STUDIA UBB AMBIENTUM, LX, 1-2, 2015, pp. 39-47
(RECOMMENDED CITATION)

VALEA IERII'S RIVERBED DYNAMICS AND THE NECESSITY OF ITS RECONFIGURATION WITH THE AIM OF CREATING AN ECOLOGICAL CORRIDOR

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ABSTRACT. The evolution of Valea Ierii's riverbed from the perspective of erosion and alluvial deposits influences the configuration of the habitat of alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior.* This habitat presents a great number of species protected by the European legislation.

This study presents the rehabilitation of Valea Ierii's riverbed characteristics with the aim of creating a linear and continuos corridor. Even if this concept is not entirely investigated at local and global level, the submitting and the implementation of this type of natural structure endorses the sustainable development. As a result of this research, we applied geomorphological, cartographical and ecological methods for 3 different sections chosen in the field. This paper presents a series of discussions and propositions for the support and conservation of biodiversity. To this effect, we analyzed the evolution of the studied area by making a simulation of the river course and the habitat structure for the following 15 years.

Key words: *riverbed, ecological corridor, reconfiguration, alluvial forests*

INTRODUCTION

The study area is represented by the protected site of Valea Ierii, with special focus to the alluvial forests habitat with *Alnus glutinosa* and *Fraxinus excelsior*. Being an integrated part of Natura 2000 network, Valea Ierii is situated in the central area of Apuseni Mountains (Pop, 2000), on two administrative territories: Băișoara and Valea Ierii. The targeted habitat occupies 50 ha (0.9% of the total site surface) and has a linear distribution that follows the river course (Doniță et al., 2005).

The conservation status of the mentioned habitat is primarily endangered by the defragmented structure. This is caused by the invasive species of *Picea abies*, which is occupying the *Alnus glutinosa* and *Fraxinus excelsior* specific territory, and also by the anthropogenic activities, as it follows: deforestations; the construction of Bondureasa dam, which reduces the river flow; the straightening of Valea Ierii's river course that is determined by the reduction of meandering coefficient (Grecu and Palmentola, 2003). Another significant impact which causes the eradication of this area is induced by the development of the transport infrastructure which has a powerful effect on the habitat and its representative species.

By consulting the scientific literature, the local authorities and the local community, we found that the past configuration of Valea Ierii's river course was largely different from the current one. We also determined that the past configuration was stable and sustainable for creating life conditions for many species like *Lutra lutra, Bombina variegata, Cottus gobio, Barbus meridionalis, Eudontomyzon danfordi, Triturus vulgaris ampelensis* etc. According to Tatole et al. (2009), these species are dependent on the water support and soil characteristics of the riverbed, which are currently inadequate. Moreover, the orthophotomaps and the topographical maps from the studied area showed that the vegetal species which are now featuring the mentioned habitat had a uniform and a continuous distribution in the past. This confirmation led us to further research studies that indicate a set of measures and specific techniques for the elaboration of an ecological rehabilitation strategy for the targeted habitat.

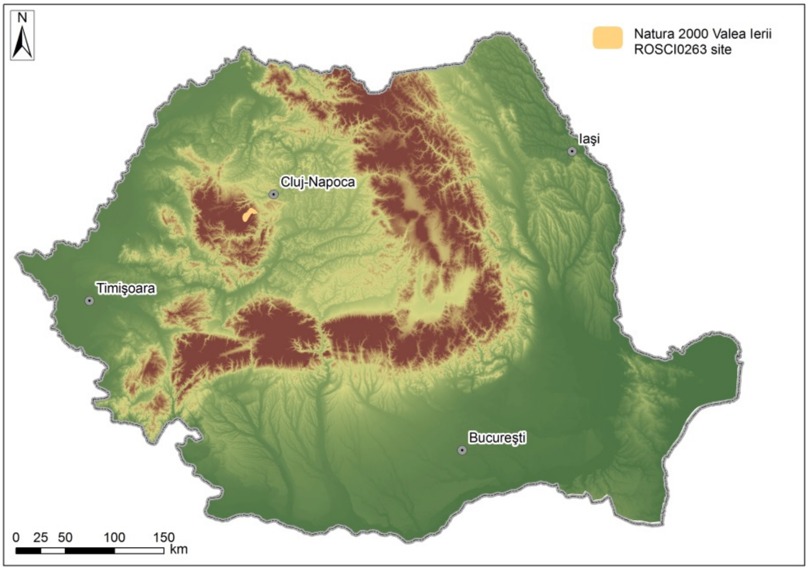

Fig. 1. *The geographical position of Valea Ierii site within the territory of Romania*

MATERIALS AND METHODS

For this study we applied a series of specific practices for geomorphological, ecological and geographical approaches that offered us details about the evolution of species and riverbed characteristics in the studied area. We analyzed these aspects through the *landmark method,* the *transect method* and the *cartographic method*.

The landmark method

Also called the sign method, the landmark method is based on a set of geometrized symbols that help in fixing the position of a geomorphological phenomenon in a certain space (Morariu and Velcea, 1971). This method offers the interpretation of large types of geomorphological signs, by using the following instruments: GPS equipment, measuring tape, pickets, hammer, ribbon, scissors and a camera. For this stage of the field research, we established three areas affected by the meandering process and we took their coordinates with the GPS instrument, marking the points in a database. To this aim, we took a series of values of the length in two ways: the first type of values were taken from the riverbank to the chosen sign (a picket) and the other type, from a fixed point which was easily to identify to the chosen sign. For analyzing the riverbed evolution, we took two sets of measures in two different months: December 2013 and April 2014.

The transect method

The second method is part of the ecological methodology and it is based on choosing a specific alignment of the studied area and establishing the characteristic vegetal association (Fabian and Onaca, 1999). This method, called the transect method or the square method (Zhang, 2007), facilitated the analysis of *Alnus glutinosa* and *Fraxinus excelsior* evolution by approximating the number of the individuals that are present along the studied river course. The results showed that the spatial distribution in the analyzed sections of the targeted species is irregular and interrupted by the uncontrolled number of *Picea abies*.

The cartographical method

Applying the cartographical method was the last stage of our research. For representing the obtained data we used a GIS (Geographic Information System) software (ArcGIS 9.2), which made possible the selection of the existing information in the database. This was conditioned by tracing different environmental components from both topographical maps and orthophotomaps. Using GPS (Global Positioning System) techniques in the field research, we localized more precisely both the chosen points and the geomorphological processes. The main GIS functions used for this purpose were the following: the function of creating shapefiles, the function of editing in a shapefile (for rivers, landforms, depositions, geomorphological processes, habitats, etc.), the function of spatial analysis, the function of inserting new map elements, and the function of exporting the obtained maps in JPG format. This method will also help us monitoring, in time, the situation of the studied sections.

RESULTS AND DISCUSSIONS

By using the GIS instruments and the data obtained in the field, we digitized the existing habitat of *Alnus glutinosa* and *Fraxinus excelsior,* and the future possible spatial arrangement of the alluvial forests in the studied area, on a thematic map (figure 2).

In accordance to the final results, we propose the following actions: the removal of the existing invasive species of *Picea abies* in the targeted area and the replanting of *Alnus glutinosa* in the studied sections; the meandering of Valea Ierii river course in order to provide the specific humidity for the vegetal species; the monitoring and periodical checking of the area with the aim of ensuring the protection and the conservation of the above mentioned species.

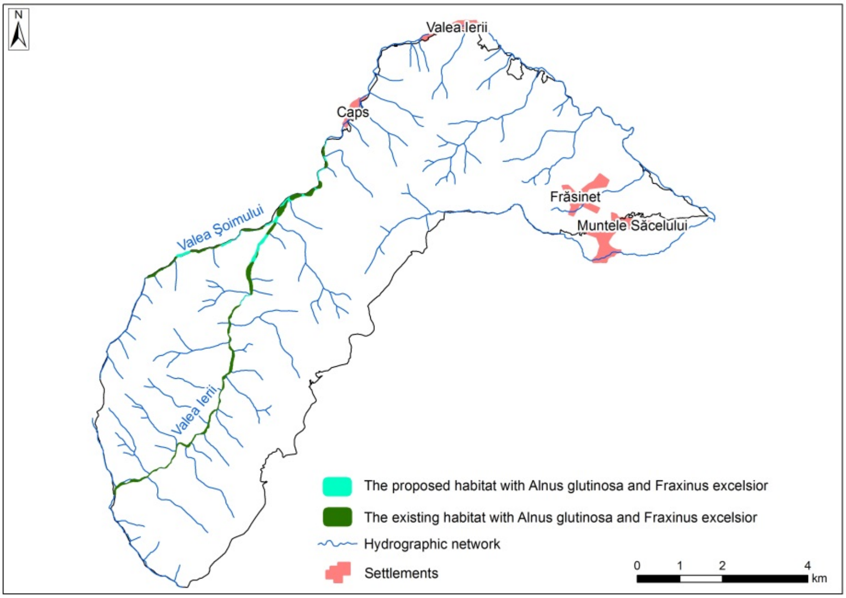

Fig. 2. *The reconfiguration potential of alluvial forests habitat with Alnus glutinosa and Fraxinus excelsior*

For the three sections that were chosen in the field, we obtained the following length values (table 1):

Table 1. *The values of the modifications in the targeted sections*

Section*	**Period**					
	1.XII.2013			30.IV.2014		
	Measure-ment points	Left river bank	Right river bank	Measure-ment points	Left river bank	Right river bank
I (the confluence between Valea Ierii and Valea Șoimului rivers)	I	Retreat 7 cm	Aggrada-tion 5 cm	I	Retreat 10 cm	Aggrada-tion 8 cm
	II	Retreat 16 cm	Aggrada-tion 8 cm	II	Retreat 30 cm	Aggrada-tion 26 cm

Section*	Period					
	1.XII.2013			30.IV.2014		
	Measurement points	Left river bank	Right river bank	Measurement points	Left river bank	Right river bank
II (deposition in the central sector of Valea Ierii's river course)	III	Retreat 55 cm	Aggradation 27 cm	III	Retreat 110 cm	Aggradation 116 cm
	IV	Retreat 6 cm	Aggradation 4 cm	IV	Retreat 10 cm	Aggradation 9 cm
III (deposition in the Caps village proximity)	V	Retreat 22 cm	Aggradation 18 cm	V	Retreat 30 cm	Aggradation 32 cm

The first section is located in the very proximity of the confluence between Valea Ierii and Valea Șoimului rivers. The aggradation of the river bank is not major but it indicates an erosion that evolves over time, both on the concave and convex river banks. Moreover, this section is affected by intense deforestation and wood processing activities.

The second section is situated in the central sector of Valea Ierii's river course, along a deposition. In the point number V we found the maximum erosion rates from the studied area, where the course of the river divides. After consulting the locals, we discovered that this river sector has modified its course from the base of the forest to the road. This fact can also be observed in the field. As a result, this section presents a higher level of erosion impact which can affect the river meadow area.

The last section can be found in the proximity of Caps village and can be distinguished by a well outlined deposition and by the pronounced river banks resulted from an intense process of erosion. In this area, the retreat of the sediments reached 30 cm, which means that the convex river bank is exposed to downfall processes. In the proximity of the water course there are a series of saplings planted for fixing the surface, but the floods affect all the vegetation.

To underline the erosional evolution at the concave river bank throughout the four-month study, we calculated the affected surfaces, as it follows (see table 2):

Table 2. *The surfaces affected by erosion at the concave river bank*

River section	Lenght of the concave river bank	Erosional surface
Section 1	53 m	5.3 m²
Section 2	288 m	28.8 m²
Section 3	126 m	37.8 m²

For the investigation of the riverbed configuration, we calculated the coefficient of sinuosity (Cs), represented by the ratio between the length in straight line of Valea Ierii's river course (Ld) and its sinuous length (Ls). The coefficient of sinuosity has values between 1 and 3, where 1 indicates a linear river course and 3 indicates a high potential of meandering (Ichim et al., 2000). Using the ArcGIS calculation instruments, we obtained the following results:

$$Cs = \frac{Ld}{Ls}$$

where: Cs = coefficient of sinuosity
Ld = lenght of the river course in straight line
Ls = sinuos lenght of the river course

$$Cs = \frac{2.77\ \text{km}}{3.44\ \text{km}} = 1.24$$

According to the study conducted by Leopold et al. (1964), a river is meandered when its coefficient of sinuosity is bigger than 1.5. On the other hand, Chang (1979) states that a value that exceeds 1.3 indicates a meandered river. To sum up, the obtained value (1.24) is near the value of 1.3, which denotes that Valea Ierii river is in the above mentioned category.

After analising the obtained data, we performed a simulation of the future configuration for each studied section of the river bed with its corresponding targeted habitat. By extrapolating the level of meandering for other points than the ones chosen in the field, we determined a new structure of the studied area that could have the following aspect in the next 15 years (Fig. 3., Fig. 4., Fig. 5.).

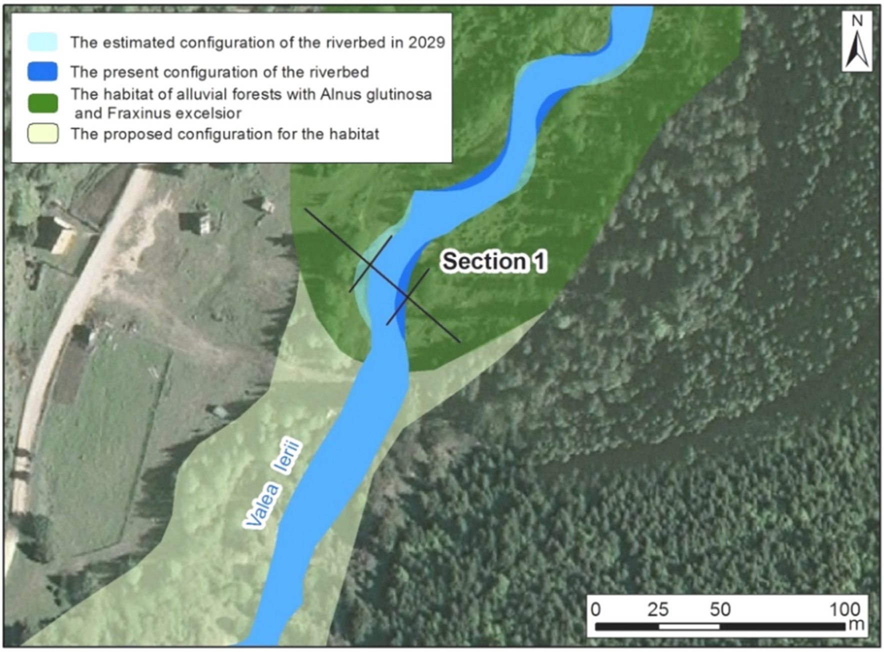

Fig. 3. *The simulation of the configuration for Valea Ierii river and alluvial forests habitat in Section 1*

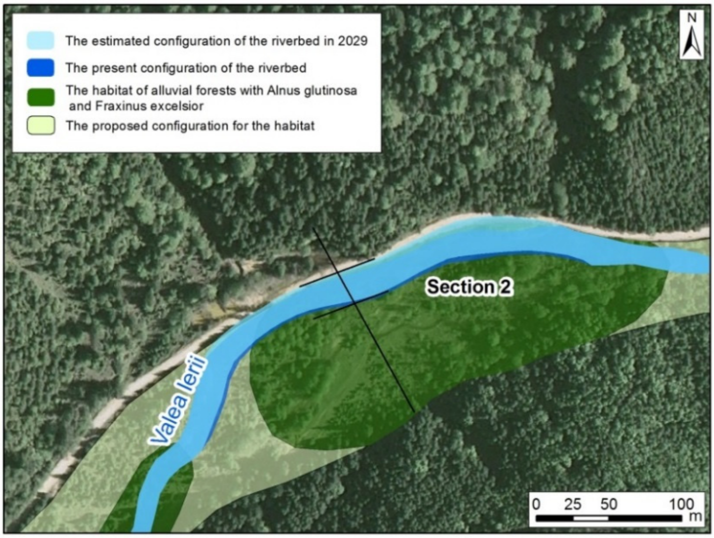

Fig. 4. *The simulation of the configuration for Valea Ierii river and alluvial forests habitat in Section 2*

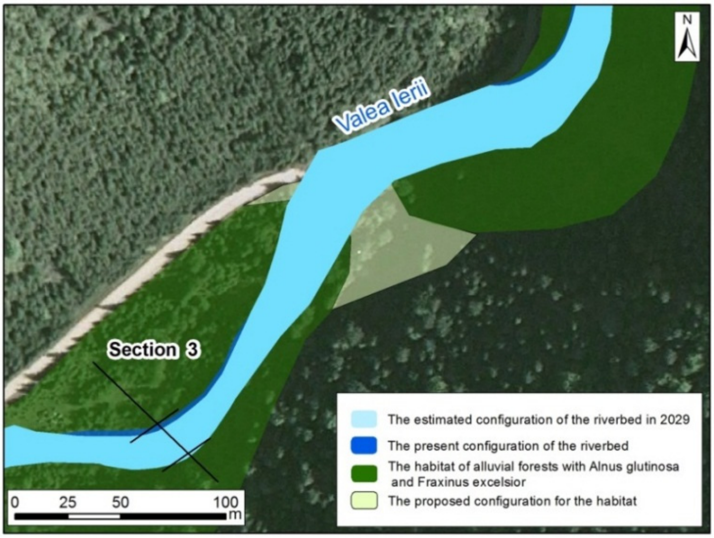

Fig. 5. *The simulation of the configuration for Valea Ierii river and alluvial forests habitat in Section 3*

Similar with the solutions mentioned by Sofronie (2000), we recommend a set of prevention measures which can be applied especially in the proximity of the road near Valea Ierii river and Caps village:

- The construction of bottom sills in order to regulate the drainage of the water into the river bed, the water aeration, the speed reduction and the riverbed erosion. These will be constructed from wood and will be embedded in the river banks;
- The installation of twig supports which will be harvested in the vegetative period and will be fixed under the low-water line, in order to keep the required humidity;
- The disposal of a series of gabions which are indicated for narrow riverbeds which have a consolidation role, especially in case of floods;
- The projection of a vegetative curtain for fixing the riverbed by planting characteristic species.

There are two proceedings that would sustain Valea Ierii riverbed reconfiguration in order to mantain and improve specific conditions for *Alnus glutinosa* and *Fraxinus excelsior* habitat, as it follows:

- The recalibration of the studied riverbed by using specific equipment in the areas where the alluvial forests are discontinuos. This action implies the longwise profile modification of the riverbed;
- The action of rectification that increases the meandering coefficient and the humidity value. This improvement could create life conditions that will mantain a favorable microclimate for both vegetal and animal characteristic species.

CONCLUSIONS

The Valea Ierii protected area benefits from an important ecological potential, not only for its representative species and habitats, but also for the possibilty of reconstructing the area in order to improve the life conditions for its biodiversity. On the one hand, the physical and geographical characteristics exert a majore influence on the mentioned species, and on the other hand, these particularities provide life conditions and support for its specific biodiversity.

The habitat of alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* has a linear distribution and a fragmented structure caused by the human activities and the invasive species of *Picea abies* that are occupying the territory. During our experimental study (December - April 2014), the retreat of the riverbank reached a maximum value of 0.3 m, which indicates a considerable change in the riverbed configuration in several years. The sinuosity coefficient has a value of 1.24 that implies the application of viable measures in order to protect and maintain the ecological potential of the area.

The results and discussions presented in this paper describe the interpretation of the measures taken in the field. The information presented above also creates a simulation for reconfiguring the Valea Ierii's riverbed and the analysed habitat for the following 15 years, in order to identify the meanders' general direction and their influence on the alluvial forests.

REFERENCES

Chang H.H., 1979, Minimum stream power and river channel patterns. *Journal of Hydrology*, **41**, pp. 303-327.

Doniță N., Popescu A., Paucă-Comănescu M., Mihăilescu S., Biriș I. A., 2005, *Habitatele din România*, Tehnică Silvică Publishing House, Bucharest, 442 p.

Fabian A., Onaca R., 1999, *Ecologie aplicată*, Sarmis Publishing House, Cluj-Napoca, pp. 24-69.

Ichim I., Bătucă D., Rădoane M., Duma D., 1989, *Morfologia şi dinamica albiilor de râuri,* Tehnică Publishing House, Bucharest, 408 p.

Leopold L.B., Wolman M.G., Miller J.P., 1964, *Fluvial processes in geomorphology,* San Francisco, W.H. Freeman, 544 p.

Morariu T., Velcea V., 1971, *Principii și metode de cercetare în geografia fizică*, Academiei Publishing House, Bucharest, 284 p.

Pop Gr., 2000, *Carpaţii şi Subcarpaţii României,* Presa Universitară Clujeană Publishing House, Cluj-Napoca, 260 p.

Sofronie C., 2000, *Amenajări hidrotehnice în bazinul hidrografic Someş - Tisa*, Gloria Publishing House, Cluj-Napoca, 265 p.

Tatole V., Iftimie A., Stan M., Iorgu E.-I., Iorgu I., Oțel V., 2009, *Speciile de animale Natura 2000 din România*, edited by MNINGA/A.S.A. S.C, Bucharest, 174 p.

Zhang C., 2007, *Fundamentals of Environmental Sampling and Analysis*, John Wiley and Sons Publication, New Jersey, 456 p.