THE DYNAMICS OF THE RAVINATION PROCESSES IN SĂLĂTRUCEL-OLT RIVER BASIN

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Abstract. The dynamics of the ravination processes in Sălătrucel-Olt river basin. In the contact area between the Carpathian and Subcarpathian space, the geomorphological processes have remarkable manifestations through their frequency and intensity. Our observations have focused on the geomorphological problem of ravines, considered processes that affect the anthropic use of space. The study of ravines can be considered complex, through the methodology approached, but especially through the diversity and difficulty of obtaining information, materialized in statistical data strings, from the morphometry and morphodynamics of the relief. In this paper the results of instrumental measurements of land are transposed over a certain period of time, allowing for geomorphological interpretations and analyses.

Keywords: ravine, erosion, aging, observation.

1. INTRODUCTION

The study of geomorphological relief modelling processes involves multiple analyses with an experimental character, for the measurement and quantification of evolutionary parameters. The field experiment in geomorphology is a complex scientific method, which requires extensive specialized knowledge, but also an applied side based on calibrated instrumental measurements, made according to a unanimously accepted methodology, taking into account the particularities and the specificity of the work area.

The Sălătrucel River Basin is a space affected by intense geomorphological processes, among which the ravines have a special role in their frequency and intensity, influenced by local morphometry and morphometry, along with lithology, structure and manifestations of climate elements, especially precipitation regime.

2. DATA AND METHODS

The study was realised on the basis of systematic observations, conducted over 10 years, on ravination processes. Although several areas affected by the

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ravination process were observed, seven ravines, representative of the covered space, as well as a series of evolutionary and morphometric features, were selected for this material.

Instrumental measurements were made using: the Leica NA 720 automatic level, the Bosh GLM - 150 Professional, the topographic rod, the roulette and the compass. For location, the Garmin Map 64 G, GLONASS Satellite GPS was also used. The monitoring of the ravine evolution was done by measurements on GPS points, but especially by the placement of witnesses in the form of wooden poles, but also of metal, on which precise measurements of planimetry and altimetry were made, according to the degree of precision of device calibration.

During the observation period (2005 - 2015), metric data were obtained, which were then processed by statistical cartography techniques.

3. RESULTS AND DISCUTIONS

The Sălătrucel hydrographical basin is located within the Getic Subcarpathians, in contact with the mountainous unit of the Southern Carpathians through the Cozia Massif (Figure 1). Sălătrucelul River is a tributary of the Olt River, the confluence being made at the Călimănești locality in Vâlcea County.

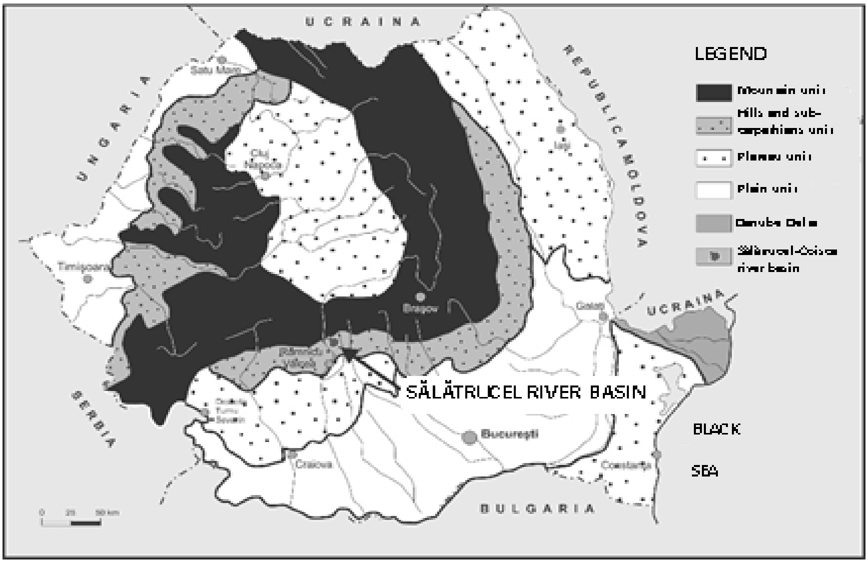

Fig. 1. Geographical position of Sălătrucel Basin within Romania

3.1. Characteristics of geological support

The basin develops on a series of geological formations with a great diversity, namely: gneiss of Cozia, conglomerates and sands of Mătău, sandstone with interlayers of marl, sands and gray clay. In these conditions, there is an appreciable degree of deepening between the central water course and the slopes, at the level of watershed (Achim, Daniela - Paula, Achim, F., 2013). The superficial deposits are predominantly made of clays, marls and sands, which, in correlation with morphometric and climatic features, favour geomorphological processes of erosion: ravination, torrentiallity and landslides.

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3.2. Morphometry of ravines

In order to carry out the study on the ravines in Sălătrucelul River Basin, a series of parameters were necessary, in order to define them as shapes and to set them into dynamic and functional types (Rădoane, Maria, Rădoane, N., Ichim, I., Surdeanu, V., 1999). As can be seen in Table 1, the measured values of the morphometric parameters are specific for the realization of some correlations for the elaboration of the proposed study (D. Bălteanu, 1983).

Table 1. The main morphometric parameters of the studied ravines

Ravine location and the toponym assigned	Slope (‰)	Lenght (m)	Level differ-rence (m)	Average depth (m)	Maximum depth (m)	Average width (m)	Maximum width (m)	Drained surface (m^2)	Slope type
Ravine 1 Dângești	20	280	52	4,5	8,1	18	38	10350	convex
Ravine Seaca	34	170	50	5,5	9,4	8	18	4270	complex
Ravine Plaiul Galben	28	210	51	5,1	7,3	13	28	6320	complex
Ravine 4 Robaia	17	250	28	3,4	8,2	11	33	11330	convex
Ravine 5 Rădăcinești	11	160	19	3,5	5,4	22	35	8400	convex
Ravine 6 Coasta Câmpului	30	197	49	4,8	9,1	6	15	5500	convex
Ravine 7 Robaia	25	220	50	4,4	11,0	12	17	9100	convex

3.3. Analysis through the evolution profiles of the ravine processes.

During the observation period, precision topographic measurements were performed on the Seaca and Plaiul Galben ravines, which aimed to obtain profiles, both longitudinal (valley) and transverse.

In both situations there have been remarkable developments, the ravine suffered numerous changes, in relation to the local conditions and the interaction with the modelling agents. The two ravines were a model of analysis, evolving in natural conditions.

In the longitudinal profile, Seaca ravine is situated at an altitude of 410 m - 370 m. In 2005, the ravine was in an early stage of evolution, with a length of about 70 m, and an altitude difference of 405 - 385 m (Figure 2). The ravine evolved, reaching 165 m in length, having a width of 410 m at the beginning and 370 m at the base.

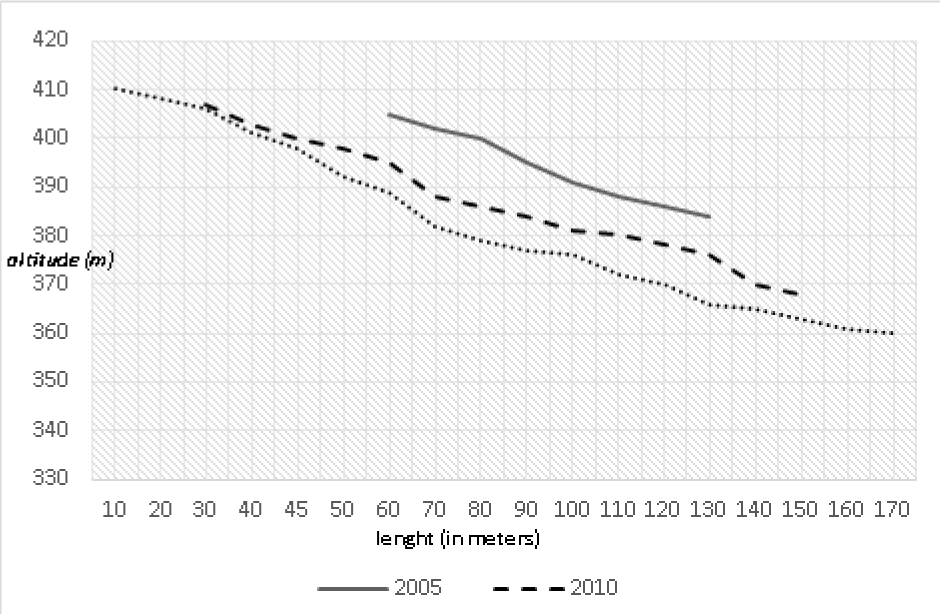

Fig 2. Evolution of Seaca ramp in longitudinal profile

Analyzing the configurations of the resulting longitudinal profiles, by evolving at five-year intervals, their sinusoidal aspect is noted, indicating the succession of the slope values with the appearance of some thresholds during the evolution.

Thus two causes of slope change can be identified:

- the first is determined by the different hardness of sedimentary ravine deposits;
- the second is due to ravine ramifications, being observed that at the confluence points, such as those near the 60 m and 110 m terminals, the lateral sedimentation intake generates thresholds in the longitudinal profile.

In cross-section, the three profiles were obtained by measurements in the lower sector of Plaiul Galben ravine (Figure 3).

During the 10 years of observation, the ravine has undergone intense modelling processes, as follows:

- the width of the ravine has increased from 7 m in 2005 to 22 m in 2010, reaching 20 m in 2015;
- the depth of the ravine has increased from 1.8 m in 2005 to 7.2 m in 2010, a sign of an intensification of the linear erosion process, for five years later, the depth to be reduced to 3,5 m, due to sediment deposits and the development of lateral erosion;

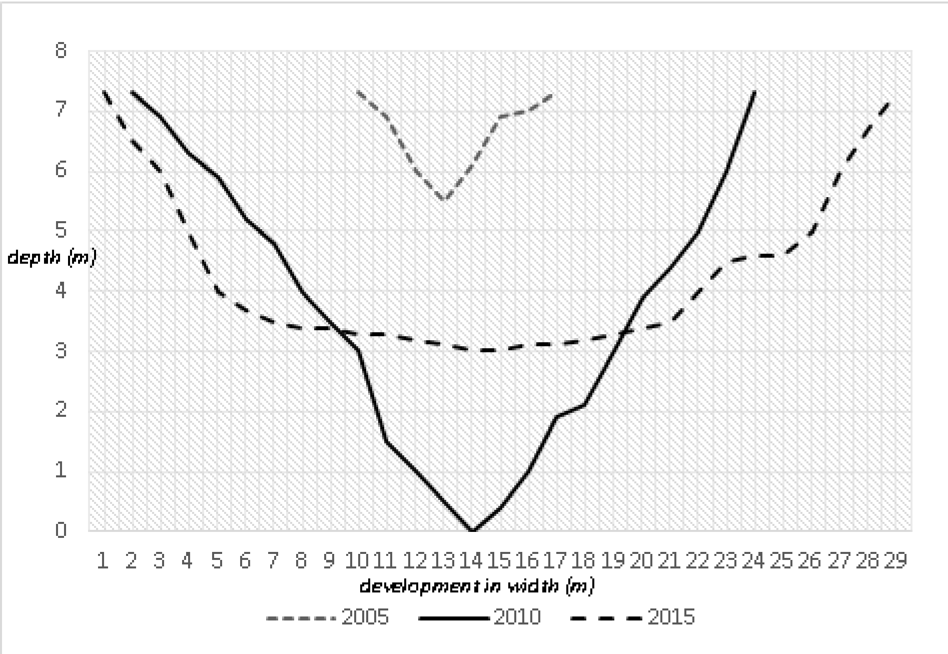

Fig. 3. Evolution of the cross-section of Plaiul Galben ravine

- the cross-section profile has evolved from the sharp "V" to the wide open "U";
- on one of the profile's slopes a step appeared, in the form of a microstructural threshold, due to the resistance of the sedimentary layer to the torrential erosion.

3.4 The relationship between the mean and the maximum depth.

From the comparison of the average and the maximum depth values (Dauphine, A., 2001), it is observed that there is a correlation between the two, thus (Figure 4):

- in the case of ravines where the slopes are bigger, there are differences in values, such as the Seaca ravine;

- bigger depths occur in the middle section of the ravines, or even higher in the case of ravines located in the lower part of the slope. In these cases, the ravines get more water out of the rainfall.

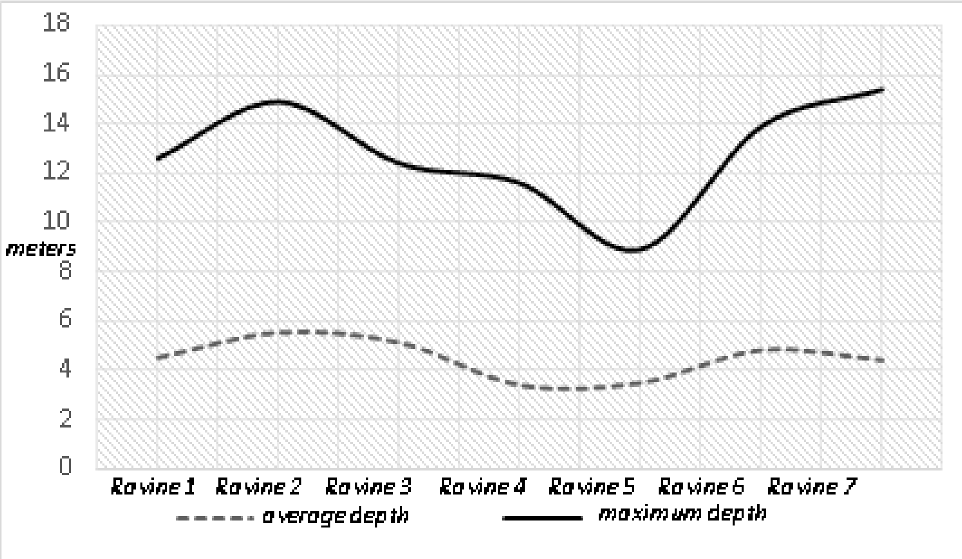

Fig. 4. The correlation between the average and the maximum depth at the studied ravines

3.5. Correlation between vertical erosion and lateral erosion of the ravines

To establish correlations between vertical and lateral erosion, 16 observation points (Figure 5) were chosen, placed in the lower parts of the 7 ravines used for the study.

- in the case of ravines where the slopes are bigger, there are differences in values, such as ravine 2 (Seaca);
- bigger depths occur in the middle section of the ravines, or even higher in the case of ravines located in the lower part of the slope. In these cases, the ravines get more water out of the rainfall.

As a result of the measurements it was found that at this level, as well as the evolution stage of the ravines analysed, the lateral erosion is more intense than the vertical erosion. At some observation points such as 9, 11 and 14, the rates of lateral and vertical erosion processes have very close values, factually materialized by balanced cross-sectional profiles.

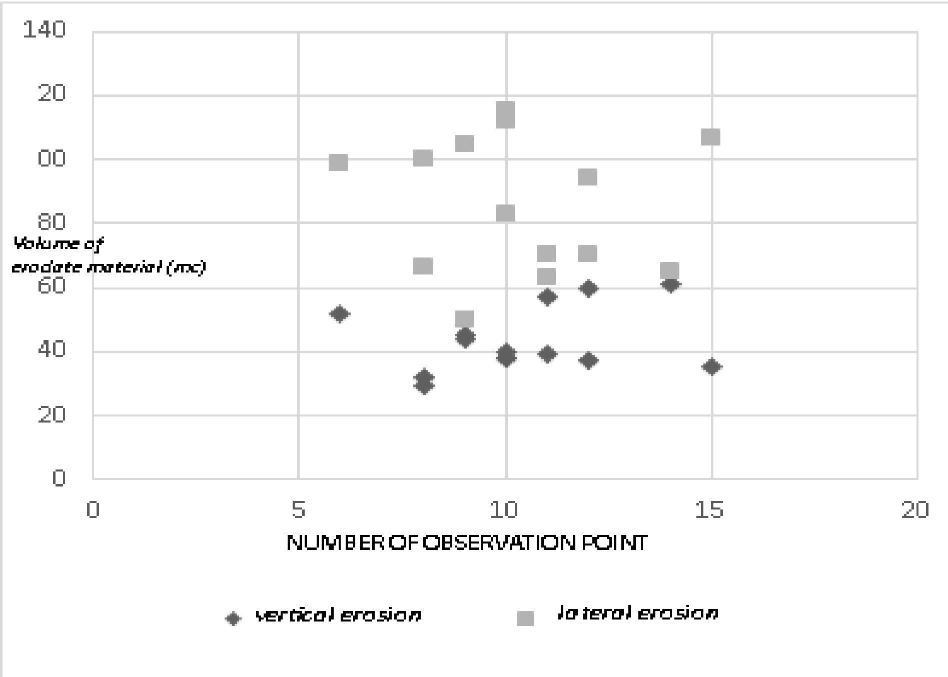

Fig. 5. Correlation between vertical and lateral erosion processes at the lower part of the ravine

3.6. Hydrograph of liquid and solid discharges

The correlation between liquid and solid discharges (Figure 6) shows the degree of evolution through pluvial erosion of the ravines (Irimus, 2006). Short-term light rains have little effect on the ravination process. Instead, long rains are the most effective on ravines, in that they train a considerable amount of sediment (Armaş, 2006).

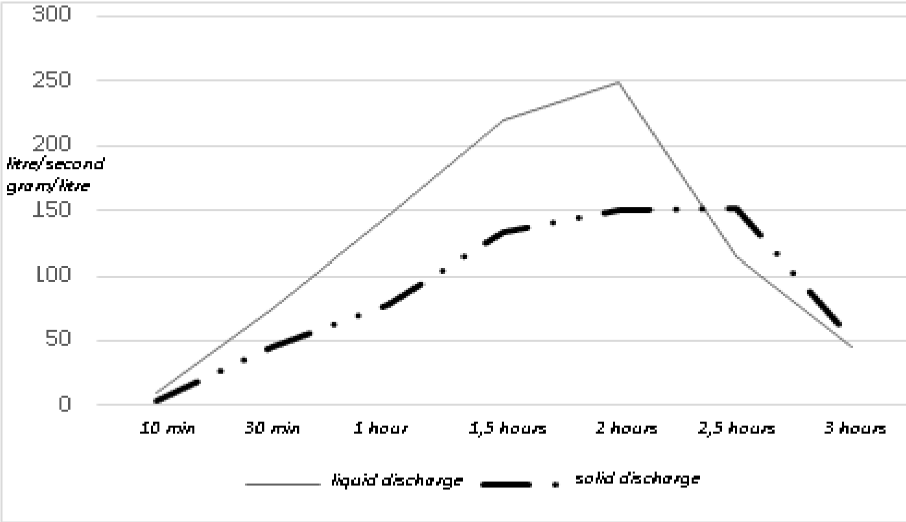

Fig. 6. The correlation between liquid and solid discharges through the Seaca ravine

For the study in question, measurements were made on the Seaca ravine. Thus, after the start of the rain, the liquid discharge starts to appear after about 10 minutes when the liquid discharge has reached 50 l/sec. Under these conditions the sediments were removed during the dry period and reached the drainage channel, so that the solid discharge will continue to increase with the liquid discharge due to the weakening of the cohesiveness of the slope deposits. The maximum point of solid materials was reached after 2.5 hours of liquid discharge, followed by a rapid drop.

3.7. The relationship between the slope and the drained surface of the ravines

The relationship between the slope and the drained surface of the ravine (Surdeanu, 1998, 2003) appears as a direct one, and the situations of 4 of the ravines indicate an inversely proportional ratio, so the ravines with high slopes drain small areas (Figure 7).

The explanations are also related to some particularities of the slope morphography, but also the fact that where the slope is high, the rainfall water flow has a lower degree of concentration, compared to the average slope values, where there is a better concentration of it (Sorocovschi, V., 2016).

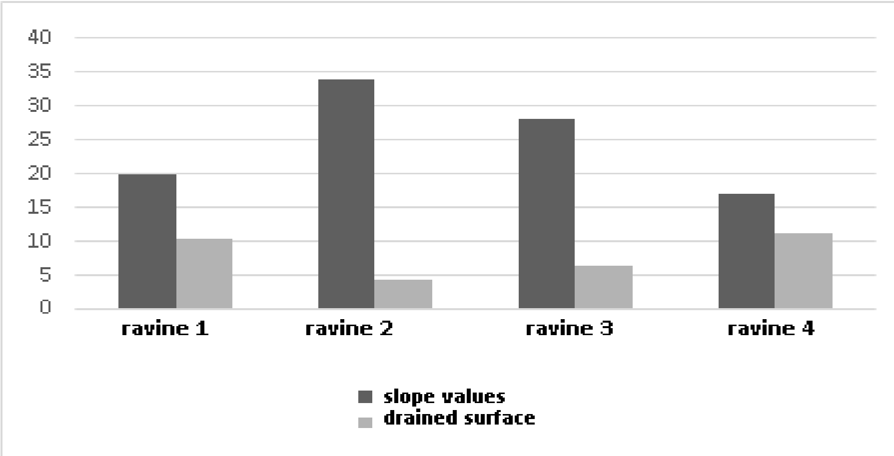

Fig. 7. Correlation between the slopes and the drained surfaces of the ravines

3.8. Agradation rate

The agradation rates (Surdeanu, V., Rădoane Maria, Rădoane, N., 2003, 2004) in the middle sectors of the studied ravines show the following particularities (Figure 8):

- the agradation parameters were determined by topographic level measurements. For the study, measurements were made in the middle sector of the seven ravines under review.
- a correlation can be made between the ravines' inclination grade and the agradation rate. Thus Seaca ravine has a high slope, but a low agradation rate, the situation is similar for other ravines. Instead, ravine 5 shows a high agradation rate due to the low overall slope.
- During the 10 years of monitoring, the agradation process had a oscillating, pulsating evolution.

Thus, freeze-thaw processes have a great contribution, especially observed in the spring (Achim, F., 2015, 2016). Important contributions also have the reduced amount of precipitation, where the water from the slopes reaches the ravine network, depositing fine sedimentation materials.

On the other hand, the rich quantitative rainfalls lead to erosion of deposited sediments, which reduces the agradation rate at the level of each year. It can be noticed on the graph above that the years 2005, 2007, and 2013 present lower agradation rate, even drops in some places, due to the slope morphology and the rainfall manifestation regime.

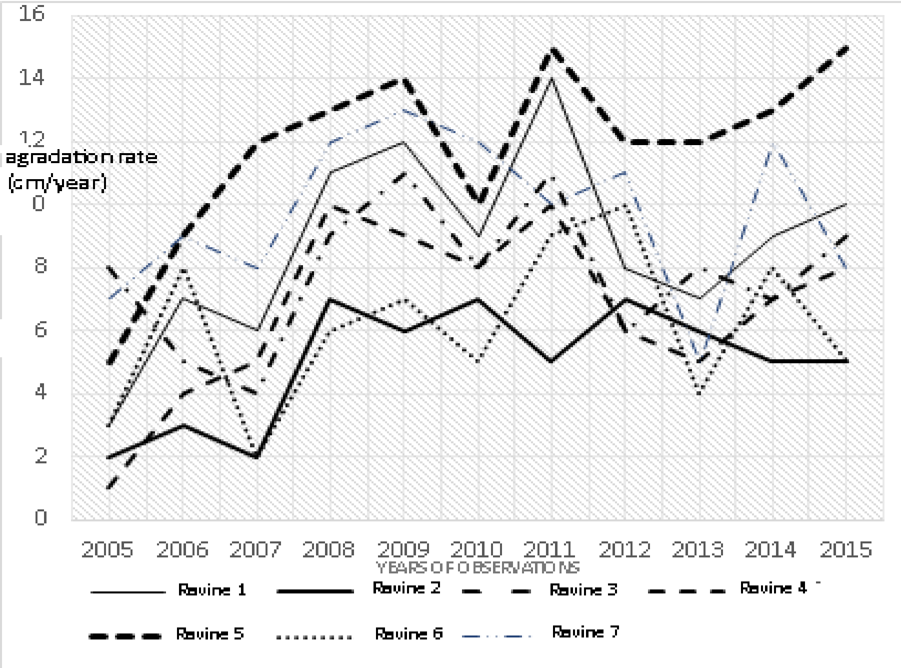

Fig. 8. Evolution of agradation rate, in the medium sectors of the seven ravines during the period 2005-2015

4. CONCLUSIONS

In the Sălătrucel River Basin, ravination as a geomorphologic relief modelling process is a frequently encountered one, being also a factor for rapid soil degradation, favouring rapid water runoff from precipitation, which leads to an increase in the floods risk (Voiculescu, M., 1995).

Very important can be the assessment of hazards and risks induced by ravines, in relations established in the regional geographic system, where the problem of a functional approach can be posed (Gotiu, Dana, Surdeanu, V., 2007).

From the geomorphological analysis on the resulting relief forms, it can be emphasized that the process is more intense on the slopes with medium grades, at their inflow points and slope change, especially at the convection points.

After appearance, the ravines have a rapid evolution in the first 5 years, during which they are deepening and extending in length, in order to continue to undergo an agradation process by deposition of sediment in the lower and middle parts. Basically, after a period of 10 years, one can notice a natural extinction of the action of the ravination process in the Sălătrucelul Basin.

Since mowing is a geomorphological process that contributes to intense land degradation and increased flood risk, a number of anthropogenic measures are needed to prevent or combat them. Recommended works (Blaga, L., Josan, N., Ilieş, and Dorina Carmen, 2014) must reduce the drained water discharge and the vertical erosion. Avoiding farm work, along with the plating of trees belonging to the site, are basic measures to prevent ravens.

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