ROCK HABITATS IN THE RUDĂRIEI GORGES PROTECTED AREA

Ilinca M. IMBREA[1], Alma L. NICOLIN[1] , Carmen SORESCU[2], Ciprian CORPADE[3], Liviu BUZILĂ[3]

[1]Banat's University of Agricultural Sciences and Veterinary Medicine ,,King Michael I of România", Timisoara, România
[2]Environmental Protection Agency, Caraş-Severin, România
[3]Babeş-Bolyai University, Faculty of Geography,Cluj-Napoca, România
imbreailinca@yahoo.com

Abstract: *The Nature Reserve Rudăriei Gorges is located South-Western Caraş-Severin County in the Almăjului Depression. Though it is known more for its Mill Reserve and the value of the landscape, the area conserves plant species and habitats that are specific to the rocks of South Banat. The vegetation of the Rudăriei Gorges has a sub-Mediterranean character with numerous thermophilous species and vegetal associations similar to those of Serbia and Bulgaria. The mosaic-like aspect of the vegetation and the nature of the geological substratum have made the habitat mapping in the area difficult; some of them, included in the Standard Form of the ROSCI 0032 Rudăriei Gorges cannot be found in the protected area. Thus, of the four protected habitats included in the Standard Form, only one has been reconfirmed in the field. However, we have identified other seven habitats Natura 2000, four of which are rock habitats that are presented in this paper: 40A0* - Subcontinental peri-Pannonic scrub, 6190 - Rupicolous Pannonic grasslands (Stipo - Festucetalia pallentis), 8220 - Siliceous rocky slopes with chasmophytic vegetation, and 8230 - Siliceous rocks with pioneer vegetation of the Sedo-Sclerantion or Sedo albi - Veronicion dillenii. Inventorying and mapping vegetal habitats and species consisted of two stages: the field stage and the laboratory stage for the synthesis of collected data. Field studies were carried out during vegetation, starting in March-April, to also capture the early-spring flora. Determining plant species was done based on nationally acknowledged works (Ciocârlan V., 2009; Săvulescu T., 1952-1976) that we have checked in the electronic database of the Royal Botanical Gardens of Edinburgh (http://rbg-web2.rbge.org.uk/FE/fe.html). Identifying the main habitats and species in the reserve with accuracy allows the establishment of proper measures of conservation and monitoring – a compulsory component of the Management Plan. Studies were financed through a project Operational Programmes Environment, Axis 4: "Developing the Management Plan of the Rudăriei Gorges protected area" (code SMIS 36427).*

Key words: *rock habitats, Nature Reserve, Rudariei Gorges*

INTRODUCTION

Rudăriei Gorges cover an area of 250 ha, having been declared a nature reserve on the basis of Decree 499/1982 and of Decision 8/1994; the reserve is bordered to the north by the town of Eftimie-Murgu, to the east by Rudina Peak (825 m) and to the west by Tâlva Gârboţului Peak (992 m) (Bădescu, B., 1998). In 2008 the area becomes Natura 2000 site of community importance: ROSCI0032 Rudăriei Gorges (by Ministry Order 1964/2007) with an area of 300 hectares. Other protection status under the national/international in forced legislation is the one related to the Watermill Reserve in Rudăria (Eftimie Murgu).

As an ensemble, the geology and morphology of the north-western part of Almăj Mountains is strongly influenced by the presence of the tectonic accident represented by Rudăria Line, developed at the contact between the crystalline formations of the Danubian area, part of Almăj Mountains, and the crystalline and sedimentary formations of the Getic Nappe that form the foundation of Almăj Depression. The substrate of the area under study is composed of crystalline Meso-metamorphic schists belonging to Lelova crystalline composed of micaceous paragneisses and mica schists as well as amphibolic gneisses and amphibolite

schists. In the area of Rudăria Gorges, serpentinite occurs on the right slope, derived from the transformation of amphibolite during the dynamic metamorphism. The contact between magma and crystalline rocks stimulated by the existing network of fractures and cracks caused the transformation of the latter by the phenomenon of contact metamorphism resulting in the formation of metablastic migmatite (hot magma injected metamorphic rocks that have gone a process of partial melting). The metabliastic migmatite formations can be observed on the right side of Rudăriei Gorges, on a strip with northeast-southwest orientation, located below Rudina Mare Peak (Fig. 1.) (BALINTONI, I., 1997).

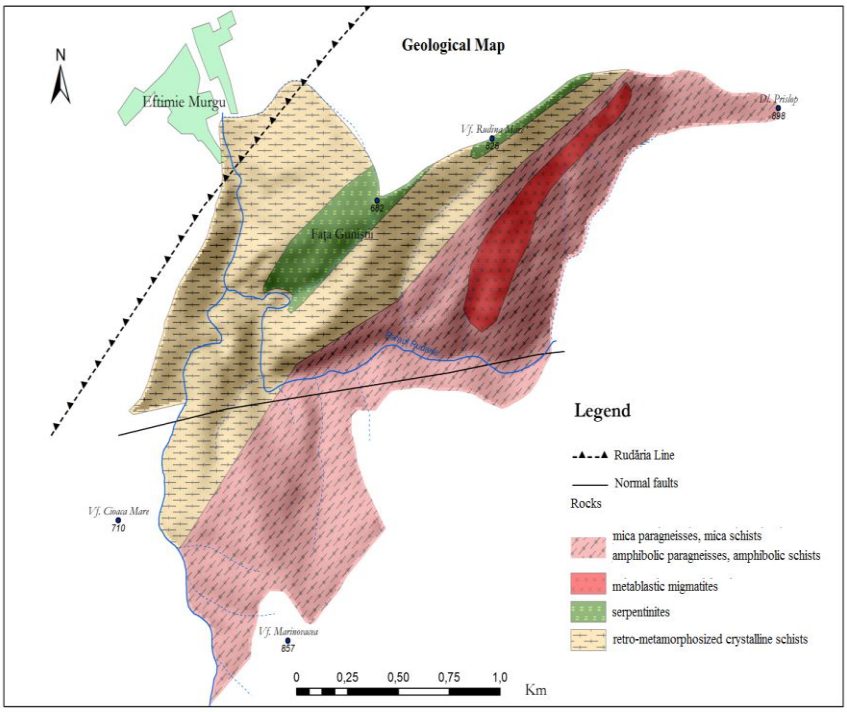

Fig. 1. Geological map of Rudăriei Gorges Protected Area

In Almăj Mountains the peculiar petrographic variety, the climate with Mediterranean influences, a certain slope exposure and the heterogeneity of the vegetation resulted in a pedological mosaic (Fig. 2). With strict reference to the soils identified in the nature reserve, two important categories should be mentioned:

- Mineral soils conditioned by time, a category that includes *Cambisoil* (*typical acid brown soil type*, *subtype lithic acid brown soils*);
- Mineral soils conditioned by the humid temperate climate, respectively Luvisol class (type luvic typical brown soils) (IANOȘ, GH. 1999).

Climatically, Rudăriei Gorges benefits from a continental climate, with strong submediterranean influences. The annual average temperature is 9 °C, with a maximum extreme temperature of 39 °C and a minimum of –21,5 °C (registered at Bozovici meteorological station).

The average precipitation rate reaches 700-750 mm, an increased value in comparison to the country average, mainly due to thestrong influence of the wet cyclonal air masses.

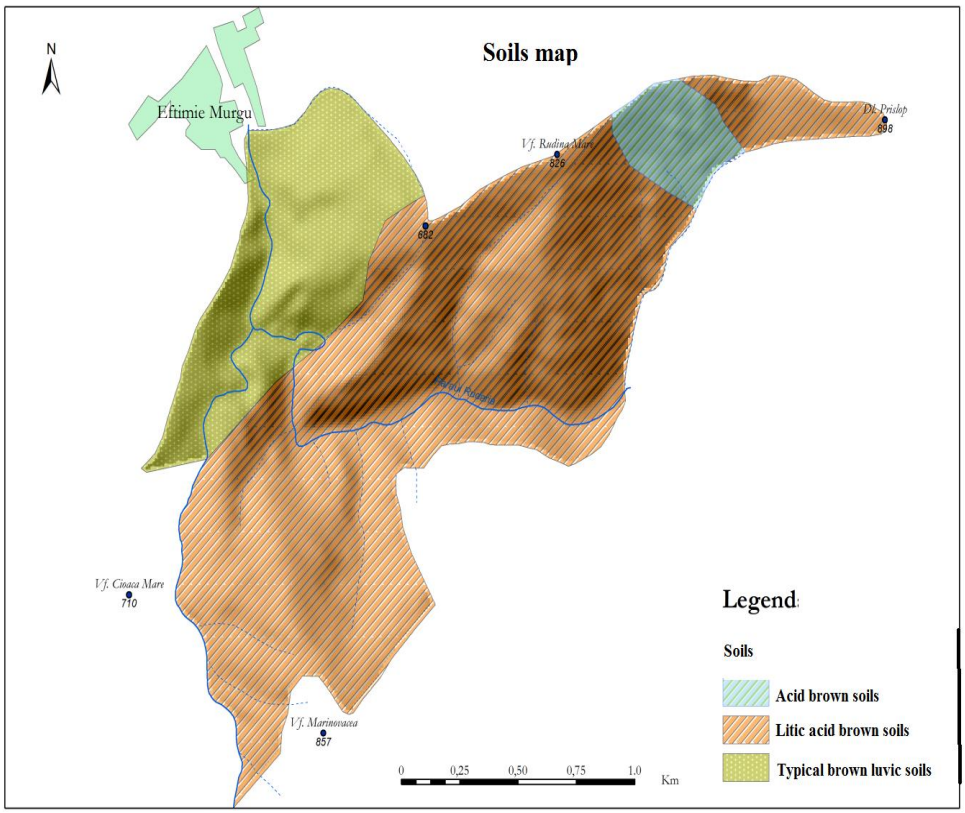

Fig. 2. Pedological map of Rudăriei Gorge Protected Area

MATERIAL AND METHODS

In order to identify the habitats, the phytocenologic research start with the methodology for identifying the plant associations applied by the Central-European school based on the principles of J. Braun-Blanquet (1926). The land studies are based on the collection of actual field samples of vegetation (surveys) on variable surfaces according to the type of vegetation under study.

The analysis of plant associations is the intermediate step in identifying the actual inventory and the mapping of habitats, according to the principles of conservation of the European network of protected areas NATURA 2000. The identification and characterization of habitats was achieved using the Interpretation Manual of Natura 2000 Habitats in România (coord. GAFTA D. & MOUNFORD O., 2008) and Habitats from România (DONIȚĂ N. et al., 2005).

The mapping of habitats is done by recording the GPS coordinates, noting the specific attributes of the studies habitats, introduction of these attributes into the GIS database and achieving the distribution map.

RESULTS AND DISCUSSIONS

According to the Standard Form of ROSCI0032 Rudăriei Gorges (updated in October 2011), in this natural area are listed four types of protected habitats: *6110* - Rupicolous calcareous or basophile grasslands of the Alysso-Sedion albi; 8210- Calcareous rocky slopes with chasmophytic vegetation; 9180* - Tilio-Acerion forests of slopes, screes and ravines; 91K0 - Illyrian Fagus sylvatica forests (Aremonio-Fagion).*

As a result of the field studies, three of these habitats could not be confirmed as present in the area: 6110*, 8210 and 91K0. For the habitat *8210 Calcareous rocky slopes with chasmophytic vegetation* correlated with *6110* - Rupicolous calcareous or basophile grasslands of the Alysso-Sedion albi*, as a result of the silica substrate of the area, the habitat *8220 Siliceous rocky slopes with chasmophytic vegetation* correlated with *8230 Siliceous rocks with pioneer vegetation of Sedo-Scleration or Sedo albi - Veronicion dillenii* is considered.

There have been described seven new Natura 2000 habitats, four of which represent the direct focus of the paper and will be presented in the following.

The habitat 8220 - Siliceous rocky slopes with chasmophytic vegetation

The habitat includes the vegetation developed into the cracks of the continental silicate rocks. It is found in close association with silicate detritus (8110) and pioneer grassland (8230). Is is a fragmented rupicolous pioneer habitat, mainly sciafil, developed into the cracks and shelves of rocks and even into the semi-fixed detritus. The herbaceous layer is formed of numerous species of small ferns: *Polypodium vulgare, Ceterach officinarum, Cystopteris fragilis, Asplenium trichomanes, A. adiantum-nigrum, A. septentrionale.* Into the moss layer the presence of *Ctenidium molluscum, Dicranum scoparium, Hypnum cupressiforme, Mnium* ssp. and others was noted. Edifying and characteristic species: *Poa nemoralis, Jovibarba heuffelii, Asplenium trichomanes* subsp. *trichomanes, A. adiantum-nigrum, A. septentrionale, Polypodium vulgare.*

The species considered representative for this habitat are the following: *Asplenium adulterinum, A. septentrionale, A. cuneifolium, Sedum hispanicum, S. maximum, Sempervivum schlehanii, Polypodium vulgare, Cystopteris fragilis, Galium kitaibelianum, Geranium lucidum, Dianthus henteri, Moehringia muscosa, Epilobium collinum, Cardaminopsis arenosa* (Gafta D. & Mountford O. (coord.), 2008). Endemic species associated with this habitat are *Campanula carpatica, Silene nutans* subsp. *dubia, Thymus comosus*. Within the protected reserve under study these species have not been identified. It is also the case of *Asplenium adulterinum* cited in the Standard Form of the reserve, however it has not been identified in recent or older studies (GRIGORIU et al., 2005).

The most common species on the rocky slopes of Rudăriei Gorges are *Polypodium vulgare, Asplenium ruta-muraria, Asplenium trichomanes, Asplenium scolopendrium, Asplenium septentrionale, Ceterach officinarum, Cystopteris fragilis, Sedum hispanicum, Sedum album, Sempervivum marmoreum, Saxifraga paniculata, Poa nemoralis, Festuca pallens, Alyssum saxatile, Allium flavum, Dianthus carthusianorum, Medicago rigidula, Cardaminopsis arenosa, Moehringia muscosa, Melica ciliata, Teucrium montanum, Galium album, Galium verum, Acinos arvensis, Thymus comosus* etc. In some places, there is a well developed moss layer (e.g. *Ctenidium molluscum*) with role in maintaining the moisture on the slopes.

In the analyzed area, the habitat is distributed on relatively small surfaces, on the rocky slopes of the gorges formed by Rudăria River, with slopes more or less steep, with a variable degree of plant coverage. The habitat is frequently interspersed among other types of

habitat, including hedges (40A0*). It is associated with habitat 8230 - *Siliceous rocks with pioneer vegetation.* (Fig. 3)

Spread particularly on steep rocky slopes, the habitat presents a favourable conservation status. No major direct threats were identified concerning this Natura 2000 habitat.

8230 - Siliceous rock with pioneer vegetation of the Sedo-Sclerantion or Sedo albi – Veronicion dillenii

The habitat consists of pioneer communities colonizing the superficial soils on the silicate rocks. Due to water shortage, this open vegetation is defined by moss, succulent plants and lichens. This habitat is associated with 8220 (GAFTA D. & MOUNTFORD O. (coord.), 2008). It occupies the less profound and often rich in organic matter (thin layer of fine soil covering the rock surfaces) skeleton soils (lithosoils) developed on various parent rocks (granites, gneisses, mica, shale, sandstone, volcanic rocks). They are installed mainly on horizontal rock pieces, rarely on small ledges or small terraces of vertical walls with southern exposure (http://inpn.mnhn.fr/docs/cahab/habitats-declines/8230.pdf.).

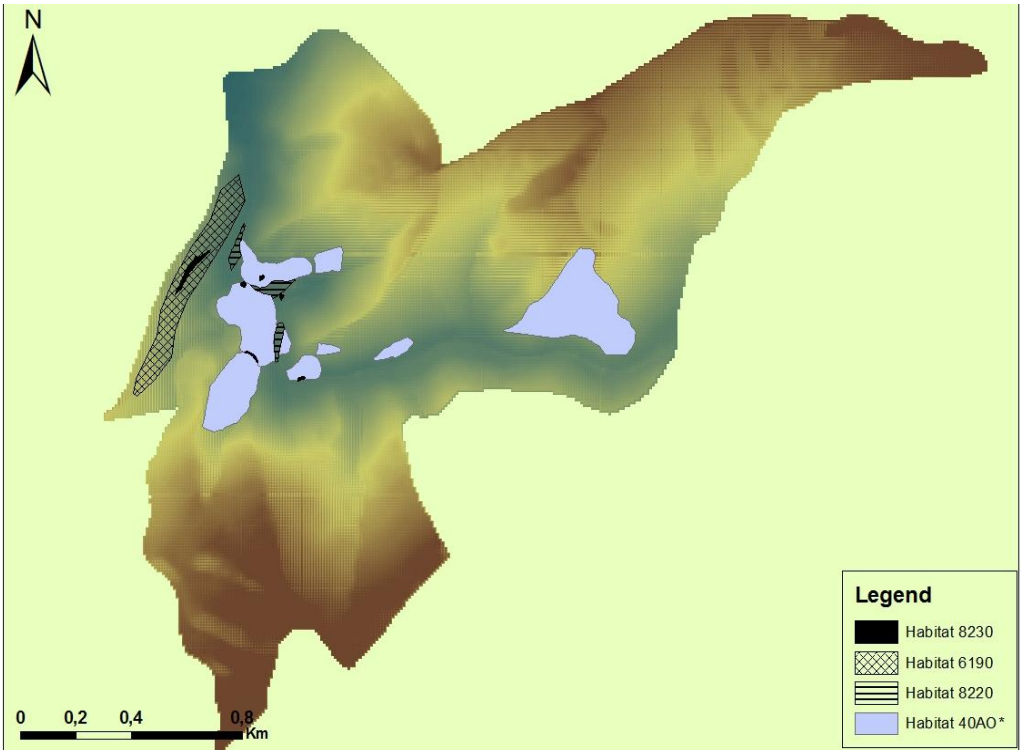

Fig. 3. Distribution of rock habitats in Rudăria Gorges

This type of habitat is widespread in most European countries. The physiognomy is the usual one of peeled vegetation, but with a fairly good coverage, consisting of plants adapted to the conditions that characterize this habitat: summer drought and high temperatures of the soil. It is composed of fam. Crassulaceae (*Sedum, Sempervivum*) and various hemicriptophytes with reduced foliar system, including numerous *Caryophyllaceae*

(*Scleranthus, Arenaria, Herniaria*). The bryo-lichen layer, usually well developed in such phytocenosis, can reach very high coverage. Acidicline silica tiles (with slight preference for acid soil/rocks), dry and warm, especially those associated with base-rich granitic arenas differ significantly as a result of their mixed floristic cortege composed of acidophilous plants and basophyle plants. Terrophytes, usually less abundant and discrete, are better represented in these situations (http://inpn.mnhn.fr/docs/cahab/habitats-declines/8230.pdf).

Among the characteristic species of Sedo-Scleranthion aliance, we mention the following: *Sempervivum montanum*, *Sedum annuum*, *Silene rupestris*, *Veronica fruticans*, iar pentru alianta *Sedo albi-Veronicion dillenii: Veronica verna*, *V. dillenii*, *Gagea bohemica*, *G.saxatilis*, *Riccia ciliifera*. Other species of vascular plants belonging to the two cenotaxons are: *Allium montanum*, *Sedum acre*, *S. album*, *S. rupestre*, *S. sexangulare*, *Scleranthus perennis*, *Rumex acetosella*, and of bryophytes: *Polytrichum piliferum*, *Ceratodon purpureus* (GAFTA D. & MOUNTFORD O. (coord.), 2008).

The habitat is spread on small areas on less steep rocks: punctiform of the slopes bounding the valley of Rudăria River and on the western ridge of the protected area, interspersed with 40A0*, 8220 and 6190. (Fig. 3)

The habitat has favourable conservations status. The main threats are due to contact with grassland habitats affected by grazing and pedestrian access. Other threats include uncontrolled tourism infrastructure development in areas easily accessible. It is necessary to control such activities to maintain the habitat in favourable conservation status.

Habitat 40A0* - Subcontinental peri-Pannonic scrub

It is a priority habitat characterized by low deciduous shrubs and appears on both carbonate and silicate substrates, forming a vegetation mosaic, composed of steppe grasslands (6210) and floristic elements steppe and grassland species in Pannonian rupicole (6190), often along the edges of the forest (Gafta D. & Mountford O. (coord.), 2008).

In România, the habitat covers a very broad area, at the bottom of the Western Carpathians, Transylvania, on the southern valleys of the Southern Carpathians, the plateaus and plains situated north of the Danube, including the ones in Dobrogea and Moldova. The habitat includes very different species and associations (as belonging to different floristic provinces), but all of thermophilic nature, most often xerofile, the exception being the association of *Syringa josikaea*. It usually grows on limestone, sometimes on siliceous substrate, frequently on rocky substrate, like the case of sub-mediterranean schrubs, but also on rendzinas and loess with large thickness (COMĂNESCU - PAUCĂ MIHAELA, 2008).

The characteristic species for this habitat are: *Amygdalus nana* (syn. *Prunus tenella*), *Cerasus fruticosa*, *C. mahaleb*, *Spiraea media*, *Rosa spinosissima*, *R. gallica*, *R. pimpinellifolia*, *Amelanchier ovalis*, *Cornus mas*, *Crataegus monogyna*, *Acer tataricum*, *Cotoneaster integerrimus*, *C. tomentosus*, *C. niger*, *Allium sphaerocephalon*, *Anemone sylvestris*, *Asparagus officinalis*, *Buglossoides purpurocaerulea*, *Geranium sanguineum*, *Peucedanum carvifolia*, *Teucrium chamaedrys*, *Aster linosyris*, *Inula ensifolia*, *I. hirta*, *Melica picta*, *Nepeta pannonica*, *Peucedanum cervaria*, *Phlomis tuberosa*, *Jurinea mollis*, *Vinca herbacea*, *Verbascum austriacum*, *Salvia austriaca*, *Stipa dasyphylla*, *Chrysanthemum corymbosum*, *Vincetoxicum hirundinaria*, *Waldsteinia geoides*, *Aconitum anthora*, *Syringa vulgaris*, *Euonymus verrucosus*, *Viburnum lantana*, *Spiraea chamaedryfolia*, *S. crenata*, *Fraxinus ornus*, *Paliurus spina-christi*, *Jasminum fruticans*, *Syringa josikaea*, *Genista radiata*, *Sorbus dacica*, *S. aria*, *S. cretica*, *Paeonia peregrina*, *Teucrium polium*, *Asplenium ruta-muraria*, *Ceterach officinarum.*

In Rudăriei Gorges, the habitat appears on the rocky slopes bounding the valley of Rudăria, the side of forest roads up to the heights, sometimes mottled with other habitats (8210, 6110). (Fig. 3) The floristic compositions is similar to the thermophilic schrubs of the neighbouring protected areas: Nera Gorges, Caraşului Gorges and Gârliştei Gorges (GRIGORIU et al., 2005).

The habitat is located in wild places, difficult to access. The main threat to the protected area is the invasion of the black pine (*Pinus nigra* J.F. Arnold) planted by foresters in the past. Due to the reduction of the habitat area by more than 1%/year, the conservation status of the habitat is unfavourable-bad, according to the criteria for reporting in the European Union. In terms of structure and functions, and considering its typical species, the habitat is not in a good condition, though no more than 25% of the area covered by the habitat is damaged, thus the conservation status of this criterion is unfavourable-inadequate.

In order to maintain the habitat in an acceptable state of preservation it is necessary to monitor the extending of the black pine over several seasons and possibly make some interventions to eliminate/stop the expansion of this species from the areas most representative for this type of habitat.

Fig. 4 Habitat 40A0* invaded by black pine

6190 - Rupicolous Pannonic grasslands (Stipo-Festucetalia pallentis)

It is a habitat of community importance that includes open rocky grasslands consisting of pioneer species that occur on steep slopes with xeric soils in the less high mountains of Pannonian Basin and in the neighbouring areas, at the altitude of 150-900 m. The bedrock is limestone, dolomite and carbonate volcanic rocks and the soils are shallow rendzinas. The habitat presents three subtypes, the one characteristic to the studied area being 34.353 - Acidophilous grasslands with *Festuca pallens (Asplenio septentrionalis - Festucion pallentis, Alysso saxatilis - Festucion pallentis)*. These are Central-European subcontinental

xerothermophilous meadows with hard silica rocks of hill and mountain scales (GAFTA D. & MOUNTFORD, O. (coord.), 2008).

Among the specific species for this habitat, we mention: *Festuca pallens, Bromus pannonicus, Stipa eriocaulis, S. joannis, S. pulcherrima, Carex humilis, Chrysopogon gryllus, Iris pumila, Pulsatilla grandis, Alyssum montanum, Globularia punctata, Anacamptis pyramidalis, Draba lasiocarpa, Polygala amara, Daphne cneorum, Festuca amethystina.*

This habitat is also mentioned in other areas on the south-west of România: Nerei-Beuşniţa Gorges, Caraşului Gorges, Gârliştei Gorges, Cerna Valley, Porţile de Fier. (OPREA A., 2008).

In Rudăriei Gorges the habitat is poorly represented, both in terms of coverage and floristic composition. The grasslands are located at the edge of the protected area, they are grazed and affected by pedestrian paths, even though the access road for automobiles is outside the limits of the protected area. The slopes are variable, sunny, xeric. The habitat is found on the plateau deriving from the rocky slopes, in mosaic with other habitats (6110*, 40A0*). (Fig.3)

CONCLUSIONS

Of the four types of habitats listed in the Standard Form of Natura 2000 site ROSCI0032 Rudăriei Gorges (6110*, 8210, 9180*, 91K0), three could not be confirmed in the field (6110*, 8210, 91K0). The same is the case of the species *Asplenium adulterinum* Milde, listed in older bibliographic data, but not identified in the field. This species can be confused with *Asplenium trichomanes* L.

We believe that such differences occurred due to the location of Rudăriei Gorges in the vicinity of the National Park Nerei-Beuşniţa Gorges. Thus, while Nerei Gorges are known for the abundance of karst phenomena generated by substrate limestone, the geology of Rudăriei Gorges demonstrates the dominance of crystalline schists. These geological differences significantly influence the vegetation habitat types and thus, some fauna species. We found significant differences between the types of habitats in the two neighbouring protected areas, regarding plant communities on rocks and the types of forest.

In terms of habitats, one of the most important problems in Rudăriei Gorges is the expansion of the black pine (*Pinus nigra* J.F. Arnold), a species previously planted by foresters to stabilize the slopes. The species is constantly expanding on the rocky slopes, to the detriment of the characteristic habitats. Planting of acacia have also been observed, all these interventions made without a prior study, with long-term negative impact on natural habitats.

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***http://inpn.mnhn.fr/docs/cahab/habitats-declines/8230.pdf