

Types of Riverbed along the Lower Course of the Buzău River

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Abstract

In the present study there were analyzed two sectors of river bed, located along the lower course of the Buzău River: Vadu Pașii – Săgeata (sector of braided channel) and Ibrianu – Custura. Through the calculation of some indices (the braiding index, the sinuosity index), the performance of correlations between elements established through measurements (length and amplitude of the meanders, the width of the river bed) could be differentiated the types of river beds. By analyzing the Austrian maps in 1910, of the topographic maps, orthophotoplans and Landsat images from 1987, 2000, 2006 and 2007 it could be observed the spatial dynamics of the specific element of each type of river bed. For the Vadu Pașii – Săgeata sector the braiding index reduced from 3.4 in 1981 to 2.32 in 2005. In the Ibrianu – Custura sector, there took place many underpinnings at the level of the complex meanders, and the length of the river reduced from 36.4 km to 24.5 km.

Keywords: *braided channel, meander stream, Buzău river, self-capture*

Rezumat. Tipuri de albie pe cursul inferior al râului Buzău

În studiul de față au fost analizate două sectoare de albie de pe cursul inferior al râului Buzău: Vadu Pașii - Săgeata (sector de albie împletită) și Ibrianu-Custura. Prin calcularea unor indici (indicele de împletire, indicele de sinuozitate), realizarea unor corelații între elementele determinate prin măsurători (lungimea și amplitudinea meandrelor, lățimea albiei) au putut să fie diferențiate tipurile de albie. Din analiza hărților austriece din 1910, a hărților topografice, a ortofotoplanurilor și a imaginilor Landsat din 1987, 2000, 2006 și 2007 s-a putut observa dinamica spațială a elementelor specifice fiecărui tip de albie. Pentru sectorul Vadu Pașii - Săgeata indicele de împletire s-a redus de la 3.4 în 1981 la 2.32 în 2005. În sectorul Ibrianu - Custura au avut loc numeroase autocaptări la nivelul meandrelor complexe, lungimea râului Buzău micșorându-se de la 36.4 km la 24.5 km.

Cuvinte-cheie: *albie împletită, curs meandrat, râul Buzău, autocaptare*

INTRODUCTION

This study proposes, besides the quantification of the elements related to each type of river bed, also to the establishment of some causal connections both at the level of the analyzed components and between them and the exterior factors.

The Buzău valley in the plain area, in the sinuous sector and especially in the sector with meander formation, was studied by Sivia Lupu (1971) who highlighted the change of the stream of the Buzău river between the localities Dedulești and Ibrianu in July 1969, analyzing the causes and effects over the fluvial banks Căineni, Amara and Balta Albă, previously fed from the Buzău River and also over the localities located in the area of the actual abandoned stream regarding the ground-water layer. Ielenicz M. (1968), analyzing Buzău Plain, makes also a short reference about the flood plain of the Buzău in the braided channel sector

(between Vernești and Săgeata) and the sinuous one in relation to the reconstitution on the right side of the river of some old streams, which represent an evidence of the flowing of the Buzău river in the Călmățui valley.

The majority of the existing works analyze the Buzău valley in the lower course from an evolutionary point of view (Vâlsan, 1915; Liteanu, 1961; Popp, 1963; Vișan, 1978) or in the context of the geomorphologic characterization of Râmnic Plain (Lupu et. al 1973).

The Buzău river is situated in the south-east of the country, having a total length of 302 km and a surface of 5,264 square km. The analyzed river bed sectors are in the lower stream at the contact point of Râmnic Plain, Buzău Plain and Brăila Plain.

The ground of the river bed is constituted in the sector Vadu Pașii – Săgeata by the deposits of the alluvial fan of the Buzău river. This is composed by two horizons of boulders and gravel (5-11 meters and 12-29 meters), and between them is intercalated

the clay (Enea, 1964). In the sector with meander formation, according to a hydrogeological drilling performed by the Directorate of Romanian Waters Buzău – Ialomita, near the Băile locality, there were found, up to the depth of 350 m, deposits of sandy clay, clayey marls, with intercalations of grey – yellow clayey sand.

The contact between the river bed and the surface of the plain is entirely made through the terrace of 1-2 meters relative altitude (Sârbariei terrace) and 4-5 meters relative altitude (named Obor terrace in the area of city) along the alluvial fan of the Buzău river. On small sections (Vadu Pașii, Dâmbroca) where they lack, the crossing is sudden through the mountainsides of 5-8 meters.

DATA AND METHODS

In the analysis of the river beds types there were used the Austrian maps from 1910, the topographic maps from 1979-1981, orthophotoplans from 2005 and Landsat images from 1987, 2000, 2006 and 2007. These materials were georeferenced in Stereo 70 projection with the help of the programs ArcGis 9.2, Arc View 3.2 and Global Mapper.

To observe the dynamics of the liquid flow, but especially of the solid flow (daily averages for the period 1974 – 2008) we used the data for the hydrometrical posts Banița (located in the sinuous sector) and Racovița (situated in the sector with meander formation) made available by Buzău Department for Waters Household.

The morphometrical analysis of the braided channel sector (between the localities Vadu Pașii – Beilic) and of the sector with meander formation (between the localities Maraloiu – Custura) was performed by calculating the braiding index of the bed river and of the main parameters of the meanders: the amplitude of the meanders, wavelength, sinuosity coefficient (Ichim, I., 1989; Rădoane, M., 2005). In the program Microsoft Excel we made some correlations between the variations of the braiding index and the width of the river bed and between the elements which define a meander.

For the differentiation of the river bed types we used two criteria: the multiplication degree of the thalwegs (for the delimitation of the braided channel) and the sinuosity coefficient (based on which there were delimited the sinuous river bed and the river bed with meander formation). The index of the braiding of the river bed was calculated as a ratio between the sum of the length of the branches and of the main stream and the length measured in straight line between the heads of the braided part of the river bed.

The deviation of the main stream was established by overlapping the topographic maps from 1981 and the orthophotoplans from 2005 and the measurement along some transversal sections traced at a distance of 0.5 km one from another.

DISCUSSIONS

The braided channel

Analyzing the river bed type it is determined that up to Săgeata-Beilic we can find a braided channel with many secondary river beds, this being a result of the transport of alluvia and the bigger slope (the medium slope is of 1.72 m/km) along the alluvial fan of the Buzău river.

In 1981, the braiding index of the river bed of the Buzău was of 3.4 having an irregular distribution along the 12 km of the analyzed braided sector. This registers greater values (between 1.77 and 4.6) in the sectors in which the width of the braided part is greater. The dependence of the braiding index to the medium width of the braided part is shown by the correlation of these elements in figure 1. The medium width of the braiding part is 765 meters, and there are registered values between 588 meters and 1,100 meters. In 2005, this is reduced to 2.32 simultaneous with the decrease of the medium width of the braiding part to 550 meters and the disappearance of some secondary branches on the left side (especially between Vadu Pașii and Stăncești), the general evolution being the realization of a unitary bed river with areas of local braiding (Fig.2, 3).

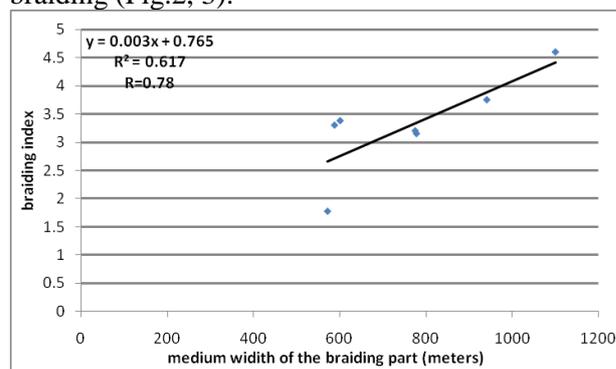


Fig. 1 Correlation between the medium width of the braiding part and the braiding index of the Buzau river (sector Vadu Pașii - Săgeata)

The tendency of the main stream is to deviate to west and south-west with average annual rhythms calculated at 4.2 m/ year (west) and 6.1 meters (south-west) in the period 1981 – 2005. This situation makes the Buzău river to sap from place to place the front of Obor terrace. Along the braided sector, there are local modifications of the stream of the main river in front of the gravel pit, as it

happens in the south-east of Stăncești village at the gravel pits Stăncești I and Stăncești II where, according to the decision regarding the issue of the environment agreement by the Environment

Protection Agency Buzău, it is predicted the execution of another route for the Buzău river, deviated towards the left bank for the decrease of the erosion of the right bank.

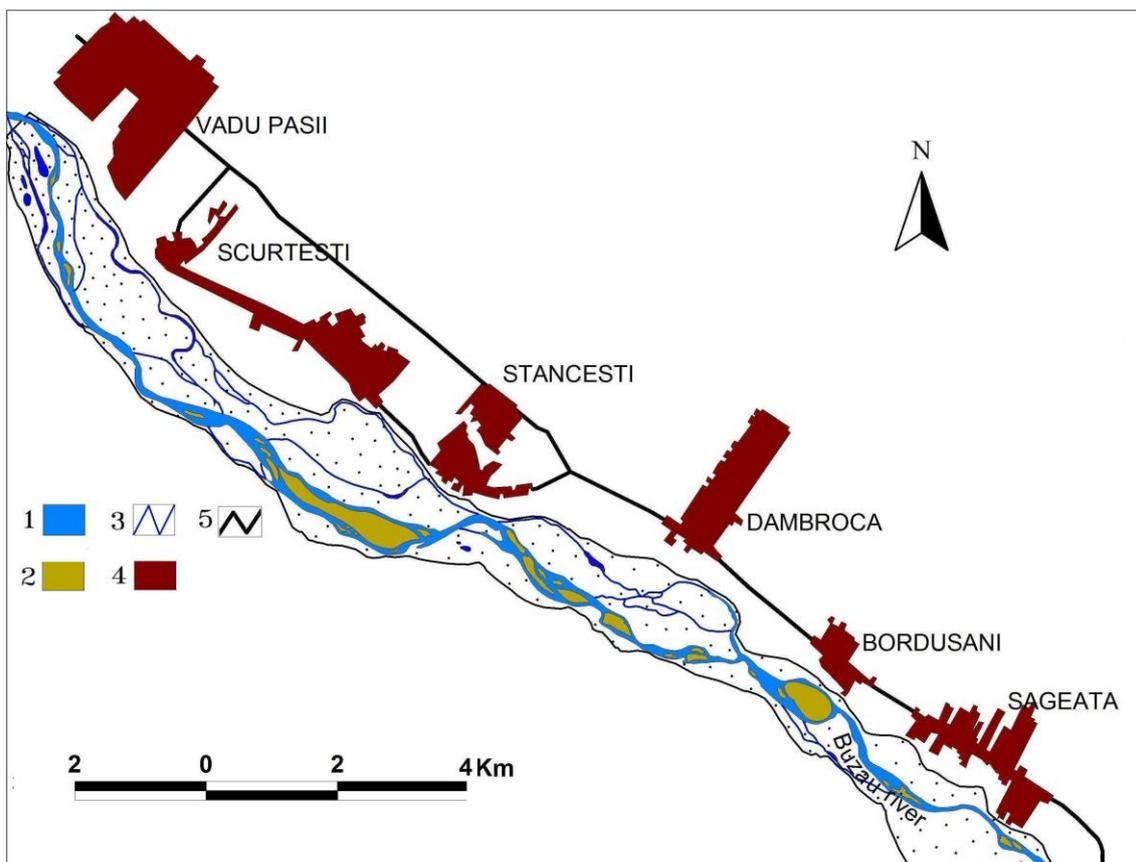


Fig. 2 The braided channel of the Buzău between Vadu Pașii and Săgeata 1981
 1-main stream, 2-eyots, 3-secondary branches, 4-localities 5-roads

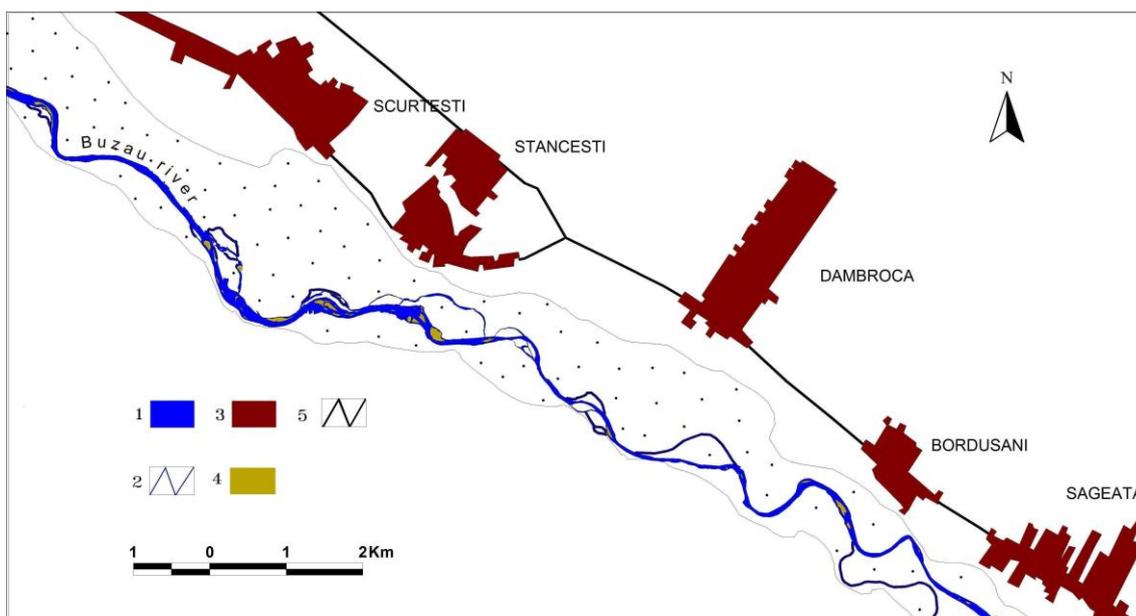


Fig. 3 The braided channel of the Buzău between Scurtești and Săgeata 2005
 1- main stream, 2-secondary branches, 3-localities, 4-eyots, 5-roads

Downstream the localities Săgeata – Beilic, the Buzău river passed from a north west – south east direction (on the braided sector Vadu Pașii – Săgeata) to a west – east direction between Săgeata and Banița having a sinuous river bed with eyots and a medium slope of 1.08 m/km. According to the Austrian maps from 1910 this sector could be included in the category of the river beds with

meander formation. From the measurements, it is established a decrease of the sinuosity from a coefficient of 1.87 in 1910 to 1.40 in 1981, and in 2005 it decreased at 1.30. The delimitation of the braided channel from the sinuous one is done at the inferior limit of the outfall fan of the Buzău river (Fig. 4).

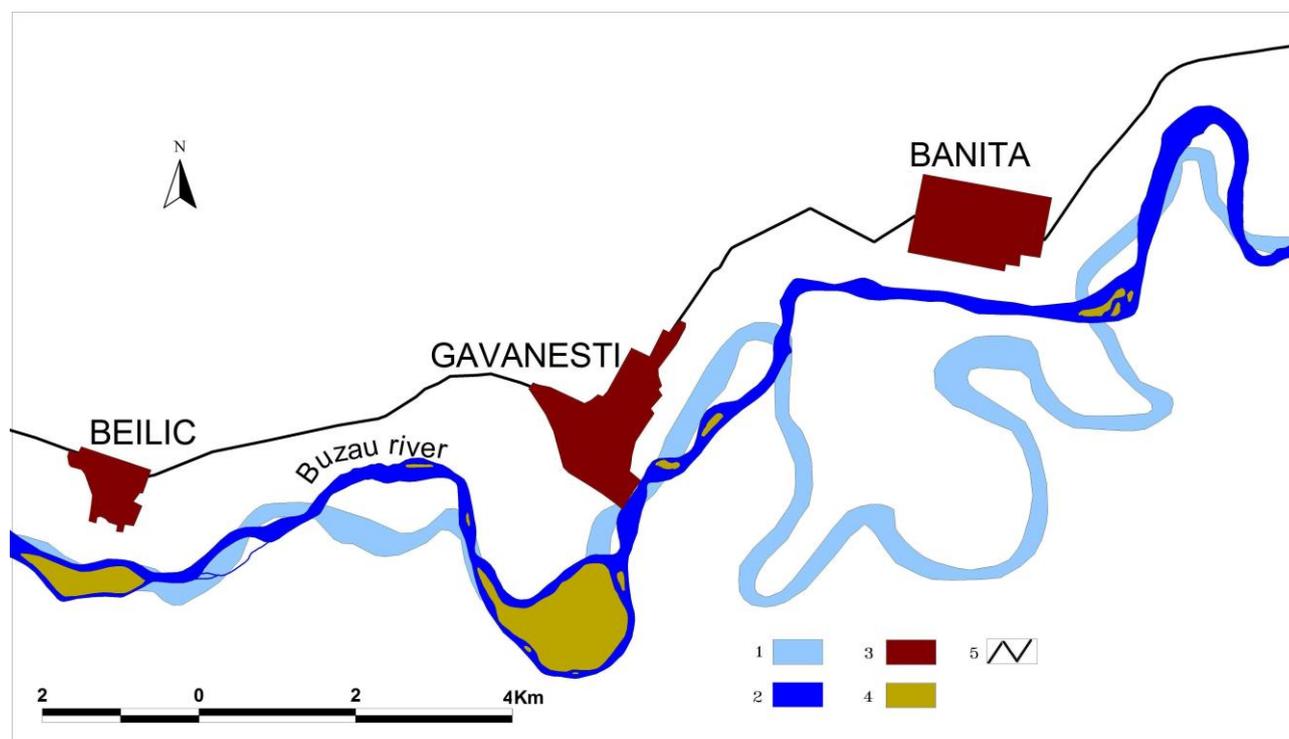


Fig. 4 The sinuous riverbed between Beilic- Banița
1-river bed in 1910, 2-river bed in 1981, 3-localities, 4-eyots, 5-road

The riverbed with meander formation

It is located between Ibrianu and Custura on a surface having a sinuosity index of 2.3 (2007). The passing to the surface of the field is generally made by the flood plain terrace. By comparing the situations existing in 1981 and 2005 on the topographic maps and on the orthophotoplans in the Ibrianu – Custura sector we can observe many modifications of the Buzău river stream by passing through some meanders, in the south-west of Ibrianu village, in the north – east of Sutești village. In the north, towards Custura locality there are localized in the points Cotul Menda (situated at 25 meters altitude) and Cotul Calugărului (situated at 23 meters altitude) other abandoned meanders. According to the situation existing on the topographic maps from 1981 the complex meanders from here had a sinuosity index of 3.3 and 3.8, after the process of self-capture had the index of 2 and 2.19. The same decreasing tendency can also be noticed in the case of the length and amplitude of

the complex meanders in 2005. So, the average length is reduced from 1,809 meters to 1,686 meters and the average amplitude from 1,243 meters to 1,030 meters.

The correlations between the main morphometric parameters of the complex meanders indicate through the coefficient of determination and correlation coefficient the ampleness of the reports existing at the level of the river bed with meander formation (Fig. 5, 6).

Regarding the average width of the river bed, there are no notable differences, but following the measurements performed on the orthophotoplans from 2005, the correlation between the amplitude of the complex meanders and the average width of the river bed is weaker (the determination coefficient is 0.58 in 1981 and 0.31 in 2005) for the configuration of the stream in 2005 following the self-capture, if the width of the river bed was not modified (Fig. 7, 8).

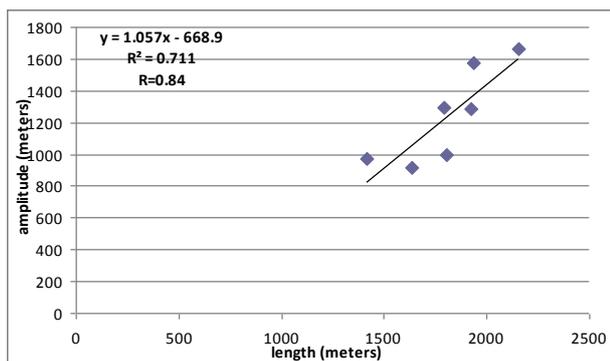


Fig. 5 Correlation between the wave length and the amplitude of the meanders (1981)

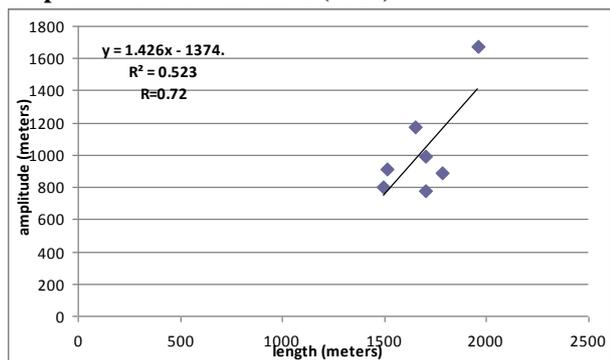


Fig. 6 Correlation between the wave length and the amplitude of the meanders (2005)

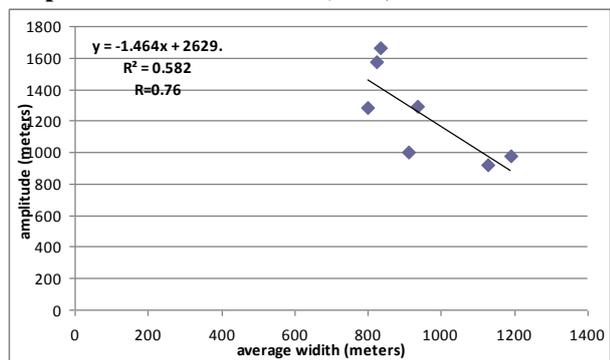


Fig. 7 Correlation between the average width and the amplitude of the meanders (1981)

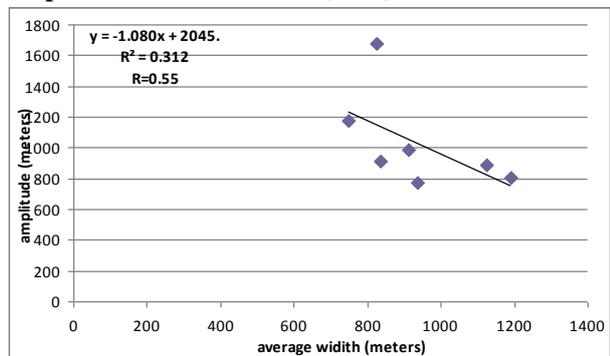


Fig. 8 Correlation between the average width and the amplitude of the meanders (2005)

A very important role in the processes which took place in the river bed with meander formation is played by the reduced slope of the river bed (0.43

m/km). From its correlation on the seven sectors of meander with the sinuosity coefficient resulted the fact that in 75% of the cases the values of the sinuosity coefficient are conditioned by the value of the slope in 1981 (Fig. 9).

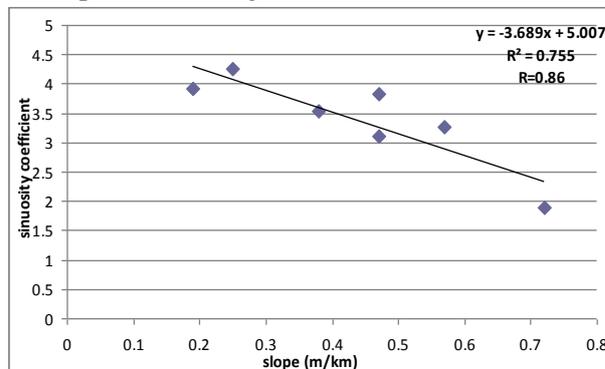


Fig. 9 Correlation between the slope and the sinuosity coefficient (1981)

The Landsat images from 2007 show other changes at the level of the river bed. In the perimeter named Lunca Suțului (situated north of Suțești village), the Buzău river, through self-capture, has straightened his stream and it flows on a route which rounds Movila Crestată. In the south of Movila Crestată there is an abandoned meander and a cut-off lobe on which, now, is located the Suțești forest (Fig. 10). The change of the stream took place between 2006 and 2007, and we obtained these information by comparing the Landsat images performed in 2006 (August 18, 2006) with the ones in 2007 (July 20, 2007). In this period, in 2006 at the hydrometrical post Racovița on the Buzău river the maximum flow did not exceed 50 m³/s (48.6 m³/s in September 4, 2006), normally having the value of 30-40m³/s. In 2007, up to the moment when the Landsat image was made, the maximum flows were between 11.3 m³/s and 51.6 m³/s except March when the liquid flow reached the value of 595 m³/s (March 25, 2007). This situation is confirmed by the information taken from the hydrometric post Banița located 30 km upstream on the Buzău river, where during August 2006 – July 2007 the maximum flow were between 16.7 m³/s (December 2006) and 79.8 m³/s (February 2007). On March 24, 2007 it was registered a maximum flow of 679 m³/s. The difference between the crests of high flood registered at the two hydrometric posts can be explained through the taking over by the flood plain of a part of the quantity of water in the conditions of a greater width of the flood plain (1,200 meters) in the meander sector at Racovița. The self-capture at the level of the complex mender in the south of Movila Crestată must be related to this high flood based on the existence of sinuosity

index of 3.19 in 2005. The length of the Buzău river suffered a decrease in the sector Ibrianu-Custura being of 24.55 km in 2007, from 28.98 km in 2005

and 36.49 km in 1981 following this event (Fig. 10, 13).

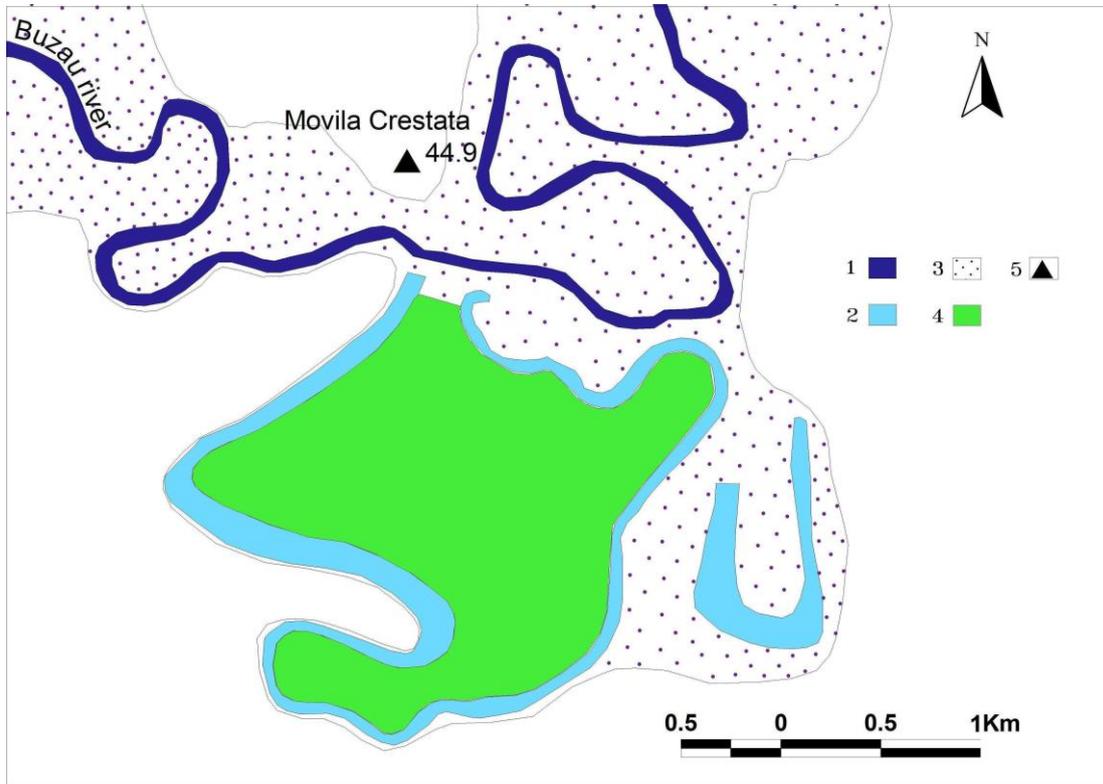


Fig. 10 The self- capture at the level of the complex meander in the south of Movila Crestată
1-The Buzău river (2007); 2-abandoned meanders; 3-delimitation of the flood plain; 4-cut off lobe; 5-altitude

The major cause for these changes for the braided channel of the Buzău, between Vadu Pașii and Săgeata, is represented by the decrease of the solid flow after 1989, following the construction of the Căndești barrage, situated 18 km upstream the studied perimeter. Before commissioning the barrage in 1989, at Banița station was registered a solid flow of 85.42 kg/sec (1974-1988), during the period 1989 – 2007 the solid flow reduced to 47.05 kg/sec. For the Racovița hydrometric post in the meander sector, the solid flow for the period 1989 – 2007 was 74.5 kg/sec.

The liquid flow (Banița station) is reduced from 28.9 m³/s (1974-1988) to 26 m³/s (1989-2007). Regarding the maximum annual flows registered downstream the barrage, these were reduced in the period 1990-2007, except for the years 1991 (when it was registered a flow of 1,686 m³/sec), 2005 and 2007. For the sector with meander formation, the small influence of the liquid flow was possible in the conditions of the existence of some greater values for the sinuosity coefficient at the level of

the complex meanders and the occurrence of major floods on the Buzău river.

The unbalance produced at the level of the alluvia transit is presented for the hydrometric station Banița for the two periods in figure 11 and figure 12 by correlating the two variables and the resulted coefficient of determination and the correlation coefficient.

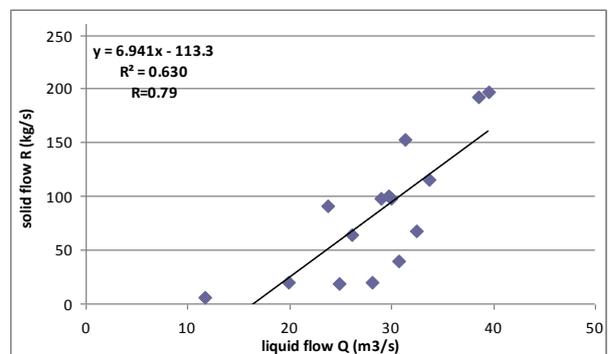


Fig. 11 Correlation between the liquid and the solid flow in the period 1974 – 1988

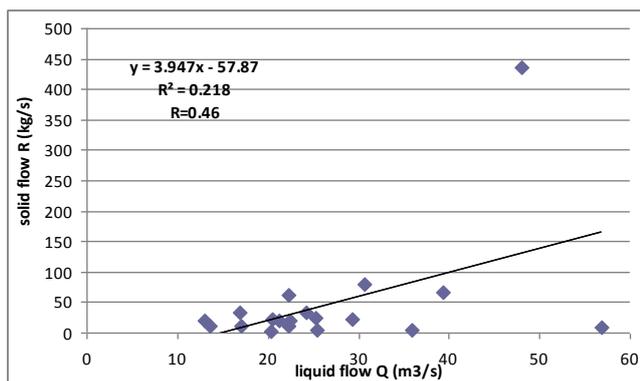


Fig. 12 Correlation between the liquid and the solid flow in the period 1989 – 2007

During the period 1980 – 2007, there were some interventions at the level of the Buzău river bed, especially over the braided sector, the ballast exploitations having a great impact on the modifications of the river bed. Along the braided sector (Stăncești I, Stăncești II and Bentu) and also upstream there are many gravel pits which purpose, apart from the extraction of gravel and sand, is the regularization of the minor river bed and in this way the flowing section is increased.

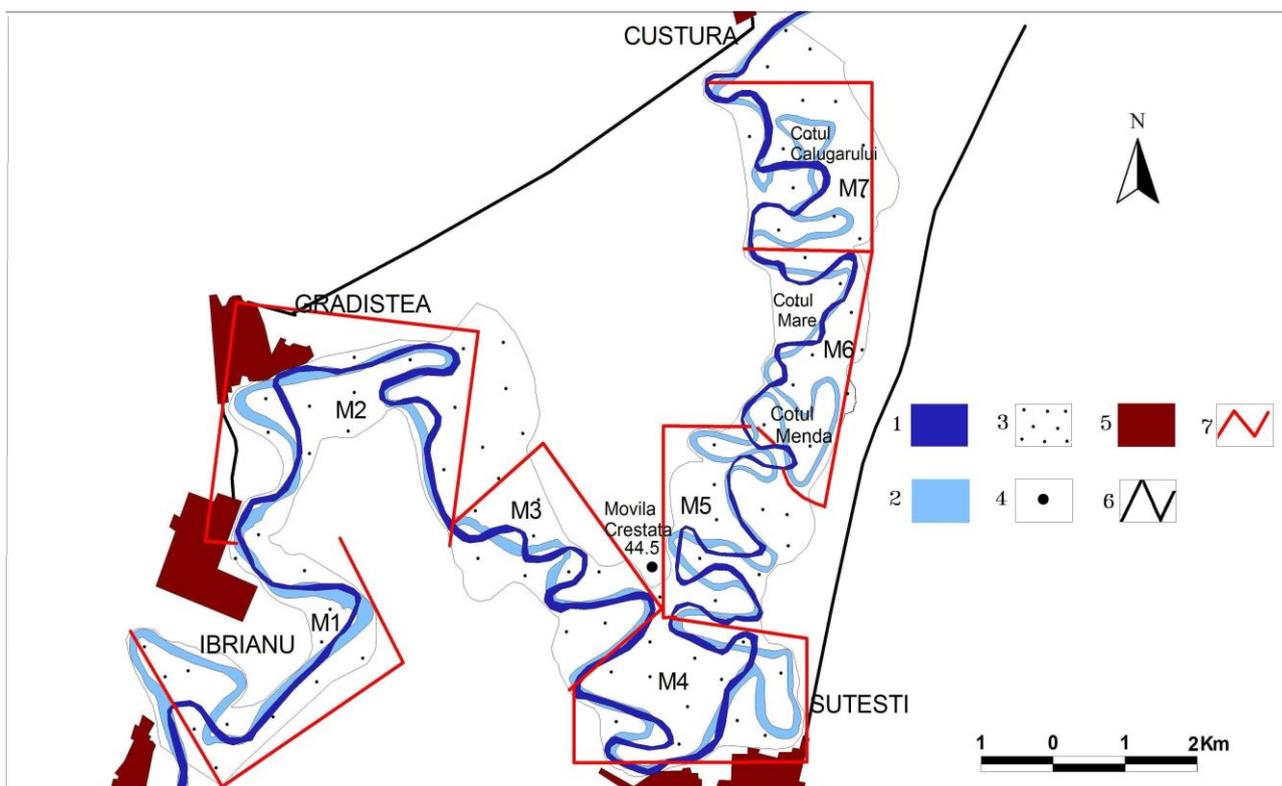


Fig. 13 River bed with meander formation between Ibrieanu and Custura
 1-The Buzău river (2005); 2-The Buzău river (1981); 3-delimitation of the flood plain; 4-altitude;
 5- localities; 6- roads; 7- delimitation of the complex meanders

CONCLUSION

The lower course of the Buzău river has a big diversity of river bed types, these being a result of the action of the local factors (lithology, slope, liquid and solid flow). The vulnerability is specific to each type of river bed. During the period 1981 - 2007, there took place many modifications in the analyzed braided channel sectors and in the ones with meander formation. Between Vadu Pașii and Săgeata, the changes affected the secondary branches which lengths significantly reduced. The decrease of the solid flow is one of the major causes of the decrease of the braiding together with the intervention for the extraction of the sand and

gravel, simultaneously with the unsilting and deepening of some sectors, which locally modify the route of the main branch and of the secondary branches. In the same time interval, the analyzed sector with meander formation between Ibrieanu and Custura, registered changes in the configuration of the stream. Many self-captures have produced, the length, the amplitude and the sinuosity coefficient of the complex meanders decrease, based on some sinuosity indices of the complex meanders which exceeded frequently 3 in 1981 and 2.4 in 2005. Based on the analysis of the maps, orthophotoplans, Landsat images and data regarding the daily

average flows at the hydrometric posts Banița and Racovița, we established the changes, relating them with the high floods produced on the Buzău river.

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