NOTES ON THE WATER MEADOW VEGETATION IN THE RUDĂRIA GORGES

VEGETAȚIA DE LUNCĂ DIN CHEILE RUDĂRIEI

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Abstract: *In the Rudăria Gorges, the water meadow vegetation belongs to the Stellario nemori-Alnetum glutinosae (Kästner 1938) Lohm. 1957 association characteristic to the hill and low mountain areas. The valley characteristics determine the water meadow vegetation to be discontinuous: on the steeper walls over the forest road, water meadow species mix with lilac and flowering ash bushes, while upstream the beech and hornbeam woods go down to the river banks. The vegetal cover contains thermophilous species also characteristic for other gorges in southern Banat. Mediterranean, Balkan, and Pontic elements underline the link between the flora in this area and that of other regions south from Romania. The diversity of flora in the Rudăria Gorges is completed by the presence of some endemic, rare species.*

Rezumat: *În Cheile Rudăriei, vegetaţia de luncă aparţine asociaţiei Stellario nemori - Alnetum glutinosae (Kästner 1938) Lohm. 1957 tipică zonei colinare şi montane inferioare. Caracteristicile văii determină ca vegetaţia de luncă să fie discontinuă: pe pereţii mai abrupţi dinspre drumul forestier, speciile de luncă se întrepătrund cu tufărişurile de liliac şi mojdrean, în timp ce, în amonte, pădurea de fag şi carpen coboară până pe malul apei. Covorul vegetal cuprinde specii termofile caracteristice şi pentru alte chei din sudul Banatului. Elementele mediteraneene, balcanice şi pontice subliniază legătura dintre flora acestei zone şi alte regiuni de la sud de ţara noastră. Diversitatea florei din Cheile Rudăriei este completată de prezenţa unor specii endemice şi rare.*

Key words**:** *Rudăria Gorges, water meadow vegetation*
Cuvinte cheie**:** *Cheile Rudăriei, vegetaţie de luncă*

INTRODUCTION

The Rudăria Gorges Reserve (250 ha) is located near the Eftimie Murgu village (in the Bozovici Depression) and covers the middle basin of the Rudăria River, an affluent of the Nera River. The Reserve preserves gorges characterized by xero-thermophilous rock vegetation, rare species of invertebrates, amphibians and reptiles, and also by a mill complex made up by 22 dip bucket mills.

The Reserve has also been studied by Peia (1978); our research shows some changes of the flora and vegetation in time. Thus, the rocks are nowadays dominated by lilac and flowering ash bushes belonging to the *Syringo-Fraxinetum orni* Borza 1958 em. Resmeriță 1972 association (Grigoriu *et al*., 2005), though in the past they used to be covered mainly by a grassy vegetation, included by Peia (1978) in the *Cytiso – Festucetum rupicolae* and *Asplenio – Syringetum vulgaris* Jakucs et Vida 1959 associations.

The vegetation close to the Rudăria River is made up not only of species typical for water meadows, beech and hornbeam species grown on the slopes, but also of elements characteristic of the bushes on the rocks bordering the forestry road.

MATERIAL AND METHODS

The study was carried out between 2003 and 2005, according to the methodology of the central-European phyto-coenologic school. For each sampling we noted the height and

vegetation covering degree for each of the three strata, the slope and exposition, the altitude and GPS coordinates. For each species we supply the values of abundance-dominance and frequency, as well as their constancy within the sampling. Because of the vegetation and dominant species variability, all the samplings were included in a single synthetic table.

RESULTS AND DISCUSSIONS

The vegetation bordering the Rudăria River varies depending on the valley characteristics. The right bank of the river (downstream) has more shadow, more vegetation, and is higher, while the left bank bordering the road is covered mainly with bushes.

Upstream, the river is bound by *Fagus sylvatica* and *Carpinus betulus* forest. Besides these species, in the samples appear *Corylus avellana, Cornus mas, Cornus sanguinea, Euonymus verrucosus, Malus sylvestris, Prunus avium, Rubus idaeus, Sambucus nigra, Tilia cordata, Tilia platyphyllos*. Towards the exit from the gorges, dominates the bushes with *Syringa vulgaris, Fraxinus ornus, Cotinus coggygria*, accompanied by *Carpinus betulus, Carpinus orientalis, Crataegus monogyna, Chamaecytissus hirsutus, Genista tinctoria, Rosa canina, Quercus robur*.

Among the species typical of a water meadow the most abundant are *Alnus glutinosa, Populus nigra*, and *Salix alba*. *Robinia pseudacacia* appears all along the valley, including on the banks of the river, at Pintenul Moşului (where there is also a portion covered by pines planted by foresters).

Thus, the water meadow vegetation proper is discontinuous and can be noticed mainly where the valley is broader and the slope resulting in the water flowing down, smoother. The dominant species here is *Alnus glutinosa* (with 40-60% from the total cover), but there are some other abundant species too: *Carpinus betulus* and *Corylus avellana* (40%), *Populus nigra, Robinia pseudacacia, Cornus sanguinea, Fraxinus ornus, Syringa vulgaris, Crataegus monogyna,* and also *Dactylis glomerata, Milium effusum,* and *Matteucia struthiopteris*.

Numerous species indicate the humidity and the shadowing of the biotopes: *Aegopodium podagraria, Caltha palustris, Clematis vitalba, Equisetum palustre, Geranium phaeum, Geranium robertianum, Moehringia pendula, Myosotis scorpioides, Petasites hybridus, Ranunculus acris, Rubus idaeus, Saxifraga rotundifolia, Stellaria nemorum, Symphytum ottomanum, Symphytum tuberosum, Urtica dioica*.

The vegetal association *Stellario nemori - Alnetum glutinosae* (Kästner 1938) Lohm. 1957 (synonymous with *Alnus glutinosa - Salix purpurea* Paucă 1941, *Aegopodio - Alnetum praecarpaticum* Kárpáti V., Kárpáti I. Et Jurko 1963, *Alnetum glutinosae* Meijer-Drees 1936) has, in general, a richer and more heterogeneous floristic composition, as a result of the altitude of the phyto-coenoses and of the hydric factor (Sanda *et al.*, 1998). It represents the river water meadows made up by *Alnus glutinosa* that can be met along the rivers in the hill and mountain areas. In the Rudăria Gorges these phyto-coenoses appears like narrow bands between the river and the forest or bushes. Peia (1978) had included them into the *Aegopodio - Alnetum* Kárpáti Et Jurko 1961 association. Sampling 1, in which *Corylus avellana*, reaches 40% of the total cover off the stratum, can be considered as belonging to the *coryletosum avellanae* Coste 1974 sub-association.

Numerous species are characteristic for this association: *Alnus glutinosa, Fraxinus excelsior, Ulmus laevis, Frangula alnus, Humulus lupulus, Stellaria nemorum, Aegopodium podagraria, Matteuccia struthiopteris, Salvia glutinosa, Circaea lutetiana, Stachys sylvatica, Festuca gigantea, Carex montana, Equisetum thelmateia, Geranium phaeum, Athyrium filix-femina* (Sanda *et al.*, 1998; Coste, 1980); some of them were identified also in our samples.

Upstream, the river crosses beech and hornbeam woods that go down to the river banks. These samplings (R_{6-8}) belong to the *Carpino-Fagetum* Paucă 1941 association. Beech

and hornbeam woods are widely spread in the Romanian Carpathians: they can be usually met at the foot of the slopes in the mountain lower levels, where they make up extra-area vegetation. Soils on which they grow are brown or rendzinic, with medium or strong trophicity in the surface horizons (Sanda *et al.*, 1998). Grassy species characteristic of the association are: *Carex pilosa* and *Galium schultesii.*

In the tree stratum of these phyto-coenoses the species *Carpinus betulus* and *Fagus sylvatica* are co-dominant, their cover reaching 100%. The wooden species with significant cover are *Malus sylvestris, Populus nigra, Cornus mas, Cornus sanguinea, Euonymus verrucosus*. Inside of the beech forest some other typical species are frequent too: *Anemone nemorosa, Arum maculatum, Asarum europaeum, Cardamine bulbifera, Daphne mezereum, Matteucia struthiopteris, Symphytum ottomanum, Ranunculus ficaria, Galium odoratum.*

Towards the exit from the gorges, the river is sometimes bordered by rocky, sunnier slopes, on which grow lilac and flowering ash bushes; even if these phyto-coenoses also contain water meadow species, unlike xero-philous bushes proper on the slopes, they can nevertheless be grouped into the *Syringo - Fraxinetum orni* Borza 1958 em. Resmeriță 1972 association.

As they are close to the river banks, these phyto-coenoses have also quite abundant water meadow species in their composition, such as *Alnus glutinosa* and *Salix alba*, reaching up to 40%. Rocky species are also very numerous: *Asplenium ceterach, Carpinus orientalis, Chamaecytissus hirsutus, Cotinus coggygria, Galium album, Genista tinctoria, Geranium macrorrhizum, Sedum telephium* subsp. *maximum*. High values for the abundance – dominance index have *Fraxinus ornus* and *Syringa vulgaris*, but also *Crataegus monogyna, Festuca rupicola, Melica ciliata, Milium effusum, Robinia pseudacacia*.

From the synthetic table we can notice the very constant species: *Fraxinus ornus, Alnus glutinosa, Carpinus betulus, Crataegus monogyna, Matteucia struthiopteris, Milium effusum, Cornus sanguinea, Corylus avellana, Fagus sylvatica, Holcus lanatus, Petasites hybridus, Robinia pseudacacia, Rubus idaeus, Symphytum ottomanum, Symphytum tuberosum, Syringa vulgaris, Urtica dioica*.

In the Rudăria Gorges, as well as in other similar gorges of the Banat area, there are numerous thermophilous species with particular features similar to those of the vegetal associations in the Balkans: *Anemone nemorosa, Asplenium ceterach, Carpinus orientalis, Cotinus coggygria, Lychnis viscaria, Melica ciliata, Melissa officinalis, Robinia pseudacacia, Symphytum ottomanum, Syringa vulgaris.* Other species also show this fact by their belonging to the geographical element, many of which are Mediterranean, Balkan, or Pontic: *Arum orientale, Cornus mas, Festuca drymeja, Fraxinus ornus, Hedera helix, Moehringia pendula, Quercus cerris, Sedum hispanicum, Thymus glabrescens*.

The variability of the biota makes the species inventoried differ from the point of view of moisture. The synthetic table contains some endemic species (in accordance with *Flora Europaea*, electronic edition): *Geranium macrorrhizum, Moehringia pendula, Pulmonaria officinalis, Symphytum ottomanum, Syringa vulgaris.*

CONCLUSIONS

In the Rudăria Gorges, the water meadow vegetation proper belongs to the *Stellario nemori-Alnetum glutinosae* (Kästner 1938) Lohm. 1957 association characteristic to the hill and low mountain areas. Because of the valley characteristics, water meadow vegetation is discontinuous; thus, on the steeper walls over the forest road, water meadow species mix with lilac and flowering ash bushes, while upstream the beech and hornbeam woods go down to the river banks.

Table 1

The abundance – dominance, the frequency, and the constancy of the species

Sample number	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	
Vegetation height (cm)														
S1	*20*	*25*	*25*	*30*	*30*	*20*	*20*	*30*	*30*	*30*	*20*	*30*	*25*	
S2	*100*	*150*	*150*	*200*	*100*	*200*	*250*	*300*	*200*	*200*	*250*	*200*	*200*	
S3	*300*	*500*	*600*	*800*	*800*	*800*	*900*	*600*	*400*	*700*	*800*	*400*	*600*	
Vegetation cover (%)														
S1	*40*	*50*	*20*	*60*	*60*	*15*	*20*	*40*	*30*	*40*	*15*	*5*	*30*	
S2	*10*	*40*	*50*	*40*	*15*	*30*	*15*	*20*	*20*	*15*	*40*	*80*	*40*	
S3	*50*	*90*	*80*	*60*	*60*	*90*	*95*	*90*	*60*	*80*	*70*	*80*	*80*	
Slope (^{0})	*70*	*0*	*40*	*0*	*0*	*0*	*0*	*0*	*40*	*50*	*40*	*60*	*20*	
Exposition	*N*	-	*E*	-	-	-	-	-	*E*	*E*	*E*	*N*	*SE*	
Altitude (m)	*390*	*390*	*400*	*420*	*420*	*390*	*390*	*390*	*390*	*390*	*390*	*390*	*390*	K
Aegopodium podagraria	+.3		+.2	+				+.1						
Alnus glutinosa	**2.4**	**3.4**	**3.4**	**2.4**	**2.5**	+.2			**1.3**		**1.3**	**2.4**	+.2	IV
Anemone nemorosa		+.3				**1.5**	+.1	+.5						II
Arum maculatum		+.1				+	+.1							II
Asarum europaeum			+.1			+.2	+.4	**1.4**						II
Asplenium ceterach			+.2				+	+	+.4	+				II
Caltha palustris			+.1		+									I
Cardamine bulbifera		+.2				+.5	+.3	**1.4**						II
Carpinus betulus		**2.4**	+.2	+.3	+.2	**1.4**	**3.5**	**3.5**					+.2	IV
Carpinus orientalis		+.1							+.1		+			II
Chamaecytisus hirsutus	+.5								+				+.1	II
Clematis vitalba		+.2		+.2	+.2									II
Cornus mas						+.4								I
Cornus sanguinea		+		**1.4**		+.3		+.2	+.2		+.2		+	III
Corylus avellana	**2.4**		+.2			+.4	+.2	+.3			+.4			III
Cotinus coggygria								+.1					+.2	I
Crataegus monogyna	+.4		**1.4**		+	+.2			+.2	**1.4**		+.2	+.2	IV
Dactylis glomerata				**1.5**										I
Daphne mezereum						+.2	+.1	+						II
Equisetum palustre		+	+.3		+	+	+							II
Euonymus verrucosus						+.3								I
Fagus sylvatica		+.3			+.1	**3.5**	**2.5**	**1.3**		+.1				III
Festuca rupicola													**1.5**	I

Fragaria viridis				+			+		+				+.3	II
Fraxinus ornus		+.3	**1.5**	+.3	+.1	+	+.1	+	**2.4**	**2.3**	**1.3**	**1.3**	**3.5**	V
Galium album	+.2								+.2				+.3	II
Galium odoratum		+				+.2		+.2						II
Genista tinctoria										+.3				I
Geranium macrorrhizum									+	+		+.3		II
Geranium phaeum			+.2		+									I
Geranium robertianum		+.3			+.3									I
Geum urbanum		+.2		+.1										I
Holcus lanatus		+.3			+.3	+.2	+	+.2			+	+.2		III
Lychnis viscaria													+.4	I
Lysimachia nummularia		+.2		+.3				+.2						II
Lysimachia vulgaris											+.4		+	I
Malus sylvestris								**1.3**						I
Matteucia struthiopteris	+.4			**1.4**	**1.3**	+.2	+.3	+.3	+.2		+.2	+.4		IV
Melica ciliata									**1.4**					I
Melissa officinalis		+			+						+.3	+.4		II
Milium effusum	**1.5**	**1.4**	+.4		+.2			+.2	**1.4**	**1.5**		+.3		IV
Moehringia pendula			+.2		+.1									I
Myosotis scorpioides		+.2		+.1	+.1		+	+.2						II
Oxalis acetosella			+	+	+		+	+.1						II
Petasites hybridus				+.3		+	+.3	+.2		+	+.2			III
Peucedanum oreoselinum			+.2						+.2				+.3	II
Populus nigra				**1.3**	+.2	**1.3**								II
Ranunculus acris		+			+.4									I
Ranunculus ficaria	+			+.2	+.4	+		+.2						II
Robinia pseudacacia		+.3		**1.3**	+.3	+.2	+	+.3				**1.3**		III
Rosa canina	+.3										+	+	+.1	II
Rubus idaeus	+.5	+		+.2		+		+.2		+.3	+.2			III
Salix alba										**2.4**	**2.4**			I
Sambucus nigra			+.3					+.1						I
Saxifraga rotundifolia			+.3											I
Sedum telephium ssp. maximum									+.2	+.4			+	II
Stellaria nemorum		+.1			+.1									I
Symphytum ottomanum	+.5			+		+.3	+.1	+.5			+.2			III
Symphytum tuberosum			+.2	+.3	+.1	+.2					+	+	+.2	III
Syringa vulgaris	**1.3**	+.3	+.4				+ 3		**1.3**	+.1		**3.5**	**1.3**	III
Tilia platyphyllos														
Tanacetum vulgare	+.3								+.2			+.2		II
Urtica dioica		+		+.2	+.1	+	+			+	+.4			III

Veronica longifolia				+.3	+.2					+			+.2	II
Viola odorata				+	+.1			+				+.1	+	II

Other species with low frequency and abundance in samples: *Acer campestre, Achillea setacea, Agrimonia eupatoria, Alliaria petiolata, Arum orientale, Cardamine impatiens, Carex pillosa, Centaurea scabiosa, Circaea lutetiana, Corydalis cava, Epilobium montanum, Festuca drymeja, Fraxinus excelsior, Galium aparine, Galium schultesii, Galium verum, Hedera helix, Luzula luzuloides, Pyrus pyraster, Polypodium vulgare, Prunus avium, Pulmonaria officinalis, Quercus cerris, Sanguisorba minor, Sedum acre, Sedum hispanicum, Tamus communis, Teucrium chamaedrys, Tilia cordata, Thymus glabrescens*

The vegetal cover contains thermophilous species also characteristic for other gorges in southern Banat. Mediterranean, Balkan, and Pontic elements underline the link between the flora in this area and that of other regions south from Romania. The diversity of flora in the Rudăria Gorges is completed by the presence of some endemic, rare species.

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