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THE DYNAMICS OF THE PRESENT PROCESSES WITHIN THE SĂRĂȚEL CATCHMENT AREA

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Abstract

The Sărățel catchment displays a territory mostly located in the molasse area of the Buzău Subcarpathians. The physical-geographical characteristics, as well as the social-human impact, created a complete geomorphologic system, in which the present geomorphologic processes register accentuated dynamics. Starting with the year 2002 until 2008 there were monitored areas with significant impact on the landscape, among the most important processes under study being the landslides, the torrents, the ravines and the creep.

Keywords: *present geomorphologic processes, landslides, torrents, ravines, creep*

Rezumat

Dinamica proceselor actuale din Bazinul Hidrografic Sărățel. Bazinul Sărățel prezintă un teritoriu localizat în cea mai mare parte în arealul molasic al Subcarpaților Buzăului. Caracteristicile fizico-geografice, la care se adaugă impactul socio-uman, au creat un sistem geomorfologic integral, în cadrul căruia se manifestă o dinamică accentuată a proceselor geomorfologice actuale. Începând din anul 2002 şi până în 2008 au fost monitorizate areale cu impact însemnat asupra peisajului, dintre care se remarcă alunecările de teren, torenții, ravenele şi creepul.

Cuvinte-cheie: *procese geomorfologice actuale, alunecări de teren, torenți, ravene, creep*

INTRODUCTION

The dynamics of the present processes represents a segment of global interest because of the always more extended altered surfaces and of the intensities that sometimes affect the human society, even if occasionally the location, the amplitude and the intensity are (irreversibly or not) generated by man. The geomorphologic research passed from the descriptive studies conducted at the beginning of the last century to a monitoring and highly accurate analysis based on the technologies and the methodologies in use. The present studies can facilitate the explanation, the stage and the dynamics of certain geomorphologic processes and this is why the field familiarity with the area under analysis constitutes a requirement.

In the Romanian Subcarpathian area, the modelling processes represented the subject or constituted chapters of the numerous PhD theses or scientific papers bearing the title „study of geomorphology". Among the published theses we mention those edited after 1967, in which the dynamic morphology is highly important - Roşu Al. (1967), Badea L. (1967), Grumăzescu H. (1973), Brânduş C. (1981), Bălteanu D. (1983), Armaş Iuliana (1999), Dinu Mihaela (1999), Ene M. (2004) and so on; there are to be added other PhD theses defended but not yet published (Micu M., Cruceru N. and so on). Furthermore, the palpable results of the present processes monitoring were presented in scientific papers that are well supported by field data. We shall limit the area to that in the Buzău Subcarpathians, where we quote the studies related to the dynamics of the processes, which were conducted by Mihăilescu V. (1951), Posea Gr., Badea L. (1953), Alexandru Medelaine, Dragomirescu Ş., Şeitan Octavia (1964), Posea Gr., Ielenicz M. (1970), Popescu Dida (1971), Posea Gr. (1969, 1972), Badea L. (1972, 1973), Iancu Silvia (1974), Ielenicz M. (1978, 1986), Bălteanu D. (1979), Niculescu Gh. (1986), Cruceru N. (2004, 2005), Vespremeanu-Stroe A., Micu M., Cruceru N. (2007) and so on.

The present study aimed at achieving detailed mathematical data related to the present morphology and to the dynamics of certain processes (*landslides, torrentiality, ravination and creep*). Through the time monitoring of the main geomorphologic processes, we aim at quantifying and extending the monitored area.

Study area

The morpho-hydrographical catchment of the Sărățel river is located at the exterior of the

Carpathian Bend, in the Buzău Mountains group and in the Buzău Subcarpathians sub-group.

From the mathematical viewpoint, it is located within the following coordinates:

- North – 45°28'40" N and 26°30'52" E;
- South – 45°17'10" N and 26°40'38" E;
- East – 45°24'21" N and 26°43'46" E;
- West – 45°25'12" N and 26°31'56" E.

From the hydrographical viewpoint, it is a left tributary of the Buzău river, the confluence being located near the settlement of Berca, Buzău County. The limit of the Sărățel is represented by the watershed between the river with its tributaries and the conterminous catchments: the Slănicul de Buzău valley in the northeast and the east; the Murătoarea valley in the east (southwards of the mud volcanoes plateau); the Bălăneasa valley in the west.

From the altitudinal point of view, in the northern part, the Sărățel catchment reaches 935.4 meters in the Ivănețu Ridge and the altitudes descend near the confluence with the Buzău to only 141.6 meters.

The catchment area covers a total surface of 189.54 square kilometres, representing one of the smallest catchments that are tributary to the Buzău. At national level, it enters the category of small catchments.

The river is 34.21 kilometres long and it is characterised by an average multi-annual flow around 1 cubic meter/second.

From the geological viewpoint, the catchment area is located in the south of the Paleogene flysch and within the Mio-Pliocene molasse, with friable rocks, affected by present modelling processes. There appear rocks such as the sandstones, the limestone, the conglomerates, the gypsum, the salt, the marls, the clays, the sands, included in the folded and faulted structures. The impact of the external agents generated a special landscape, dominated by landslides and torrential organisms.

The altitudes descend from the north to the south, from 900 meters in the Leordețu Hill, 885 meters in the Pietrișului Peak, 821 meters in the Bocu Peak, 802 meters in the Pițigoiului Peak and so on, to altitudes under 150 meters in the lower sector of the Sărățel floodplain.

Within the catchment area there are dominant the narrow interfluvial ridges, the main ones respecting the morpho-tectonic influence, while the secondary ones are perpendicular on the former. The structural relief, with numerous cuesta escarpments, creates a special note within the landscape. In the saliferous areas, there was formed a spectacular specific karst relief with accentuated dynamics.

The hydrography is represented by a poor phreatic nappe, with scanty flows. The surface water shows important seasonal and annual variations. Nevertheless, there are to be noticed the sulphurous, chlorinated, salty etc. springs located in the areas of Căneşti, Păcuri, Negoşina, Gonțeşti settlements.

From the climatic viewpoint, the Sărățel catchment area is comprised between the 6 and 10° C isotherm, with an average pluvial value of about 700 millimetres/year.

METHODOLOGY

Besides the classical methods that imply the use of maps and the field mapping with traditional means (compass, theodolite, steel measuring tape etc.), we used new instruments and methodologies in the detriment of the geographical science.

The maps or other finalities of the system impose two types of structures/models: raster and vector. The raster model uses a network of cells with regular distribution and an element belonging to this network is called pixel, being distributed row after row (from top to bottom) and column after column (from left to right). The raster data are presented under the form of points, lines and areas. The raster model answers the requirement of representing an object in a more precise image (closer to the truth), results through numerous geometrical data, such as the position, the shape and their dimensions in space. The data analysis and the combination of strata (data or maps) are based on complex algorithms and imply an ideal topology, which imposes the elimination of the errors from the beginning.

The topographical elevation surveys were conducted during many field campaigns:

- for the landslides: August 2002, August 2005 and September 2008;
- for the torrents: June 2007;
- for the ravines: August 2002, August 2005 and August 2008;
- for the creep, depending on the depth: July 2003 – July 2007.

During the topographical measurements/ elevation surveys, the theodolite was used in 2002, afterwards the total topographical station (Sokkia 610), the Garmin GPS (GPSmap 60Csx) for the landslides (the contour and the markers implanted in the slid mass), torrents (the contour), ravines (the length and the contour), the creep (the location). For the creep, we drew upon the "pillar test" method mentioned by A. Young (1960, 1972), quoted by N. Rădoane, 2002 and which consists in the introduction of plastic rodlets (5 millimetres in diameter and up to 5 centimetres long) in the profile of the materials; this method offers the possibility to know the general movement of the superficial part

of the phenomenon but not the differentiation of the movement speed of the material in depth. For this purpose, we used another method inspired by the examples emitted by N. Rădoane in 2002, with small changes. Thus, on two of the sample-plots (Plopeasa and Scoroşeşti) we used, instead of the plastic rodlets and wooden stakes (numerically marked with paint), red brick powder perpendicularly introduced (in 2003) on the topographical surface down to the depth of 50 centimetres, with the help of certain metallic tubes (3 centimetres in diameter), disposed at about 10 meters distance. Within these plots, the depth observations were conducted during 4 years, only at the beginning and at the end of the monitoring.

As database, there were used:

- ***The Topographical Maps*** scale 1:25,000, editions of 1979, 1981, 1982 (scanned and georeferenced);
- ***The Geological Maps*** scale 1:200,000, Covasna sheet (29 – L-35-XXI; year 1968) and Ploieşti sheet (36 – L-35-XXVII; year 1967) (scanned and georeferenced);
- ***The Satellite Images*** LANDSAT TM in seven bands, with 30 meters resolution;
- ***The Aerial Images or Aerial Photographs*** overlapped on the Digital Terrain Model (DTM), based on the above-mentioned topographical material.

RESULTS

The Sărăţel catchment lies on a complex fundament from the geological-structural and lithological points of view, represented by tight folds and faults and a diverse lithology dominated by Mio-Pliocene formations, poorly resistant at erosion and favourable to the present modelling processes. There are to be added the frequency and intensity of the downpours, the temperature variations, the energy and the fragmentation density of the relief and the land use, which lead to a great complexity and variety of the present geomorphologic processes. The present study deals with the complex of slope processes, such as the landslides, the torrentiality, the ravination and the creep.

The landslides

Numerous landslides with a great complexity of types are present within the Sărăţel catchment area. A total number of 338 plots with landslides were inventoried (2006-2007), covering an affected surface of more than 100 square meters (both the active and the stabilised ones). As case studies, we present two landslides monitored between 2002 and 2008.

Căneşti 1 Landslide

The landslide is located on the southern slopes of the Bocu hill, the slope "towards Păcuri", on an old, relatively stabilised glacis. The deposits belong to the Bedanian and they are dominated by marls and clays, tuffs and gypsums. The landslide is located within Căneşti settlement, in the concave bank of the former meander of the Sărăţel river. After the construction of the communal road, the water of the Sărăţel was deviated 80 meters towards the south. From the mathematical viewpoint, the landslide has the following coordinates: in the south 45°23'46'' N and 26°36'41'' E, in the north 45°23'51'' N and 26°23'36'' E, in the east 45°23'48'' N and 26°36'39'' E and in the west 45°23'49'' N and 26°36'43'' E.

This is a landslide tongue with average depth and it is located on a slope with relatively small inclination, of up to 27°. The movement of the clayey mass does not take into account the geological structure (asequent landslide). The study area is crossed by a drainage that is only maintained during the rains that supply the clayey matrix with water. The area affected by the landslide extends on about 5,000 square meters, 4,020 of which are comprised between the detachment scarps and only 3,224 square meters represent the body of the landslide (September 2008) (Table 1).

Table 1 Morphometrical characteristics of the Căneşti 1 Landslide

Morphometrical features	in meters
L (average length)	158
l (average width)	22.6
h (average thickness of the mass)	2.4
S (surface of the slid mass)	3224 square meters
V (volume of the slid mass)	8569.92 cubic meters
Average movement speed (per year)	2.2

The sector of the slope that is strictly affected by the landslide extends on a maximum length of 166 meters and a maximum width of 37.5 meters, having a maximum thickness of 5.3 meters in the narrowing sector from the terminal part. The detachment scarp has an almost circular shape, being fragmented by ravines that favour the withdrawal of the cornice. It is 0.5 – 3 meters deep and it is affected by gullies and ravines. The slid mass shows a wavy micro-morphology, with steps comprised between 0.30 and 0.70 meters. There are also present small steps that are perpendicular on the flowing direction and are characterised by dimensions under 0.8 meters (Fig. 1).

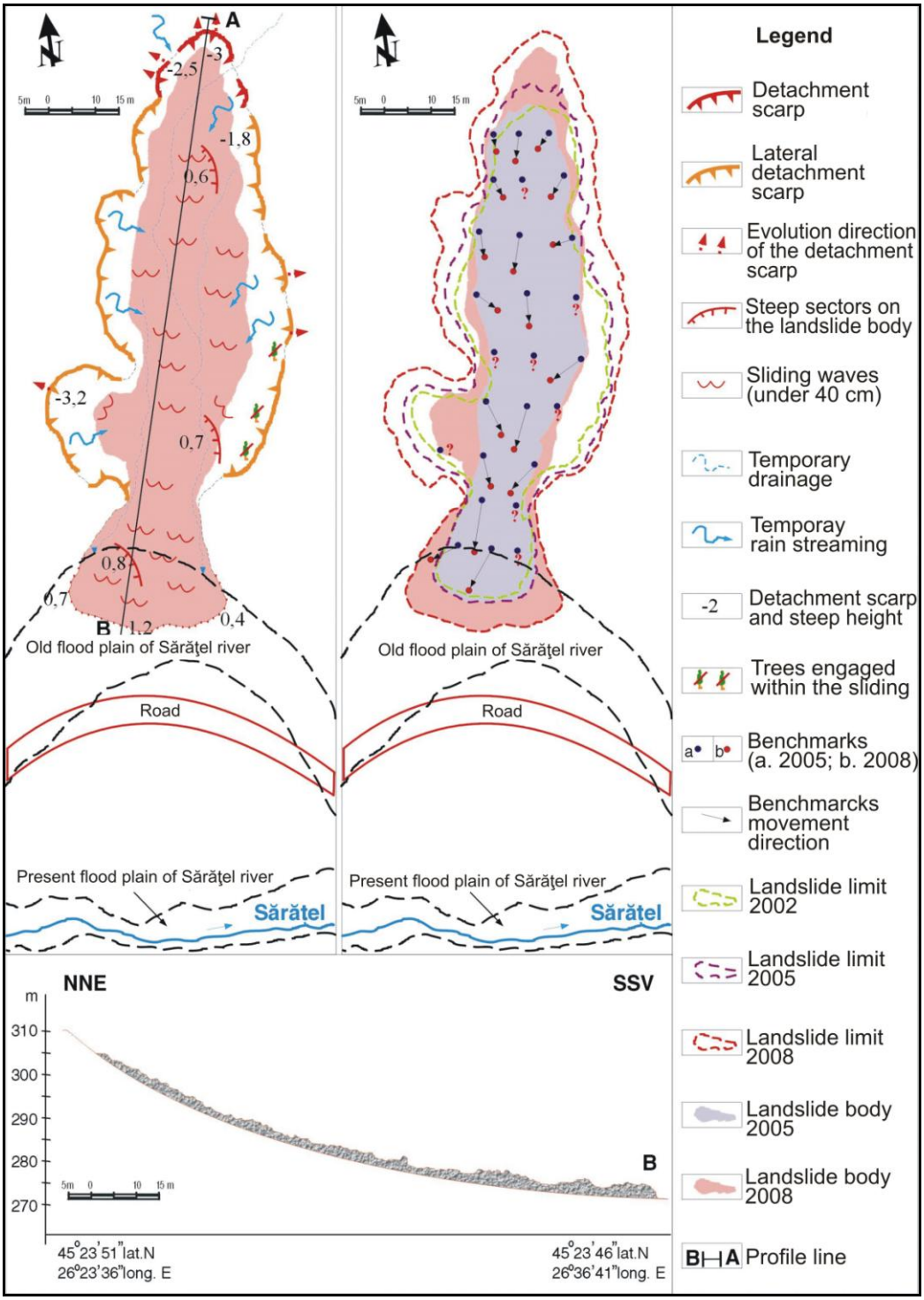

Fig. 1 Căneşti 1 Landslide

The slid mass has a volume of 8,569.92 cubic meters. The landslide toe is located on a quasi-horizontal surface, having the shape of a spreading cone and, at the terminal part, it takes the form of a wave that slightly surpasses one meter. The movement speed of the slid mass is realised differently. The monitoring period of the markers was relatively short (only three years) and, thus, no pertinent conclusion can be drawn. During this interval, the movement speed of the markers varied from 2.1 meters to 11.3 meters (during 3 years, from August 2005 until September 2008) (Table 2). The data acquired in the field support the fact that the most intense movements took place in 2005, both in spring, after the sudden snow melting, and at the end of the summer, after a downpour. After this period, the movement was extremely slow, almost imperceptible.

There developed a drainage network that crosses the body of the landslide on its central part, sometimes leading to a strong moistening of the nearby material and imposing it a more rapid movement speed than to the other stripes.

It is a semi-stabilised landslide, being invaded by a vegetation of small bushes. Nevertheless, it remains a geomorphologic process with important impact on the landscape and it represents a risk factor because of the nearby social-economic activities. The terrain on which the landslide is located belongs to the common pasture. In the eastern part, the residences are situated at only 30 meters of the lateral detachment scarp, while the courtyard and the orchard are located on the upper part of the respective cornice. In the western part, the residences are to be found starting with 63 meters. From the landslide toe to the communal road there is only a distance of 16.35 meters, this portion presenting a prolonged spring moistening.

Table 2 Distance covered by the markers within the Căneşti 1 Landslide

Markers No.	Distance covered between August 2005 and September 2008 (meters)
1.	2.1
2.	4.8
3.	4
4.	3.8
5.	-
6.	5.1
7.	5.3
8.	7.7
9.	5.1
10.	6.2
11.	6.8
12.	-
13.	-
14.	-
15.	10.1
16.	6.2
17.	10.2
18.	-
19.	-
20.	6.3
21.	8.2
22.	11.3
23.	-
24.	6.2
25.	8.9
26.	-
Average speed = 6.6 meters	

Şuchea Landslide

The landslide is located on the northern slopes of the Pietricica Suchii hill, on the slope called ”Strâmbu Şuchii cu Pini”, which has been stabilised through pine tree plantations starting with the ’60s. The deposits belong to the Badenian and to the Helvetian, being dominated by marls, clays and gypsums. The landslide is located within Şuchea settlement, near the Strâmbu Şuchii riverbed, which is a tributary of the Sărățel on the right. From the mathematical point of view, the landslide has the following coordinates: in the south 45°24’06’’ N and 26°35’01’’ E, in the north 45°24’30’’ N and 26°34’58’’ E, in the east 45°24’26’’ N and 26°35’02’’ E and in the west 45°24’25’’ N and 26°34’60’’ E.

It is a landslide tongue with average depth and it is located on a slope with relatively small inclination, of up to 28°. The movement of the mass is realised on a dominantly clayey slope and it does not consider the geological structure (asequent landslide). The landslide under study developed as a typical mudflow, but without having a clear supply area. Initially, the landslide appeared at the end of the 60’s under the form of a ravine that evolved regressively both upstream and laterally. In the 90’s, it became a real mudflow that reached the riverbed, the materials being subsequently taken by the Strâmbu Şuchii stream. The lateral slopes mainly supplied the materials. Once the slope gets milder, the flow becomes a landslide, having a slower and periodical movement.

The area affected by the landslide extends on almost 3,300 square meters, 2,120 of which are comprised between the detachment scarps and only 1,943 square meters represent the body of the landslide (September 2008) (Table 3). The slope that is strictly affected by the landslide extends on a maximum length of 202 meters, a maximum width of 46.7 meters near the toe (the spreading cone) and a minimum one of 5.3 meters, having a maximum thickness of 6.9 meters in the narrowing sector from the terminal part. The detachment scarp has an ovoid shape and it is fragmented by ravines that favour the withdrawal of the cornice. Its depth varies between 0.5 and 0.8 meters and it is affected by gullies and ravines. The slid mass shows a wavy micro-morphology, with steps comprised between a minimum of 0.30 meters and up to 0.80 meters. There are also present small steps perpendicularly disposed on the flow direction, their dimensions being less than 1.8 meters (Table 4 and Fig. 2). The volume of the slid mass is of about 7,469.28 cubic meters. The landslide toe is located on a quasi-horizontal surface, a floodplain terrace, and it takes

the form of a spreading cone, while on the terminal part it has the shape of a wave that reaches the riverbed of the stream. The terminal part of the landslide is washed after each flash flood.

Table 3
Morphometrical characteristics

Morphometrical features	in meters
L (average length)	182
l (average width)	10.8
h (average thickness of the mass)	3.8
S (surface of the slid mass)	1,943.6 square meters
V (volume of the slid mass)	7,469.28 cubic meters
Average movement speed (per year)	3.23

Table 4 Distance covered by the markers within the Şuchea Landslide

Markers No.	Distance covered between August 2005 and September 2008 (meters)
1.	9.8
2.	7.9
3.	7
4.	12.7
5.	11.3
6.	12.2
7.	11.9
8.	7.6
9.	10.3
10.	7.9
11.	7.8
Average speed = 9.67 meters	

There are differences related to the movement speed of the slid mass. The monitoring duration of the markers was relatively short (only three years), which does not allow for a concrete evaluation of the dynamics on a statistical term. During this period, the movement speed of the markers varied from 7 to 12.7 meters (during three years; from August 2005 until September 2008) (Table 4 and Fig. 2). It can be said that the average movement speed of the landslide is of about 3.23 meters. The data acquired in the field support the fact that the dynamics of this landslide is felt during the entire year, with peaks within the snow melt period and during the downpours. It is important to mention the fact that the landslide evolves both regressively and laterally, a fact which affects the pine tree plantation.

This is an active landslide, with negative impact on the slope. The landslide is located on a forest that belongs to the Local Council, which did not take any pertinent measure to stop the evolution of the respective process until 2008.

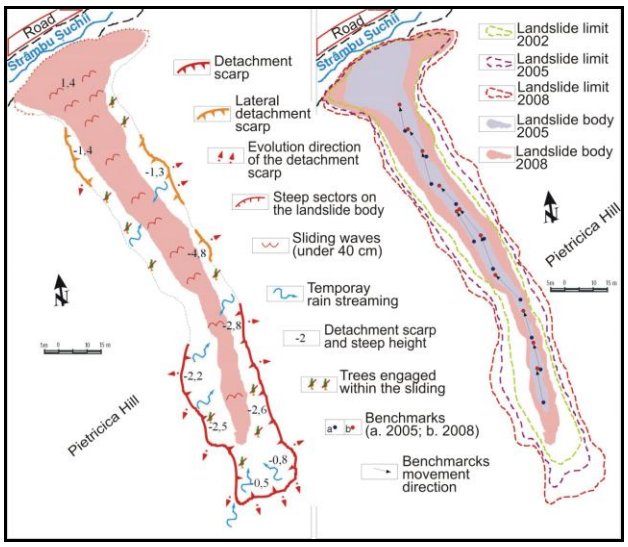

Fig. 2 Şuchea Landslide

4.2. *The torrents* or *the torrential bodies* appear on the slopes with friable rocks (especially marls, sands, gravels and clays, to which there are to be added the sandstones) and even on the old, relatively stable deluvial accumulations. The forms and dimensions differ from one place to another under the impulse of the local conditions and the processes generally occur during the spring (March - April) and towards the autumn (June - September).

In order to determine the intensity of the torrential phenomenon within the Sărățel catchment (Table 5) and in certain sub-basins, the torrentiality index (I_T), was calculated with the formula:

$$I_T = \Sigma_{LT} / \Sigma_{LH} \bullet 100$$, *where:*

I_T – *torrentiality degree (in percent);*

Σ_{LT} – *the summed length of the ravines and of the torrents (in kilometres);*

Σ_{LH} – *the total length of the hydrographical network (in kilometres).*

The computation of the index for the Sărățel catchment area was based on the topographical map, scale 1:25,000 and on ortophotographs, scale 1:5,000. There were mapped torrential organisms up to 500 meters long, which justifies an extremely high torrentiality index. There is to be noticed the fact that on two of the tributaries, the torrentiality index is in the general note of the Sărățel morpho-hydrographic catchment. As case studies, we present three torrents that are well defined in the landscape.

The Şuchea torrent is located near the Sărățel - the Slănicel confluence, on the right side of the collector, on the eastern slope of the Pietricica Hill. It is developed on friable Sarmatian rocks (marls, clays, sands). It is a poorly developed torrential

organism, with prolonged shape. Most of the flow channel crosses a pine and oak forest, while the catchment basin is located on an intensely used pastureland. The alluvial fan overlaps the floodplain terrace of the Sărăţel. The catchment area displays an ovoid shape, being 186 meters long and 85.3 meters wide (maximum width) (Fig. 3). The catchment basin covers a surface of about 7,439 square meters, with extremely intense occurrence of ravines and of gullies. The flow channel is 204 meters long, being characterized by a maximum width of 33 meters, a minimum one of 10.3 meters and a maximum depth of 11 meters. The alluvial fan covers a surface of 4,650 square meters. The catchment basin developed as a consequence of the irrational land use, on an average slope of more than 20º. Within the catchment area, the evolution is mainly realized through ravination and sheet washing, which acquire maximum intensities within the pluvial summer period and during the sudden snow melting; there are to be added small superficial landslides. The flow channel has a "V" shape, with the thalweg freed of sediments. On the left side, there are located three ravines that are 62 m, 27.5 m and 31.6 m long; the share of the alluvia is significant, even though the ravines are located within the forested area. On the left side, there is located only a 61 meters long ravine, less active that the ones situated on the opposite bank. The alluvial fan consists of two different sectors, one of which is relatively stable, covered with grass, with a 35º slope in which the torrent dug a valley heading towards the Sărăţel riverbed. At the terminal part, there is situated a new sector with a slope under 12º, which pushes the thalweg of the Sărăţel towards the opposite bank.

Table 5 Torrentiality index within the Sărăţel catchment

Name of the catchment	Total length of the hydrographical network (kilometres)	Total length of the hydrographical network (kilometres)	Torrentiality index (percent)
The Slănicel	204.21	132.05	64.66
The Băligoasa	294.55	192.13	65.29
THE SĂRĂŢEL	1,565.67	1,029.25	65.74

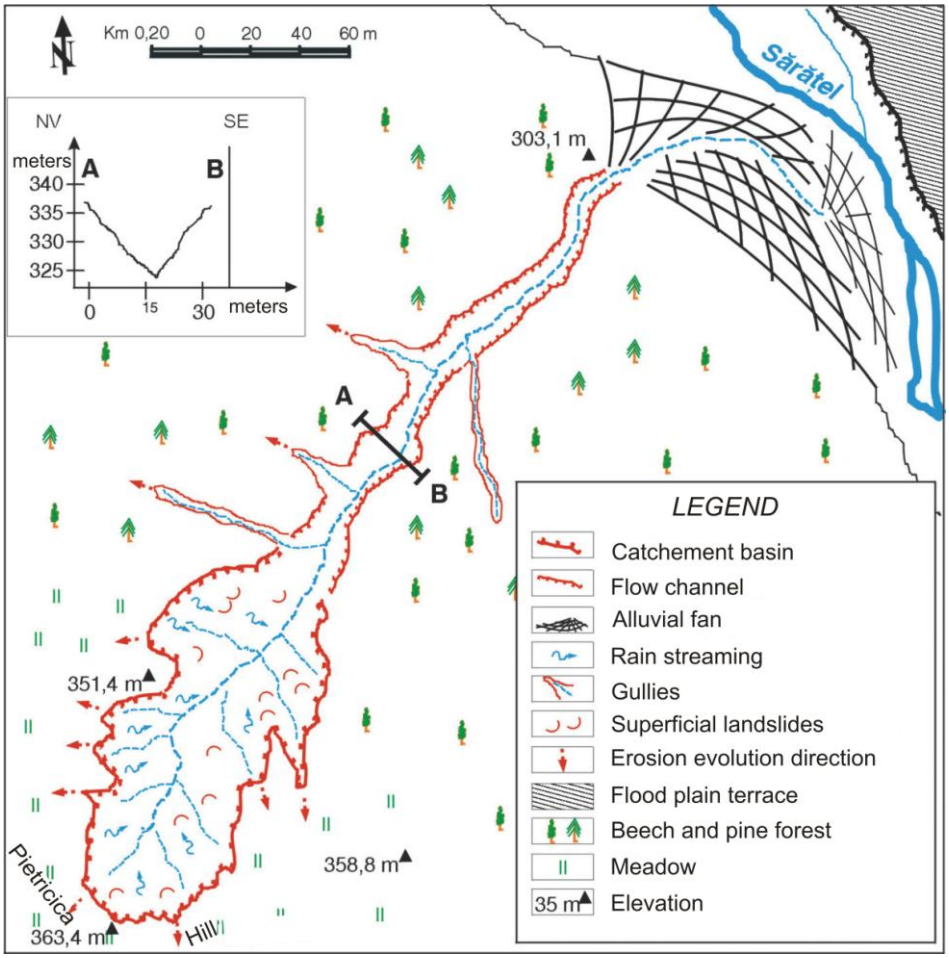

Fig. 3 The Şuchea torrent

The Goluri torrent is located on the left of the Sărățel, between Gura Văii and Scorțoasa settlements, on the western slope of the Muchia Golului Hill, which is sporadically covered with oak and pine forest. The lithology is dominated by (Dacians and Quaternary) sands, gravels, marls and clays. The catchment basin displays an almost circular shape and covers a surface of about 6,230 square meters, being relatively covered with forest and touching the top of one of the Sărățel's terrace. The flow channel is 150 meters long, the maximum width of which is 32.4 meters and minimum one 9.6 meters. The channel is 5.7 meters deep and shows massive accumulations that are relatively stabilised. The alluvial fan is of important dimensions, being located within the Sărățel floodplain, with a general slope below 18º in the upper part and around 10º in the terminal one. It displays a triangular lobed shape, which pushes the course of the collecting valley. It covers a surface of 4,655 square meters and it is mostly covered with grass. Because of the degree of forest coverage, the torrent shows a slower dynamics than the other similar organisms. The liquid flow transported along the discharge channel is mostly due to the snow melting or to the downpours, without an underground contribution. Within the alluvial fan there is to be found a shallow prolongation of the flow channel, which conducts the water of the torrent (Fig. 4).

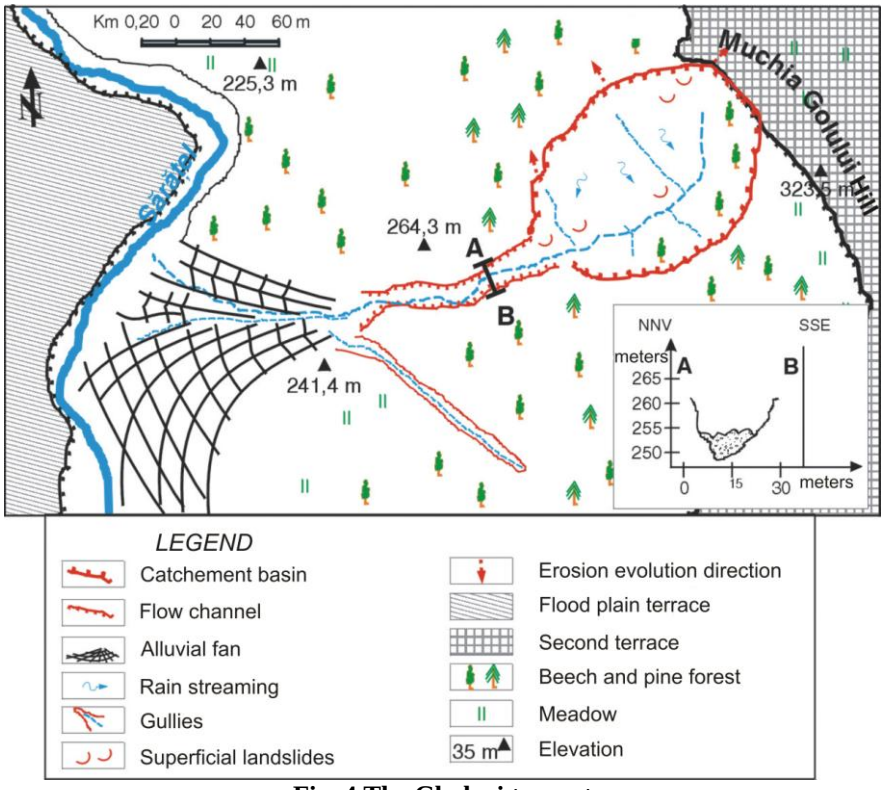

Fig. 4 The Gloduri torrent

The Negoşina torrent is located on a right tributary of the Sărățel, called the Valea Negoşina, within a saliferous sector that actively influences the dynamics of the present geomorphologic processes.

The lithology is diverse and it presents a succession of sandstones, marls and Sarmatian sands, while in the base there are marls, clayey schist, breccia and salt. The slope displays a complex shape (with the general inclination of about 40º), both concave (in the upper half) and convex (in the lower half). At the morphographic inflexion, there appeared numerous saliferous depressions (Cruceru N., 2004), at the base of which there are salt kernels (Badenian); the depressions are located in the left of the torrent under study. Despite the fact that the slope is significantly covered with pine tree forest, the gullies and the ravines display an intense manifestation (Fig. 5).

The catchment basin displays a prolonged, ovoid shape, covering a surface of about 21,250 square meters and evolving regressively towards Negoşina and towards the road that heads to this settlement, which is located on an interfluvial top surface that is relatively flat and characterised by about 450 meters of altitude (the 350-450 erosion level), which display the

shape of replats, being apparently carved at the end of the Upper Pleistocene (Ielenicz M., 1978).

The scarps of the catchment basin are affected by ravination and sheet washing, which are extremely active. The flow channel is 432.8 meters long, its width varying from 57.4 meters to 1.7 meters in the discharging sector. The banks are affected by gully erosion and ravination (giving the aspect of *bad lands*). The ravines are dominantly short, about 3 meters long, but in rare cases, they can reach 162 meters (such an example is located on the right side, at 114.1 meters downstream of the catchment basin). Approximately in the same point there is the confluence with another ravine, which is located on the left side, is less active and is 98.7 meters long. The cross section of the channel is carved under the "V" letter shape, being strongly deepened from 8 to 15 meters. The alluvial fan is extremely small, covering only 104 square meters. This torrent shows high dynamics because of the lithology, diapirism and slope. Starting with the year 2006, within the catchment basin there have been conducted improvement works under the form of small terraces, on which box thorn and southernwood were planted. The implants accelerated the propagation speed of the processes because of the irrational system, i.e. the roots of the plants were not taken out from the transporting plastic bags, which were brought to the surface by the gully erosion and were moved during each downpour.

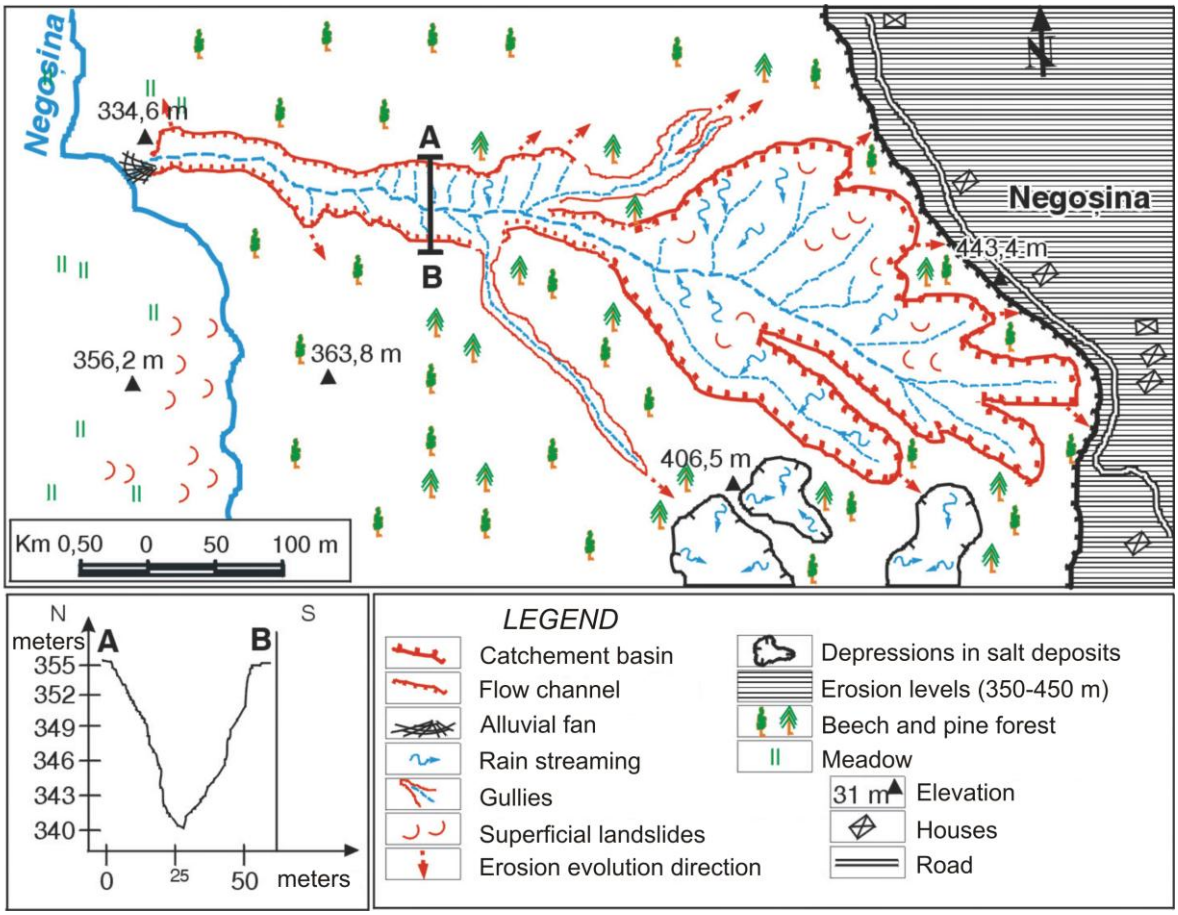

Fig. 5 The Negoşina Torrent

The ravines. As in the case of the processes presented above, the ravines display a great variety, their most important classifications following: the location within the catchment area, the shape of the transversal section, the criterion of the evolution cycle (used by Poesen and Govers, 1990), the depth, the width and the drainage surface (Kozmenko, 1954; Armand, 1955; Bălăiu, 1965; Moţoc, 1963; 1975; quoted by Rădoane Maria et al., 1999 and so on). Among the ten monitored ravines, we shall concisely present only three.

The Căneşti 1 ravine is located 300 meters downstream of the confluence between the Slănicel and the Sărăţel, on the right slope of the Sărăţel, in the Bocu hill ("Dinspre Păcuri"). The slope (mostly used as a pasture, with the exception of the upper third part) on which the ravine appeared is affected by sheet washing processes, ravination and torrentiality on a surface of 1700 square meters.

Following certain intense deforestations that occurred at the beginning of the 90's, these processes affect the lower third part of the slope. The soil was mostly washed because of the ablation processes and, on the remaining surfaces, it is only 30 – 45 centimetres thick. The general inclination of the slope is comprised between 23 and 45º, its length being around 750 meters. In August 2002, the ravine was 249 meters long, 23 meters wide (maximum width) and 6.3 meters deep. In June 2005, the ravine was characterised by a length of 254.5 meters, a maximum width of 24.3 meters and a depth of 6.8 meters (Table 6 and Fig. 6).

In August 2008, the length of the ravine reached 259.3 meters and its width was considerable, within the confluence sector with the Sărățel measuring 25.3 meters, with a widely open "V" profile. In the source sector there is to be found a small basin with numerous rills, which is characterised by a maximum width of 27.5 meters. The maximum depth displays values up to 7.5 meters. The altitude of the source area is 355.4 meters, while the mouth of the ravine (the Sărățel riverbed) is situated at an altitude of 255.2 meters. The ravine follows approximately the general west – east direction.

Table 6
The average multi-annual regression of the continuous ravines between 2002 and 2008

No.	Name of the ravine	Total regression of the length of the ravine (meters)	Average multi-annual regression
1.	The Şuchea	8.6	1.43
2.	The Căneşti 1	10.3	1.72
3.	The Căneşti 2	19.5	3.25
4.	The Berca	3.4	0.57
5.	The Negoşina	14.4	2.4
6.	The Scoroşeşti	8.4	1.4
7.	The Măneştilor	7.8	1.3
8.	The Mociaru	6	1
9.	The Budeşti	10.9	1.82
10.	The La Şicari	8.3	1.38

The Scoroşeşti Ravine is located on the right bank of the Strâmbu valley, under the Pietricica Hill. From the lithological viewpoint, it is dominated by marls and clays, to which there is to be added the soil intensely affected by pluvial denudation. The ravine displays two important branches located in the upper half part, while the terminal part is intensely affected by slope processes, such as the shallow landslides. The general inclination of the slope is comprised between 18 and 25º. In 2002, the length of the valley sector down to the confluence reached 252 meters, while the right branch was 145 meters long and the left one was 151 meters long. The maximum depth reached 2.3 meters and the width of the main sector was comprised between 7 and 18 meters, depending on the slope processes. In 2005, the main sector was 252.6 meters long and the branches were 146.2, respectively 153.2 meters long. On a long part of the main sector (after the confluence), the thalweg of the ravine displays important heterogeneous accumulations that are mainly obturated by the slope contributions. In 2008, the length of the ravine down to the confluence reached 253 meters, while that of the branches arrived at 148.2 and 158.4 meters respectively (Table 6 and Fig. 6).

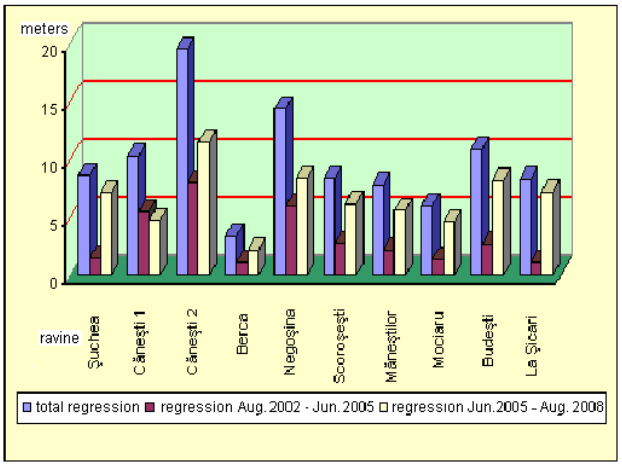

Fig. 6 The graphic representation of the ravines regression between 2002 and 2008

The main sector was 3.1 meters deep and its width varied between 7 and 25 meters. The ravine follows the general north-east – south-west direction and descends from 373.4 meters to 334.2 meters. It is worth mentioning that the thalweg is alluviated, even strongly clogged on certain sectors. The

terminal sector displays narrowing parts that can reach 3 meters and are correlated with the presence of numerous knickpoints.

The Budeşti ravine is located on a cuesta escarpment (with northern orientation) that is situated on the left side of the Sărăţel (which cuts it perpendicularly) and consists of an alternation of sandstones and marls. The soil does not exist and at the upper part of the cuesta (on the structural surface), there is to be found a vegetation dominated by beech forests and pine tree plantations. The general slope of the cuesta is comprised between 25 and 35º. In 2002, the ravine was 145.2 meters long, 23.8 meters deep (maximum depth) and 82.3 meters wide (maximum width). In 2005, the length of the ravine reached 147.9 meters, while its maximum depth and maximum width were 25.5 meters, respectively 84.2 meters. In 2008, the ravine arrived at a length of 156.1 meters, a depth of 26.8 meters and a maximum width of 85.5 meters (Table 6 and Fig. 6). The ravine follows the general south-east – north-west direction and descends from 649 to 566.3 meters of altitude. It is a linear, strongly deepened ravine because of the accentuated slope, undergoing intense dynamics in spring, after the snowmelt and the periglacial action that is manifested on the cuesta escarpment since the beginning of the winter until in the early spring. The thalweg of the ravine displays numerous structural knickpoints under the form of veritable thresholds, behind which certain sandstone blocks sometimes stagnate. It becomes free of materials after the spring downpours. The banks are steep and affected by weathering through frost-thaw, which contributes significantly with materials. The ravine undergoes accentuated dynamics on its entire surface and the most important fact that must be noticed refers to the incapacity to stop its evolution.

The creep

Within the Sărăţel catchment area, there can be distinguished more areas affected by creep, among which the more evident in the morphology are located on the slopes with small and average inclination, which are developed on strata with poor forest coverage and with a varied lithology (fragments of weathered rock – marls, sandstones, limestones etc., with superficial mobile sandy-clayey deposits). During 4 years there were monitored 7 sample plots: **I** – on the eastern slope of the Botanul Hill (near Plopeasa settlement); **II** – on the eastern slope of the Botanul Hill – under the peak called La Stână (towards Gonţeşti settlement); **III** – on the northern slope of the Botanul Hill (towards Scoroşeşti settlement); **IV** – on the north-western slope of the Bocu Hill (towards Chiliile settlement); **V** – on the southern slope of the Trestioara Hill (near Trestioara settlement); **VI** and **VII** – within the Ivăneţu Ridge (near Potecu settlement, on the right bank of the Sărăţel, where two sample plots were prepared) (Table 7).

Table 7
Characteristic data of the monitored perimeters, on the creep within the Sărăţel catchment area

Perimeter /sample plot		Geodeclivity	Land use	Period and distance covered (millimetres)				Total distance covered (in mm)	Annual average speed (mm/year)
				VII 2003 – VII 2004	VII 2004 – VII 2005	VII 2005 – VII 2006	VII 2006 – VII 2007		
I	at surface	25-28°	pasture land	7	5	5	11	28	7
	at - 25 cm			-	-	-	-	15	3.75
	at about - 40 - 50 cm			-	-	-	-	10	2.5
II	at surface	15-20°	shrubs	4	6	7	5	22	5.5
III	at surface	30-35°	pasture land	9	7	6	12	34	8.5
	at - 25 cm			-	-	-	-	21	5.25
	at about - 40 - 50 cm			-	-	-	-	15	3.75
IV	at surface	35-45°	shrubs	12	10	12	13	47	11.75
V	at surface	15-20°	pasture land	4	3	4	5	16	4
VI	at surface	30-35°	rare forest	5	3	6	6	20	5
VII	at surface	35-45°	rare forest	8	5	9	11	33	8.5

Within the monitored plots, there appear numerous trees with modified trunks, phenomenon generated by the soil creep, and the monitoring would require a much longer observation period. The changes mainly occur in the rooting area of the trees, leading to the downhill inclination (in the direction of the creep propagation). These changes get accentuated with the tendency of the (growing) trees to regain their initial position, to return to the vertical one.

The inherent anomalies appeared when big mobile fragments that had been gravitationally detached during the winter - spring periods descended from the upper part of the slope.

CONCLUSIONS

Within the Sărățel catchment, as well as in almost the entire Subcarpathian Bend space (and not only), the present geomorphologic processes undergo intense dynamics, are very diverse and are correlated with an indirect, sometimes direct, implication of the social-human activities.

During the monitoring period, within the landslides there is to be noticed a seasonal cyclicity influenced by the downpours and by the sudden snow melting.

The ravination and the torrentiality display a significant distribution, which justifies the high terrain fragmentation.

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