54
%	8,33	15,6	57,08	17,52	1,47	100
Route no. 3 - Baraj - Stânişoara						
Accessibility	1	2	3	4	5	Total
Length (km)	0,17	1,72	1,27	0,68	0,02	3,86
%	4,46	44,64	32,82	17,63	0,44	100
Route no. 4 - Călimăneşti - Cozia						
Accessibility	1	2	3	4	5	Total
Length (km)	1,38	3,93	4,03	0,93	0,07	10,36
%	13,36	37,97	38,95	9	0,72	100
Route no. 5 - Văratica - Cozia						
Accessibility	1	2	3	4	5	Total
Length (km)	0,8	2,46	3,38	1,33	0,04	8,01
%	10,01	30,76	42,18	16,58	0,47	100
Route no. 6 - Surdoiu - Cozia						
Accessibility	1	2	3	4	5	Total
Length (km)	0,15	2,83	2,69	1,53	0	7,2
%	2,11	39,24	37,34	21,31	0	100
Route no. 7 - Turneanu - Cozia						
Accessibility	1	2	3	4	5	Total
Length (km)	0,54	1,39	2,97	1,05	0,06	6,01
%	9,02	23,05	49,36	17,53	1,04	100
Route no. 8 - Poarta de piatră						
Accessibility	1	2	3	4	5	Total
Length (km)	0	0,11	0,33	0,23	0	0,67
%	0	16,51	48,47	35,02	0	100
Route no. 9 - Vârful Singuraticul						
Accessibility	1	2	3	4	5	Total
Length (km)	0,09	0,1	0,24	0,34	0,08	0,85
%	10,06	11,61	28,51	40,15	9,67	100
Route no. 10 - Cascada Gardului						
Accessibility	1	2	3	4	5	Total
Length (km)	0	0	0,27	0,25	0	0,53
%	0	0	52,03	47,97	0	100
Route no. 11 - Turnu lui Teofil						
Accessibility	1	2	3	4	5	Total
Length (km)	0,22	0,68	0,82	0	0	1,72
%	12,88	39,38	47,74	0	0	100

Based on the percentages of the accessibility classes, pyramid-type graphical representations were presented, showing their distribution within the tourist trails. Different types of standard graphs that describe the degree of difficulty of the trails, based on topographic accessibility, have been individualized. Thus, the pyramid with extended base (bell type) is a characteristic of accessible routes, with little difficulty. As the accessibility decreases, the base continues to decrease (amphora pyramid type),

developing the pyramid's median midline for medium-difficulty routes or the higher one for difficult-to-reach routes. These models can be very useful in planning new routes, the accessibility of which can be determined by reference to the proposed model.

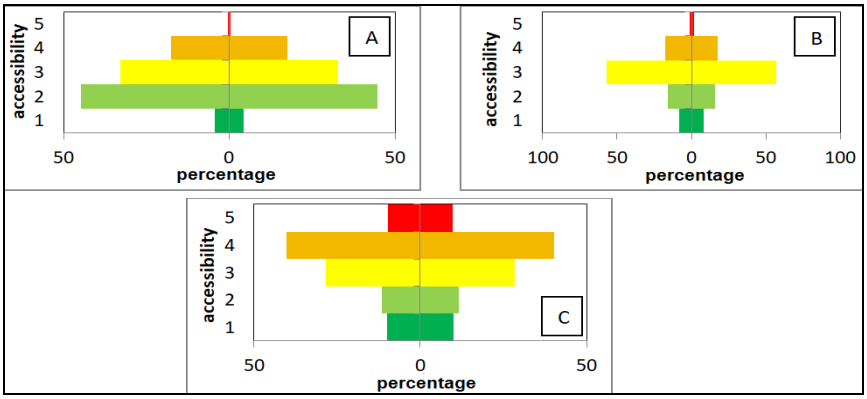

Figure 5. The degree of difficulty of touristic A - low (T3), B - medium (T2), C - high (T9)

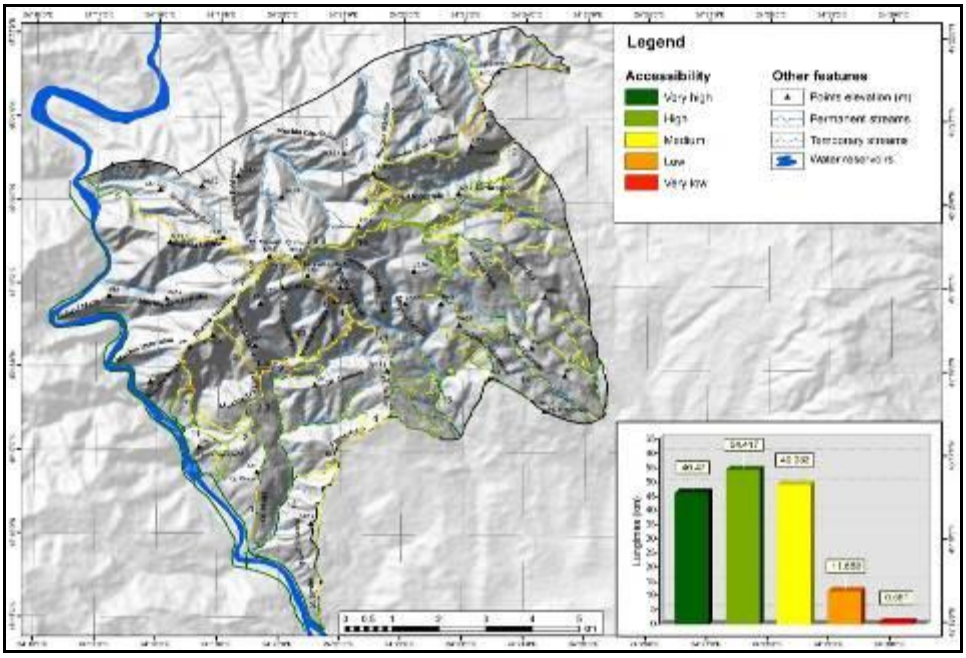

Figure 6. The accessibility of relief for tourism activities on the road sector

DISCUSSION

Cozia Massif has mostly medium accessibility. Inaccessible areas or those with very low accessibility have a fairly low share (2.67%), due to topographical conditions, land cover, but also due to the planning of tourist routes. Next, we propose to determine how the analyzed parameters influence the accessibility level of the massif. The evaluation highlights the very dependence of the accessibility on the slope values, as proved by the correlation coefficient R = 0.63 (Figure 7). This aspect is highlighted by

the arrangement of hiking trails along the rounded interfluves or valleys (routes 1, 4, 6, 7 and 13, 14, 15) avoiding areas with very rough or abrupt landform. Accessibility is also influenced to a large extent by the characteristics of the vegetal cover (R = 0.45) (Figure 8). The vegetation-free areas are especially rocky slopes and very steep slopes from the central part of the massif, with a high degree of attractiveness but difficult to cross (1 and 4 routes in Bulzu and Durduc abrupts). The inclusion in the analysis of the parameters regarding the transport infrastructure inside the massif aims at highlighting the influence of the road network on the accessibility degree.

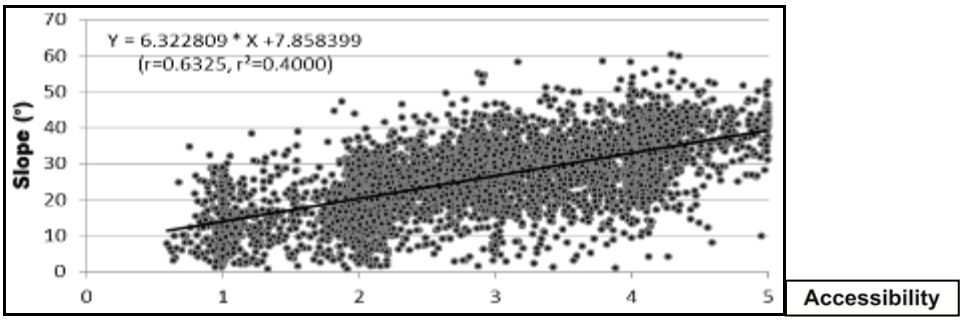

Figure 7. Relationship between accessibility and slope

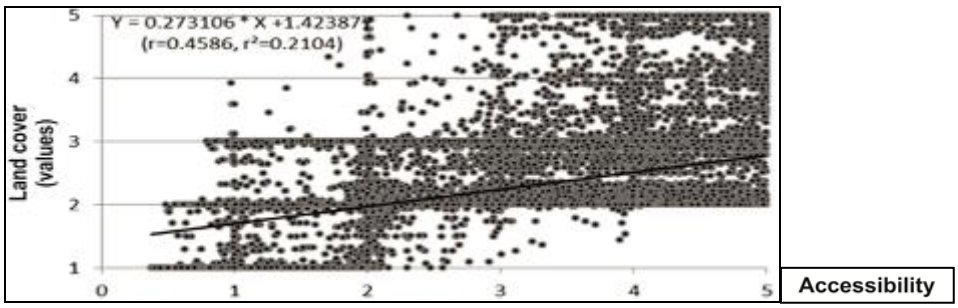

Figure 8. Relationship between accessibility and land cover assigned values

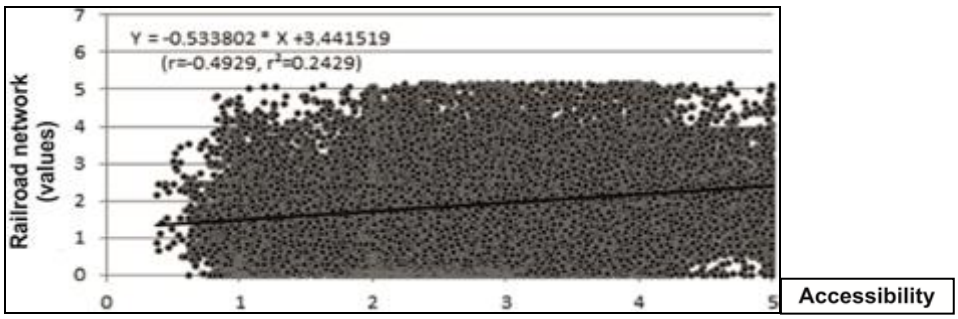

Figure 9. Relationship between accessibility and road network assigned values

The high correlation coefficient of 0.49 (Figure 9) demonstrates the interdependence of the two variables. For example, arranging routes 1 and 4 in the section that crosses the steeps of Durduc Peak has increased the accessibility of this area. Following the analysis of the three parameters that formed the basis for assessing the

accessibility of the massif for tourism activities, we can see that the most important factor in the determination of accessibility is the relief through the morphometric and morphographic characteristics, followed by the road network and the land cover.

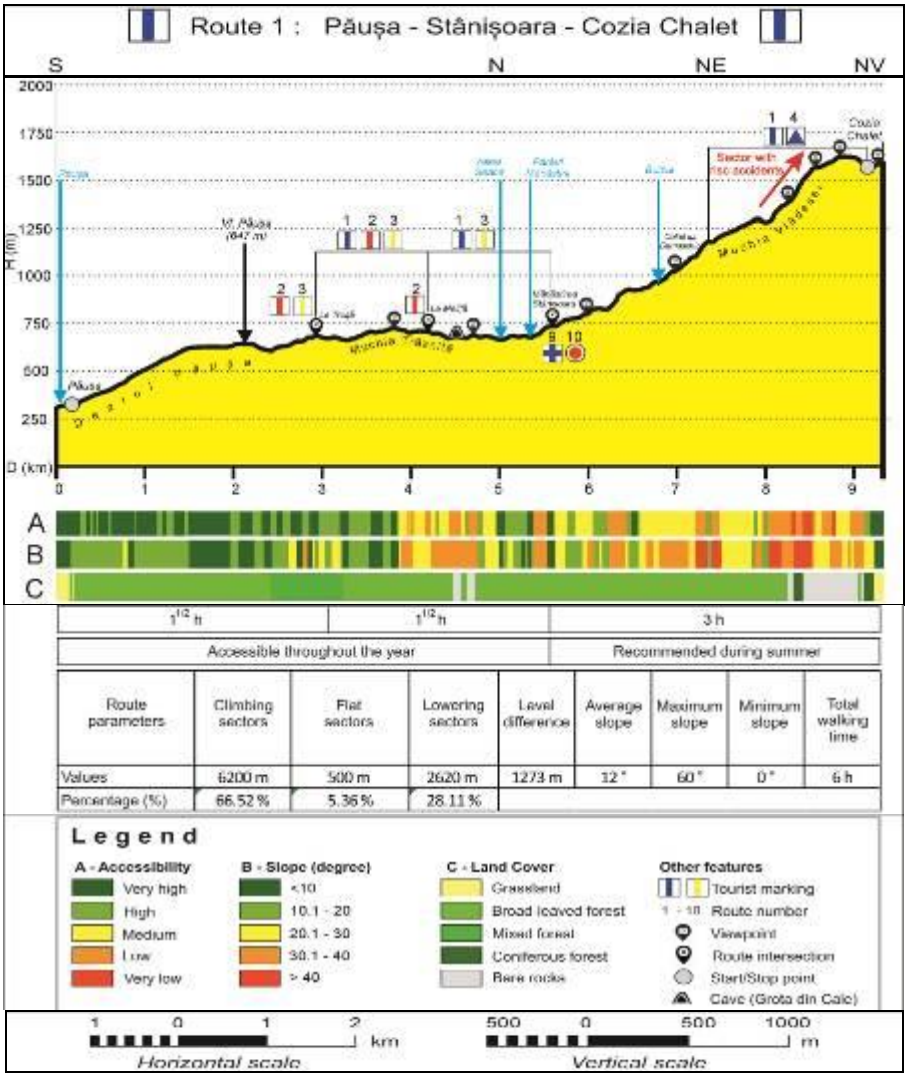

Figure 10. The longitudinal profile and its features for the touristic route 1 (Păușa – Mănăstirea Stânișoara – Cabana Cozia)

Another way to correlate the elements considered in the analysis, in the calculation of accessibility, is represented by the profiles made along the tourist trails. They offer the possibility to determine the difficulty of the routes based on a much larger amount of information, such as: the total length of the route and the ascending and descending sectors, the average and sectoral slopes, level difference, land cover, high risk areas, accessibility by road, accessibility during the year, total walking time and intermediate times, points of connection with other trails and belvedere points (Figure 10).

Figure 11. The touristic route 1 Păușa – Stânișoara – Cozia Chalet: a) Intersection la Troiță; b) The sector with very high accessibility; c) Cave Grota din Cale; d) Intersection „La Meliță"; e) Marking belvedere point; f, g) Point of view towards Cozia Ridge and Pausa Valley; h) Bridge- Gardului Valley; i) Poiana Stânișoara; j) Bulzului Valley; k) Belvedere point „Colțul lui Damaschin"; l) Vlădesei Edge; m, n) cables; o) Cozia Chalet; p) Belvedere point Ciuha Mică

For example, the number 1 tourist route, marked with a blue stripe, was chosen from Pauşa to Cozia Chalet. This is the main route that can be reached from Calimănesti resort and presents numerous points of tourist importance: caves (Grota din Cale), abrupts, needles (Colţul lui Damaschin), "stone faces" (Bulzu - Durduc area), belvedere points and connection with other tourist routes. The configuration of the route demonstrates the geomorphological diversity of the massif: the first part is along Păuşa Hill, with soft slopes, which determines a high degree of topographic accessibility; then the trail crosses sectors with a lower accessibility such as Muchia Trăznită and the abrupts of Muchia Scorţaru; the last part of the route has a more pronounced climb because it is in the crystalline area of the horst, characterized by steep slopes and rocking. In this section, the sector with the highest degree of accessibility difficulty crossing Bulz's "Stone Fortress" („Cetatea de Piatră" a Bulzului) is also met. Here are installed cables that ensure safe crossing of the rocky thresholds, especially during the winter (Figure11).

This tourist route records 47.59% of the total length of high and very high accessibility, and 33.47% average accessibility. Segments with low accessibility are 17.96% and the very hardly accessible places have a value below 1% of the route length. Therefore, from the point of view of topographic accessibility, route 1 presents a small degree of difficulty, but according to Government Decision no. 77/2003, routes that require a 4 to 8 hour walking time and sustained physical effort on certain sectors are included in the medium difficulty category and those with a difference in the range of 500 to 1500 m, in the one with high difficulty. Thus, for a correct approach of the difficulty level of tourist trails, a strictly topographic analysis of accessibility is not sufficient, but a complex, integrated assessment is needed taking into account all route parameters. Analyzing the elevation profile of the route 1, we can conclude that it has an average degree of difficulty.

CONCLUSIONS

Data validation in the field demonstrates the accuracy and effectiveness of the methodology being approached. Thus, the proposed model is an important source for informing tourists about the difficulty of the trails, as well as a support for the competent authorities for the monitoring and arrangement of the mountainous area, including for the managers of Cozia Natural Park. Proper management of tourism activities in protected areas is necessary to limit anthropic pressure on the environment, to reduce land degradation through erosion processes and to adequately capitalize the tourism potential. On the other hand, the relief accessibility map is also a basic tool in the design of new tourist routes, but also in the delimitation of areas suitable for the development of special types of tourism (geotourism, mountaineering, climbing). Complex profiles of accessibility analysis for tourist trails are a complete method of assessing the difficulty level as it includes in the analysis a much larger number of variables with an important role in mountain hiking planning. In a future approach, we propose the development of a mathematical model of accessibility assessment that integrates into the equation the topographic factor, land cover and transport infrastructure, as well as other parameters of interest for tourists (difference in level, length of the route, walking time).

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