

THE ANALYSIS OF MOUNTAIN TOURIST TRAILS WITH GIS METHODS. IN THE LACUL ROȘU (RED LAKE) REGION, HĂȘMAS MOUNTAINS (ROMANIA)

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Abstract. *Almost all tourist trails in Romania were marked in the first decades of the last century. Nowadays these routes are remarked, and represent an important segment of touristic offer. Our research is concentrated on verifying some of the routes characteristics such as length, time. For this we developed a GIS system, which calculates these values, based on region DEM and tourist routes positions. The developed system has a friendly interface developed in Borland Delphi and a powerful GIS background using IDRISI modules. The results obtained from the system are quite surprising, values of the walk time differ very much in some cases from those specified in route descriptions. After verifying the base data and calculation methods in Hășmas Mountains we concluded, that historical route description holds some errors and our analysis system can be a valuable tool in tourist route analysis.*

Key words: *GIS, Lacul Roșu, programming environment, tourist trail*

Introduction

Almost all tourist trails are a result of the 1920's and 1930's. These trails are reconditioned by NGO's and by ecologic associations to promote tourism.

Although today's tourism and services within tourism are much different from those in the last century, the material aspect of tourism got reevaluated and recalculated, tourist trails are a new way of discovering the beauties of the wilderness thus acquiring new knowledge. It's needless at this day to mention that covering some tourist trails is not just healthy but also relaxing and helps maintaining a healthy lifestyle.

The today's tourist demands much more information that is precise and plentiful than its predecessor in the last century, even though he or she can't use to a good extent all the received information. Starting from this necessity of the travel agencies, of the agents and holiday makers this precise and vast database can be a considerable help.

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The description of tourist trails can be classified into two categories. The first part of the description is short and precise, that offers data like: the type of the marking in use, the estimated time one needs to cover it, total length, the biggest elevation level, etc. The description continues with the presentation of the important sights and elements of the trail just as we would cover the trail led by a virtual guide. In this description we will have info regarding the landscape and sights, flora, fauna, existence of springs, shelters, etc. Outlining the differences between the two descriptions is very important because they are stored and processed differently on PC and furthermore search for data in these information databases is done differently.

The Lacu Roșu (Red Lake) Region

The tourist resort is situated 35 km from the town of Bicăz and 25 km distance from the town of Gheorgheni, over the Pângărați pass (1,254 m), that is part of the national road 12C, that connects Transylvania to Moldavia.

Jurisdictionally it belongs to the town of Gheorgheni. The appearing and development of the resort is closely linked to this town. Gheorgheni was first mentioned in 1332 in a papal census. Its development through time is closely related to the development of the sekler society's development. Its harsh and cruel history (social ranking – horsemen, footman, serfhood – the Mongol invasions, plague, Austrian dominance, the 1848 revolution, the First and Second World Wars, the slow evolution of capitalism, centralization of power, socialist economy, the disappointments that followed the 1989 changes and the not so favourable climate) led to the closing in of the population, that became weary, suspicious and held back.

There are 25,000 people who live in Gheorgheni, and the town is the biggest one in the Gheorgheni basin, and an important starting point to numerous touristic attractions (Borsec, Praid, Sovata, Lacul Roșu Lake, Miercurea Ciuc).

On the eastern side of the city, near the road that leads to the Lacul Roșu Lake, lies the 77m long, 33m wide, elliptical shaped Both Castle, which was built at the end of the 15th century and the beginning of the 16th century, and its tale has to do with Rakoczi Ferenc the 2nd's revolution. Further up the Belchia creeks valley, near the 4th km, another creek enters the main stream, where a fine tourist resort was established, where wooden cabins and huts, a motel, ski slopes for beginners, a lake measuring half a hectare awaits the adventurers. At the 5 km mark there was established the finest and best

established ski slope of the region, with ski lift in the lower part of the course. Further upstream at km 6 and 7 two more creeks join the Belchia, the Cerbul spring (5 + 800 m), and the Cianod brook (6 + 600 m) and the water collector of the town is located. After this the main brook heads north.

The next important stop is located at Km 9, where a fine restaurant is located at the juncture of the Moghioros brook with the Belchia brook, from here the road ascends 300m, in just 15 km, to the Pângărați pass (1,257m), located under the Pângărați peak, from where one can have an outstanding panorama over the whole valley and mountain range.

The Pângărați Peak is an important point, from here marked trail (red stripe) leads to the Căliman mountains, following the main crest of the Giurgeu Mountains. The trail marked with a blue stripe leads the adventurers to the Ceahlău Reserve. The red stripe that heads south west follows the main crest of the Hășmas Mountains and leads to the Ciuc Mountains (Dombay 2007).

Descending from the Pângărați pass, we travel near pine forests, and beautiful brooks, on some of these were constructed alluvium stopping dams, and finally as we reach Km 21 we have the first glimpse of the Lacul Roșu Lake, and in the background we see the Suhardul Mic.

One of the Hungarian travelers, Orban Balazs, in its book: *A Szekelyfold leirasa* (The description of Sekler country) relates that the view that greets any tourist is as catching as any unforgettable view of the Swiss Alps, or north Italy's landscapes, not as big, but remarkably beautiful and breathtaking.

The road passing the Oii brook arrives on the right side of the lake, follows the shoreline of the lake till we reach Km 25, where we will find the boat renting small harbor.

The trail that follows the Oii brooks valley leads to the Fehermez Peak, from where the tourists can reach the main crest of the Hășmas Mountains that leads to the mountain cabin at the Piatra Singuratică (Lonely) Peak, on the trail marked with a red stripe.

Using GIS in tourist trails analysis

The purpose of our research wasn't the creation of a GIS database just for one target region. The purpose is to create an analysis system with which we can determine some of the characteristics of the tourist trail. Some of these

characteristics one can find in the description of the trail, as a conclusion they are meant to be compared and verified others are new information.

As a principle the following calculations can be performed with GIS analysis that can offer new information:

- the visibility from some points on the trail
- the visibility of some points
- determining the sunny areas on the trail
- determining the angle of the slopes to different parts of the trail
- determining the quantity of energy necessary to cover the trail's length
- longitudinal profile of the whole trail,

At the same time some figures can be determined just as in the description, like:

- maximum elevation
- time needed to cover it
- distances,

To be able to assess such a database we used as a starting point the digital elevation model and the exact position of the trail. If we want to assess the visibility from the trail, we need to know the height of the neighbouring vegetation.

The big majority of GIS programs are made for specialists and not for any user with limited knowledge of the software. A disadvantage could be that the average user can use this software only after some specialized training (Haidu 1998; Imbroane 1999).

GIS software offer a wide variety of calculus that refer to the angle of the slopes, exposition, visibility, profiles, but could present problems if a travel agency's agent needs to analyze it on the spot and answer to questions like: what is the average elevation along a single slope? What is the quantity off energy that one requires to cover that part of the trail? etc.

The element missing from GIS software is that of offering the possibility of controlled supervision that could be accomplished according to some predefined algorithms. This could lead to the results accomplished by the user, without the user knowing the calculating methods and the steps of the analysis, but through the existence of some predetermined variables it could

be personalized. So there is a need to some predefines software for GIS, specialized in some specific areas of research.

To develop such products we need two things: the first step is the creation of the base of the system, or to integrate some of the existing GIS algorithms into our own. The first method is not popular because it's not cost-effective; the second one would be accepted if we can combine multiple elements from different parent software's.

Almost all GIS systems offer the possibility of automatic calculus, based of script languages, macros or graphic models, but these lack the parametrized interaction or they lack control structures. There is a possibility of integrating these systems into programming environments. By this the interface receives a friendly appearance, uses GIS operations without letting the user notice this.

GIS and the programming environments

Spatial modeling is a key concept in GIS systems. (Magyari-Sáska 2006) The effort for the development of a modeling algorithm is proportional with the complexity of the problem. For a research field and a studied problem the spatial analysis means the definition of the model variables which has to be considered and the proper specification of the calculation methods for their determination. After this the model can be formularized.

In many cases a developed model can be reused in other situations considering the local characteristic of the geographical space. The necessary commands, their type, number of execution, used parameters are dependent of the given situation. There also exist operations which requests rising flexibility and user intervention (Chang 2008).

The analysis model could contain repeating of some steps, eventually with changed parameter values. In these cases the manual reexecution of the commands would require a reentrance of a whole set of parameters, the majority of them without being changed.

That's why we consider that a calculation model is advisable, through which:

- the complex analysis can be reexecuted just with the changed parameters, without the reentrance of the unchanged ones

decisions can be made, some of then hard coded in the analysis algorithm while the other ones to be made by the human operator (flux control).

Tab. 1. – The modeling possibilities of several GIS systems

	Possibilities of internal modeling	Possibilities of cooperative modeling	Possibilities of external modeling
IDRISI Andes Edition	graphical programming macros	IDRISI API	inovaGIS
ERDAS Imagine 8.4	graphical programming macros script language	C-Toolkit + Visual C++	
ArcView 3.2	script language	AVPython + Python	inovaGIS
ArcGIS 9.2	Batch Model VBA	MapObjects ArcGIS SDK	inovaGIS

Almost every GIS system has same automatization procedures. These can be grouped in the following categories:

- internal, which are incorporated in the given GIS system, operating just in the GIS environment, usually not offering the possibilities of a programming environment such as object handling, control structures (decisions, loops, etc.), recursivity, interoperability. In this category the following possibilities can be found: macros, script languages, graphical programming.
- cooperative, meaning that the GIS system can collaborate with a programming language by containing it or having the possibility to be called from that programming environment. In this category we can found the embedded programming languages (ex. Avenue, Python) or high level programming languages which can integrate the functionality of GIS systems (ex. IDRISI API) (Imbroane 2003, Magyari-Sáska 2007).
- externals, complete systems which contains the data access part of existing GIS databases but usually without a properly developed analysing command set (ex. inovaGIS)

Each of the above mentioned categories can be considered as a programming environment for GIS analysis, as the commands are executed one after other without a necessary human intervention.

Through our research the following four GIS environments were studied from this point of view: IDRISI Andes Edition, ERDAS IMAGINE 8.4, ArcView 3.2 și ArcGIS 9.2 (Table 1).

The developed system and its results

For this research there were 6 trails chosen from the 12 existing one in the vicinity of the Lacu Roșu (Dombay 2002, 2004). Table 2 shows the major

characteristics of these trails. In the even rows of the table there are marked the followings: type of marking, time to cover it, length, maximum elevation, trail's difficulty.

Tab. 2. - The characteristics of the trails around Lacul Rosu Lake Source: after the <http://mars3696.hu/rokaly/index-turaajanlatok.php?a=gyilkosto> map

The center of the resort (967) – the Stone Balcony (1007) – Marton Ferenc's trail – Păstrăvie (993) – Debarcader = harbor (983) - The center of the resort (967)				
Red cross	1 hour	3,5 km	40 m	easy trail
The Cupaş brook's juncture (944) - Piciorul Cupaşului (1080) – Bicz Straights 29km (850)				
Red cross, red circle	1 hour	3 km	136 m	easy trail
Resort center (967) – Veresgheu saddle (1011) – Calea Vărarilor – Cifra Saddle (1002) – Bicz Straights (850)				
Yellow triangle	1 hour	3,5 km	44 m	easy trail
Resort center (967) – Under the Veresgheu Saddle – Dosu Ghilcoşului meadows – Ghilcoş Cliff (1378)				
Red triangle	2 hour	4 km	411 m	accessible in any season
Harbor (983) – Ghilkos meadows (1210) – Ghilcoş Cliff (1378)				
Blue circle	2 hour	3,5 km	395 m	accessible in any season
Resort center (967) – Bucur Vila (990) – Suhard Chalet (1091) – Sudarului Saddle (1202) – Sudardul Mic Peak (1345)				
Blue triangle	1 1/4 hour	3 km	378 m	accessible in any season

To assemble the system of analysis there were used (figure 1):

- programming environment Borland Delphi 7, to create the user's interface and as a frame of development for applications
- IDRISI Andes Edition, it can be easily adapted and integrated into Delphi
- InovaGIS, a visualization library for many types of file.

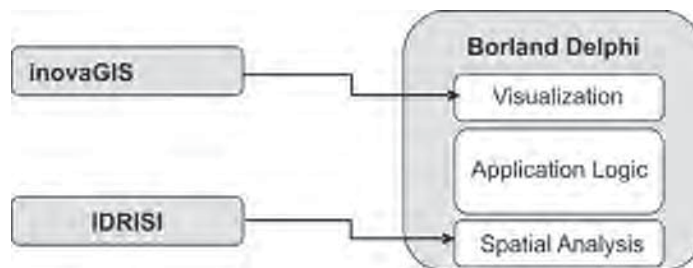


Fig. 1. - The function scheme of the elaborated system

This newly developed system requires from any host PC the prior installation of IDIRISI and of inovaGIS software.

The modifiable parameters of the application are: the tourist trail, the meal of the person, conditions of visibility.

By the selection of one of the trails this data is generated:

- the length of the trail, taking into consideration the elevation corrections as well
- the maximum and minimum points of the trail and the biggest elevation
- the total length of ascends and descends on different categories of slopes
- the necessary time to cover it taking the inequalities of the trail into consideration
- the calories burnt by one individual if one meal is taken into consideration

If the user requires the system can provide information regarding:

- visibility from a selected point

The visibility of a selected point

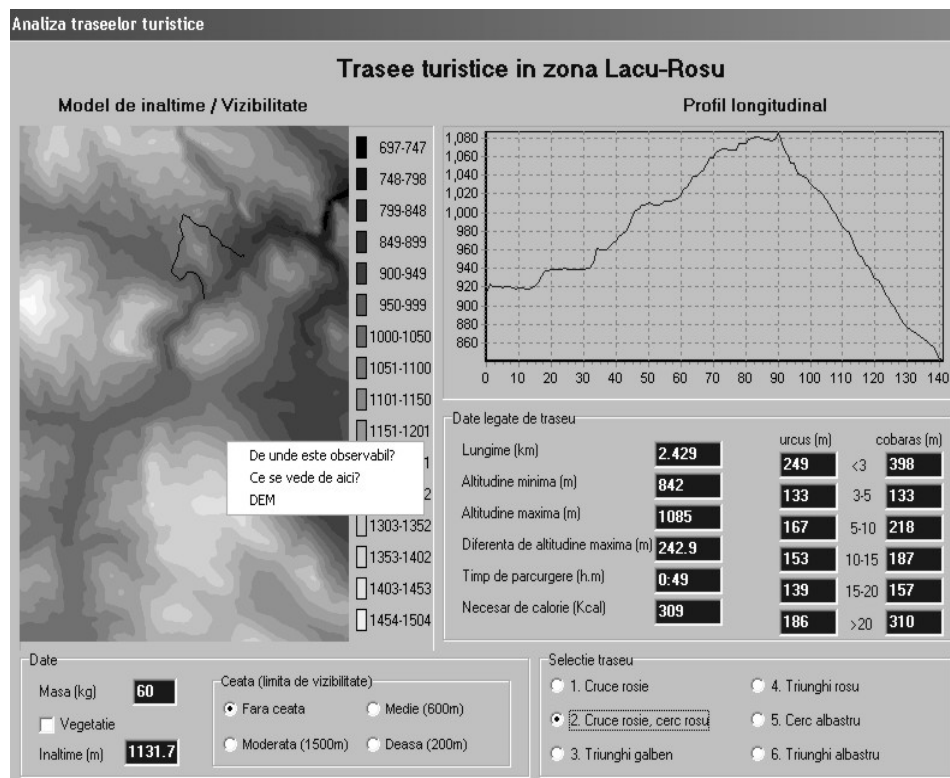


Fig. 2. - Interface of the developed system

The results that can be obtained from this database can be seen in Table 3. The italic values represent the give data form touristic maps.

Tab 3.- The calculated characteristics of the tourist trails near the Lacul Rosu

	1	2	3	4	5	6
L	3.946/3.500	2.429/3.000	4.436/3.500	2.872/4.000	2.193/3.500	2.203/3.000
minH	977.6	842.0	878.8	970.1	990.1	962.0
maxH	999.6	1085.0	1020.1	1373.4	1376.5	1330.7
dH	22.0/40.0	242.9/136.0	141.2/44.0	403.3/414.0	386.4/295.0	368.7/378.0
T	1:03/1:00	0:47/1:00	1:19/1:00	1:00/2:00	0:52/2:00	0:49/1:15
E	314	338	514	432	407	364
Lu	53	186	198	216	420	335
Ld	72	310	373	17	37	0

The abbreviations used in the table are:

- L - length in km
- minH – the lowest point (meters)
- maxH – the highest point (meters)
- dH – maximum elevation (meters)
- T – estimated time to cover the trail (hour, minute)
- E – the amount of calories burnt (kcal) for a person averaging 70 kg
- Lu – the length of the ascends (above 20 degrees) (meters)
- Ld – the length of descends (above 20 degrees) (meters)

Conclusions

The results can be surprising when we compare the calculated characteristics with the different presented elements from the descriptions. As a first step we verified the vectoring of the topographic maps, setting the maximum possible error to be 10 meters, due to the distortions of the map and the precision of the vectorisation. We tried to verify the correctness of the position of the trails as well, but because the GPS got disoriented in the thick pine forests this couldn't be done accurately. We concluded that the most precise data were registered on the trail leading around the lake. On this trail there isn't a big elevation. We studied the descriptions given in the literature and we discovered some significant differences, like:

- the difference in altitude of the reference points, of those of maximum and of minimum altitudes, the elevation showing higher numbers than the difference between the two;

- trails with portions presenting higher difficulties and registering very close times of coverage from the other segments, but the profile showing these
- some trails and descriptions had one place specified as a starting point but marked somewhere else on the map;

Our final conclusion is that the majority of the trails – at least those in the study region – present estimated numbers and values, and were not registered as a result of a rigorous field study. Although with the perfecting of the existing analytic program, we consider that these inexactitudes can be corrected obtaining accurate and useful data and information for the tourists and for the organizations and agencies as well.

REFERENCES

- CHANG K-S. (2008), *Programming ArcObjects with VBA*, CRC Press, p. 360
- DOMBAY, Șt & MAGYARI-Sáska, Zs (2002), *Studiul de oportunitate privind modernizarea, dezvoltarea și relansarea turistică a stațiunii montane Lacu Roșu*, Faza II, Capitolul 7.6, Ministerul Turismului, Institutul Național de Cercetare-Dezvoltare în Turism, București, pp. 65-72
- DOMBAY, Șt & Magyari-Sáska, Zs (2004), *Managementul activității turistice durabile la stațiunea turistică Lacul-Roșu în cadrul Parcului Național „Bicaz-Hășmașul Mare”*, Volumul celei de a II. Conferințe Internaționale de Geografie, Szeged, Ungaria, pp. 127-135
- DOMBAY, Șt & Magyari-Sáska, Zs (2007), *Posibilitățile dezvoltării turistice în zona Lacu-Roșu*, Studia Universitatis „Babeș-Bolyai”, Geographia, LII, 1, pp. 171-176
- HAIDU I & HAIDU C. (1998), *S.I.G. Analiză spațială*, Editura HGA, București, p. 319
- IMBROANE A. & Codilean A.T. (2003), *Processing Digital Elevation Models Using Avenue*, Studia Univ. “Babeș-Bolyai”, Seria Geographia, XLVIII, Nr. 2, pp.103-112
- IMBROANE A. & Moore D. (1999), *Inițiere în GIS și teledetecție*, Presa Universitară Clujeană, Cluj-Napoca, p.242
- MAGYARI-Sáska Zs. (2007), *ArcGIS software module for calculating the S.P.I. value*, Geographia Technica, No. 2, 2007, Presa Universitară Clujeană, pp. 42-48
- MAGYARI-Sáska, Zs & Haidu, I. (2006), *Posibilități de modelare spațială în mediu programat*, Editura Universității „Al.I. Cuza”, Iași, pp.57-65
- ***, *Programming in ArcGIS using ArcObjects and AML* Available from: <www.dur.ac.uk/resources/its/info/guides/93AMLGIS.pdf>[20 February 2009]
- ***, *Programming in ArcGIS using Visual Basic for Applications*, Available from: <web.mit.edu/gis/www/programming_iap2006> [20 February 2009]