



## Environmental impact during and after the construction of the bridge over Şieu River near Sărăţel village (Bistriţa-Năsăud county, Romania)

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**Abstract.** The area called "Salt Massif from Sărăţel" was declared as a protected natural area of national interest, being included in category III of the International Union for Conservation of Nature as a nature monument, geological and geomorphological type, with an area of 5 ha. The protected area is crossed by the county road DJ 172G which crosses the course of the Şieu River at kilometer 23 + 190 meters. Until recently the road at that point was cobbled, and crossed the river through a simple ford. In order to improve road traffic conditions on this specific spot, an authentic road bridge was proposed and built. This brought certain social, economic and environmental long term benefits for the entire area and for the people and localities in its vicinity. There is also a negative impact on the environment at the bridge site, manifested through the temporary disappearance of a protected plant species.

**Key Words:** biodiversity, impact, pollution, protected area, salt.

**Introduction.** The area called "Salt Massif from Sărăţel" (in Romanian "Masivul de sare de la Sărăţel") (Figure 1) was declared a protected area at the level of Bistriţa-Năsăud county by Decision no. 58/1976 of the Bistriţa-Năsăud County People's Council, reconfirmed by Bistriţa-Năsăud County Council Decision no. 3/1995. By Law no. 5/2000 regarding the approval of the National Territorial Development Plan - Section III - protected areas, it was declared as a protected natural area of national interest, being included in category III of the International Union for Conservation of Nature as a nature monument, type geological and geomorphological, in an area of 5 ha (Ielenicz 2002), with code 2.202. The location of the protected area is 14 km from Bistriţa municipality, at the confluence of the Bistriţa Ardeleană, Budac and Şieu rivers (Anca et al 1979; Ghinea 2002; Chintăuan et al 2004; Rusu et al 2012). The geographical coordinates of the center of the protected natural area are 47°34'20" N and 24°30'02" E, according to County Council Decision no. 3/1995. From the administrative point of view, the protected natural area is located on the territory of localities, namely Mărişelu and Şieu Măgheruş communes, and Domneşti, Simioneşti and Sărata villages.

The purpose of establishing the Salt Massif from Sărăţel reserve was to preserve the natural, geological, floristic and faunal heritage in the protected area, with the main object of protection being the salt diapir (salt massif) covered by thin quaternary alluvial deposits of the Şieu and Budac rivers which in a few points are removed, the massive salt appearing on the surface, resulting in the appearance of salty springs, salt water puddles, saline efflorescences and halophile plant species (Petrean & Rusu 2011).

The protected area is crossed by the county road DJ 172G, which, on this section, connects the Sărăţel village with county road DJ 154. DJ 172G road crosses the course of the Şieu River at kilometer 23 + 190 meters. Until recently the road was cobbled, and crossed the river through a simple ford (Figure 2); on days when there are heavy rains the crossing becomes impossible for vehicles. In order to improve road traffic conditions

on this specific spot, an authentic road bridge was proposed and built (Figure 3), bringing many social, economic and environmental benefits for the entire area (Costea et al 2023).



Figure 1. Study site.



Figure 2. The crossing over the river represented by a ford (photo by Claudiu Gavriloiu).



Figure 3. The new bridge over the Șieu River (source: <https://rasunetul.ro>).

However, on short term there were some detrimental environmental impacts and we will discuss about them in this study.

**The natural environment in Salt Massif from Sărățel.** Chintăuan et al (2004) made the most comprehensive and precise description of the area. Thus, the diapir within the Salt Massif from Sărățel reserve has an oval shape, oriented along the course of the Șieu River, with digitiform extensions on the three valleys (Bistrita Ardeleană, Budac, Șieu), towards Sărata, Simionești and Domești villages. Its south-eastern extremity it penetrates the terraced forehead of Făget hill and here the erosion brought out the massive salt, which used to be sporadically exploited by the locals. Sometimes the salt is covered by the sliding waves started from the Făget hill (Chintăuan 2000).

The presence of salt under the meadow deposits of the three rivers (Bistrita Ardeleană, Budac, Șieu) is signaled by the appearance of numerous lands with saline efflorescences, halophile plants, springs and salt ponds. There are a few halophile plants mentioned in the area by several authors, like Chintăuan et al (2004), Svoboda (2006) and Rusu et al (2012).

On the edge of the former Sărățel-Domnești road, downstream from the former crossing over the river, we can find saline efflorescences, and approximately 100 m downstream from the place where the salt appeared on the surface, on the right side of the road, at the base of the Făget hill, there are two salt water pools and the facilities of a spa micro-station. In the minor bed and the left bank of the Șieu, there is massive salt close to the surface, under the Badenian clays, covered by soil, which is periodically uncovered.

On the Făget hill, in the excavation left as a result of salt extraction during the Roman occupation of Dacia, there is a lake (Lake Dani) with fresh water. The lake has an area of 780 m<sup>2</sup> and a maximum depth of 4.5 m, being fed by precipitation. The water of this lake is fresh even though it is on salt, a fact that can be explained by the interruption of the contact between water and salt by a landslide started from the northern slope of the Făget hill, made up of the Badenian clays that formed an impermeable bed for the waters that accumulated. Probably at the beginning the waters of the forming lake were salty, accumulating directly on the salt, but later, by interrupting the direct contact with the salt, they gradually became freshwater, reaching the current concentration. The impermeable layer at the bottom of the lake has thickened over time through the supply of material brought by the surface waters from the Făget hill.

Going towards Sărățel, a field road branches off to the right that leads us to the place called "La mol" (Figure 4). Here, on the left bank of the Șieu River, in an old meander of it, there is a pond with salty water and salty mud. The pond, with a surface of only 100 m<sup>2</sup>, has a bank facing the road (south) higher than that facing the river; it is fed with salt water by several bottom springs.



Figure 4. "La mol" place (up), with the open pond within (down)  
(photos by Claudiu Gavriloaie).

**The environmental impact of the bridge construction.** When the construction of this bridge came into discussion, a few impact studies have been done upon the potential impact this bridge and the previous construction site will have on the structure of the salt diapir and on the halophile plants in the area. The studies concluded that no serious impact on the environment was expected based on this project. Most of the impact on the environment will be temporary, during the construction period, and will only cause a minor and local negative effect. A major part of it will be limited to effects related to the renovation works, such as dust and debris, the smell caused by the use of bitumen, the removal of bridge components during construction, the control of erosion, and the

management of the location during the works. All these types of impact are specific for infrastructure renovation works and can be reduced by existing methods. To minimize the potential off-site impact, materials (for example, asphalt, stones, etc.) will only be provided by agents with licenses, approved permits and/or other permits for the safety of the environment and workers. Moreover, any equipment used during construction works must meet international standards for the health and safety of the environment and workers. Indeed, all these aspects proved to be true and the bridge construction has been done in a very discreet manner, with minimal noise. The whole period between May and late September thousands of people kept using the spa micro-station in the vicinity of the bridge construction site. When we asked the owner we were informed that there was no decrease in the number of visitors compared with the previous years. So, the works on the bridge did not affect the tourism in the area.

However, there was a more significant impact than estimated both upon the salt diapir and halophile plants on the construction site and after the bridge was built. Before the construction, the salt emerged on the surface in the area where one of the footbridges was to be established, on the left bank of the Şieu River; in addition, there was also a small population of protected halophile plant species *Salicornia europaea* (Figure 5). On the right bank of the river, at the bridge construction site, there were only *Phragmites australis* and *Salix* sp. plants (Figure 6), which have no protection status. On both sides of the river there were some corn (*Zea mays*) plantations.

After the bridge construction, both the salt at the surface and *S. europaea* disappeared from the location (Figures 7 and 8). But this does not represent a major and long term negative impact. The species *S. europaea* was found in very low density at the site. Given the fact that it is highly abundant downstream the bridge, especially at the place called "La mol", on the one hand, and the soil that has been excavated during the construction works of the bridge has been resettled afterwards, on the other hand, the species in question is not endangered or in danger of extinction. So the bridge work will only affect its abundance at that location in the short term. Concerning the disappearance of the salt emerged at the surface it will surface again along with the future precipitations. Thus, the minor and temporary negative effects of the bridge construction are surpassed by long term environmental advantages, as mentioned by Costea et al (2023).



Figure 5. Salt emerged on the surface, *Salicornia europaea*, *Phragmites australis* and *Salix* sp. on the left bank of Şieu River, at the place where one of the bridge pillars was about to be built (photo by Claudiu Gavriloiu).



Figure 6. *Phragmites australis* and *Salix* sp. on the right bank of Şieu River at the place where the other one of the bridge pillars was about to be built (photo by Claudiu Gavriiloaie).



Figure 7. The right bank of Şieu river after the bridge construction (photo by Claudiu Gavriiloaie).



Figure 8. The left bank of Șieu river after the bridge construction (photo by Claudiu Gavriiloaie).

**Conclusions.** The area called "Salt Massif from Sărățel" (in Romanian "Masivul de sare de la Sărățel") (Figure 1) was declared a protected area of national interest, being included in category III of the International Union for Conservation of Nature as a nature monument. The location of the protected area is 14 km from Bistrița municipality, at the confluence of the Bistrița Ardeleană, Budac and Șieu rivers. The purpose of establishing the Salt Massif from Sărățel reserve was to preserve the natural, geological, floristic and faunal heritage in the protected area, with the main object of protection being the salt diapir (salt massif) covered by thin quaternary alluvial deposits of the Șieu and Budac rivers. The protected area is crossed by the county road DJ 172G, which crossed the course of the Șieu River at kilometer 23 + 190 meters through a simple ford; on days when there are heavy rains the crossing becomes impossible for vehicles. In order to improve road traffic conditions on this specific spot, a road bridge was built, bringing many social, economic and environmental benefits for the entire area. However, there was a significant impact both upon the salt diapir and halophile plants on the construction site and after the bridge has been built. One plant species has disappeared from the site and the salt emerged to the surface has gone also. But these are only temporary and reversible negative effects which are surpassed by long term environmental advantages.

**Conflict of interest.** The authors declare that there is no conflict of interest.

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