CONTRIBUTIONS TO THE PHYTOSOCIOLOGICAL STUDY OF THE *SALICI PURPUREAE-MYRICARIETUM* MOOR 1958 ASSOCIATION IN THE ORĂŞTIE RIVER BASIN (CENTRAL-WESTERN ROMANIA)

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Abstract. In the current paper we present a phytosociological study of the phytocoenoses of the association *Salici purpureae-Myricarietum* Moor 1958 identified on the bank gravels of upper Orăştie river basin, situated in the central-western part of Romania.

The characterisation of the association under analysis as well as the presentation of the phytosociological table have been done by selecting the most representative relevés performed in the undergrowths of *Myricaria germanica* in the upper Orăştie river basin. The phytocoenoses of this particular association were analysed in terms of physiognomy and floristic composition, life forms spectrum, floristic elements, and ecological indices.

The *Myricaria germanica* underbrushes represent a highly community-significant natural habitat of great conservational value, whose preservation calls for the delineation of certain off limit areas.

Keywords: phytocoenoses, association, relevés, floristic elements, life forms, ecological indices, *Myricaria germanica*.

INTRODUCTION

The hydrographic basin of the Orăştie river lies in the central-western part of Romania (Fig. 1). It is located between the hydrographic basins of the rivers Strei (to the South and West) and Cugir (to the East), while to the North the Orăştie river discharges into the Mureş river [28, 30].

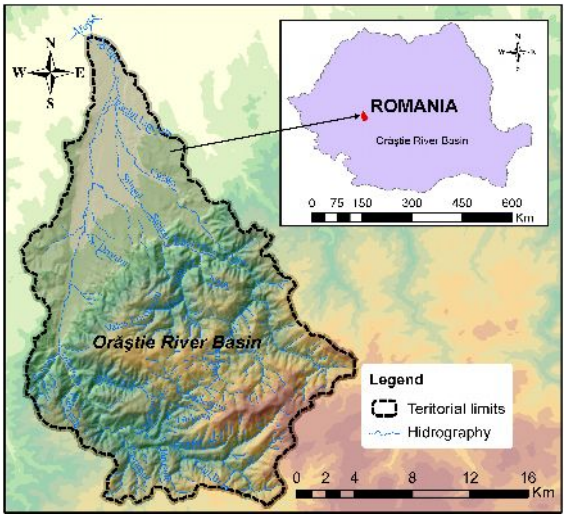

Figure 1. Location of the Orăştie River Basin in Romania [32] (modified)

The Şureanu Mountains consist mainly of meso-metamorphic and epi-metamorphic crystalline schists, surrounded peripherically by some areas of sedimentary rocks (sandstones, conglomerates, limestones etc.). We must add that within the studied territory just a portion of these mountains is included, namely the west-north-western part, commonly known as the Orăştie or Sarmizegetusa Mountains [28]. The altitudinal range wherein the phytocoenoses of *Salici purpureae-Myricarietum* Moor 1958 were identified is between 530 m and 1656 m (Godeanu Peak).

The territory under analysis is part of the temperate climatic zone, with slight maritime influences, the complex topoclimate of the Orăştie lowlands and Parâng highlands [28].

The average thermal differences between the outskirts of the mountains and their tops reach circa 10 degrees Celsius. Towards their north-western limits, due to the warm air incursions from the Banato-Crişana plains, the yearly average temperatures range from 9 to 10°C . In winter, the multiannual average temperatures vary among -2°C and -7°C, in spring they rise by 6 - 12°C, in summer they reach 8°C on the mountain tops and over 19 degrees on the outskirts, while in autumn the average temperatures decrease by 5,5°C - 7°C as compared to those in the summer months [28].

The rainfall amounts in multiannual average to circa 550-600 mm in the outskirts and increases to over 1000 mm in the high altitude central parts. In the whole of Transylvania the rainfall quantum is 500 – 700 mm/year [18].

In România, the underbrushes of *Myricaria germanica* have previously been investigated by Pázmány (1969), Sanda et al. (1970), Dihoru (1975), Fink (1977), Raţiu et al. (1984), Coldea (1990), Drăgulescu (1995); Ştefan et al. (1997); Pop et al. (2002), Chifu et al. (2006), Danci (2014) [4, 6, 8, 9, 12, 15, 19, 20, 21, 24, 27].

Figure 2. *Salici purpureae-Myricarietum* Moor 1958, Grădiştea de Munte (15.07.2012)

MATERIAL AND METHODS

The vegetation studies in the hydrographic basin of the Orăştie river (central-western România) were conducted throughout 2009 and 2014 targetting all types of sites indicative of the association *Salici purpureae-Myricarietum* Moor 1958. The vegetation research deployed the phytocoenologic survey methods drawn up by Braun-Blanquet (1964) [2], adjusted according to the particularities of the region under scrutiny. The sampling technique and the annotations (quantitative appraisals) were observed strictly in accordance with the instructions of the authors Borza and Boşcaiu (1965) [1]. The associations were identified using the characteristic species, without overlooking the differential and dominant species.

The phytocoenologic worksheets contain information regarding the stational habitat conditions in which the phytocoenoses evolve: rock, soil, altitude, exposition, slope, vegetation coverage. At the same time when we took down the taxa that define each relevé, we also gave a quantitative appraisal of the participation of each and every species with respect of abundance and dominance, in accordance with the method proposed by Braun-Blanquet et Pavillard (1928) [3], and we assessed the overall vegetation coverage using the methods designed by Tüxen (1955) [29] and Ellenberg (1974) [14].

The phytocoenologic table of the association was structured according to the methodology designed by Braun-Blanquet (1964) [2] and improved by Ellenberg (1974) [14]. The methodology we used for positioning the association into the superior coeno-taxonomic units, namely suballiance, alliance, order, class, took into consideration the traditional ecological-floristic systems developed by Sanda et. al (2008) [23].

The phytocoenologic synoptic table for this association (Table 1.) consists of information pertaining to the floristic and coenologic composition of the plant population rendering the phytocoenosis, the life form, the floristic (phytogeographic) element, the ecological indices of soil moisture (U), temperature (T), soil reaction (R), the ordinal numbers of the relevées, the absolute altitude in metres (a.s.l.), and the sampled surface (m^2). The last column of the synoptic table holds the constancy of species (K), whose classes are marked by Roman digits from I to V. The values of the synthetic phytocoenologic indices, namely the constancy (K) was computed using the methods proposed by Braun-Blanquet et Pavillard (1928) [3], and Cristea et al. (2004) [7].

The determination of taxa followed the criteria established by Ciocârlan (2009) [5], Speta et Rákosy (2010) [26] and Sârbu et. al. (2013) [25].

The nomenclature of taxa was done according to Ciocârlan (2009) [5], and the plant association was analysed using the main ecological indices of the component species, life forms and floristic elements, the data being shown graphically in spectra and diagrams [13, 22].

RESULTS

The phytocoenoses of the association *Salici purpureae-Myricarietum* Moor 1958 appear in small groves on periodically flooded bank gravels in the upper part of the Orăştie river basin, at heights of 530 - 535 m a.s.l. (Fig. 2).

The *floristic inventory* of the association totals 35 species covering 70% - 85% of the surface (Table 1). *Myricaria germanica* is the dominant characteristic species, with an average coverage of 37.5% - 62.5% and a maximal constancy (K = V), whereas *Salix purpurea* takes the subdominant position in the coenoses in which it vegetates (K = II). The two species are accompanied by the plants characteristic of the alliance *Salicion elaeagno-daphnoides*, order *Salicetalia purpureae* and class *Salicetea purpureae* (*Calamagrostis pseudophragmites, Salix triandra, Cirsium candelabrum, Salix elaeagnos*). The association comprises meso-hygrophile and hygrophile species along the riverside, belonging to the alliance *Alno-Ulmion* (*Alnus incana, Impatiens noli-tangere, Lysimachia nummularia, Alnus glutinosa, Petasites hybridus*), accompanied by a considerable number of species and subspecies of the class *Molinio-Arrhenatheretea* (*Agrostis stolonifera* subsp. *stolonifera, Prunella vulgaris, Achillea millefolium* subsp. *millefolium, Agrostis capillaris* subsp. *capillaris, Dactylis glomerata, Holcus lanatus, Leontodon autumnalis, Trifolium repens* subsp. *repens, Leucanthemum vulgare* etc.).

The life form spectrum (Fig. 3) of the association's phytocoenoses is dominated by hemicryptophytes (H = 60 %), their abundance being influenced by the mild temperate climate, as well as by the relatively large extension of the grassy formations in the target area. The relatively low percentage of phanerophytes (17.14%) illustrates the uniformity of these phytocoenoses. The terophytes (11.42%) are indicative of a certain degree of anthropic impact on the *Myricaria germanica* plant communities. The geophytes (8.57%) share a small percentage and illustrate the presence of a habitat where these species round up their short vegetation cycle in early spring and spring. The chamaephytes hold a poor share in the life forms spectrum (2.85%) due to the mild climate.

The floristic elements spectrum (Fig. 4) reveals the prevalence of the Eurasian species (62.85%), with their main genetic centre in Asia. The relatively great territorial extension of the Sureanu Mountains favoured the Circumpolar species (14.28%). The European species coming from regions with a milder temperate climate, and those Central-European, with their genetic centre in the regions with a wetter climate, from where they transgressed to the more continental regions, including the Orăştie river basin, amount to 8.56%. The Cosmopolitan elements hold a percentage of 11.42 of the floristic spectrum. It is also worth mentioning the presence of the Balkan elements (2.85%).

The analysis of the diagram of ecological indices (Fig. 5) reveals a majority of mesophilous species ($U_{3-3.5}$ = 40%), followed by meso-hygrophilous ($U_{4-4.5}$ = 22.85%), hygrophilous ($U_{5-5.5}$ = 17.14%), xero-mesophilous species ($U_{2-2.5}$ = 8.56%), and amphitolerant species (U_0 = 11.42).

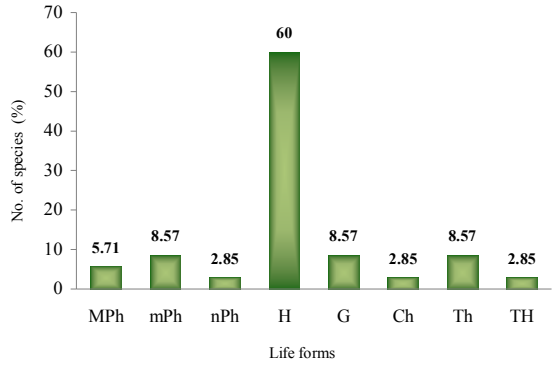

Figure 3. The life forms spectrum of *Salici purpureae-Myricarietum* Moor 1958 association, where: MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes H - Hemicryptophytes; G - Geophytes; Ch- Chamaephytes; Th - Annual terophytes; TH – Biennial terophytes

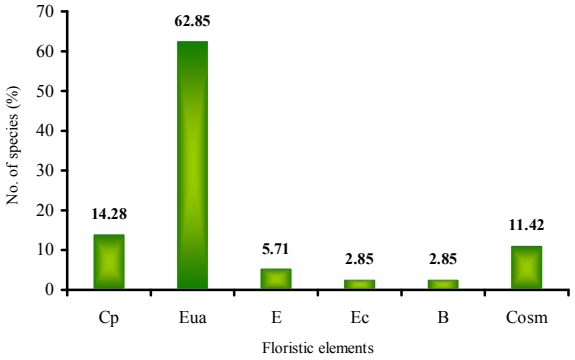

Figure 4. Spectrum of floristic elements of the association *Salici purpureae-Myricarietum* Moor 1958, where: Cp- Circumpolar; Eua - Eurasian; E - European; Ec - Central European; B – Balkanic; Cosm – Cosmopolitan

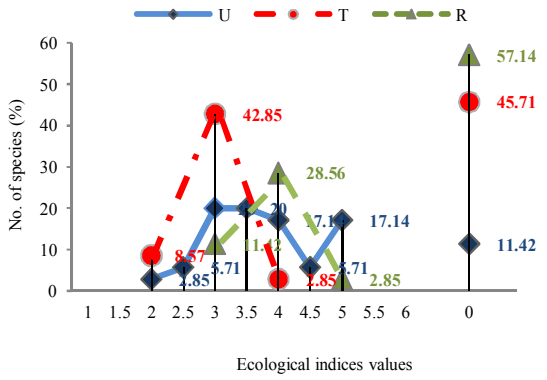

Figure. 5. Diagram of ecological indices for the association *Salici purpureae-Myricarietum* Moor 1958, where: U – soil moisture, T - temperature, R - the chemical reaction of the soil

The thermic behaviour outlines the prevalence of micro-mesothermophylous species ($T_{3-3.5}$ = 42.85%), followed by microthermophylous ($T_{2-2.5}$ = 8.57%), eurithermophylous (T_0 = 11.42%) and moderate-thermophylous ($T_{4-4.5}$ = 2.85%).

From the viewpoint of the chemical reaction of soils the species are acid-neutrophilous (R_3 = 11.42%), weakly acid-neutrophilous (R_4 = 28.56%), neutral-basiphilous (R_5 = 2.85%) and euri-ionical (R_0 = 57.14%).

Upon analysing the diagram below it goes that the phytocoenoses of the association *Salici purpureae-Myricarietum* Moor 1958 show mesophilous, micro-mesothermophilous, weakly acid-neutrophilous and euri-ionical traits.

DISCUSSIONS

The phytocoenoses of the association *Salici purpureae-Myricarietum* Moor 1958 consist mainly of *Myricaria germanica* bushes.

Drăgulescu (1995) [12] describes these vegetal communities in the Sadului river basin (380 - 1230 m). In the phytocoenoses analysed by the cited author there are somewhat different plant communities as against the ones found in the Orăștie river basin. The altitude and the humidity regime of the soils where the *Myricaria germanica* bushes vegetate in the Sadului Valley make the difference as abiotic geographic agents.

In the phytocoenoses of the Sadului Valley, in the highlands, one notices species belonging to the alliance *Adenostylion alliariae* (*Petasites albus*), and in the lowlands the species belong to the classes *Stellarietea mediae* (*Conyza canadensis*, *Equisetum arvense*) and *Plantaginetea majoris* (*Poa anua*), which plants do not show up in the phytocoenoses of *Salici purpureae-Myricarietum* Moor 1958 association of the Orăștie river basin.

The life forms spectrum reveals the prevalence of hemicryptophytes, both in Grădiștei (60%), and Sadului (57.60%) river basins. From the phytogeographic point of view the Eurasian species prevail in both regions: 62.85% (Orăștie river basin), 57,60% (Sadului Valley).

The diagram of ecological indices shows that, from the moisture viewpoint, most species are mesophilous and meso-hygrophilous, and thermally speaking, the micro-mesothermophilous species are favoured in both river basins. The higher percentage (58.80%) in the Sadului Valley, compared to that of the Orăștie Valley (42.85%), regarding the occurrence of micro-mesothermophilous species, is due to the higher altitudes where these coenoses vegetate in the Sadului Valley.

The floristic spectrum of the *Salici purpureae-Myricarietum* Moor 1958 association's phytocoenoses in the Orăștie Valley reveals the sporadic presence of alders (*Alnus glutinosa*, *Alnus incana*), pointing to the

Table 1. Association *Salici purpureae-Myricarietum* Moor 1958 in the Orăştie River Basin

L. f.	**F. e.**	**U**	**T**	**R**	**No. of relevé**	**1**	**2**	**3**	**4**	**5**	**K**
					Altitude (a.s.l.)	530	530	530	535	535	
					Coverage (%)	80	70	70	80	85	
					Surface (m^2)	25	20	25	15	10	
1	2	3	4	5	7	8	9	10	11	12	13
					Car. ass.						
nPh	Eua	0	0	4.5	*Myricaria germanica*	4	4	3	4	3	V
mPh	Eua	5	3	4.5	*Salix purpurea*	+	.	.	+	.	II
					Salicion elaeagno-daphnoides*, *Salicetalia purpureae et Salicetea purpureae						
H	Eua(C)	5	3	5	*Calamagrostis pseudophragmites*	.	+	.	.	+	II
mPh	Eua	5	3	0	*Salix triandra*	+	.	.	+	.	II
TH	B	2	4	4	*Cirsium candelabrum*	.	+	.	.	.	I
mPh	Ec	4	3	4.5	*Salix elaeagnos*	.	.	+	.	.	I
					Alno-Ulmion						
MPh (mPh)	E	4	2	4	*Alnus incana*	1	+	+	.	+	IV
Th	Eua	4	3	4	*Impatiens noli-tangere*	+	+	.	.	+	III
Ch	E	4	3	0	*Lysimachia nummularia*	+	.	+	.	+	III
MPh-mPh	Eua	5	3	3	*Alnus glutinosa*	+	.	.	+	.	II
G	Eua	5	3	3	*Petasites hybridus*	+	.	+	.	.	II
H	Cp	4	2	0	*Matteuccia struthiopteris*	.	+	.	.	.	I
					Molinio-Arrhenatheretea						
H	Cp	4	0	0	*Agrostis stolonifera* subsp. *stolonifera*	+	+	.	+	+	IV
H	Cosm	3	3	0	*Prunella vulgaris*	+	+	+	.	+	IV
H	Eua	3	0	0	*Achillea millefolium* subsp. *millefolium*	+	.	.	+	+	III
H(G)	Cp	0	0	0	*Agrostis capillaris* subsp. *capillaris*	+	.	2	1	.	III
H	Eua	3	0	4	*Dactylis glomerata*	.	+	+	+	.	III
H	Cosm	3.5	3	0	*Holcus lanatus*	+	.	+	.	+	III
H	Eua	3	0	0	*Leontodon autumnalis*	+	.	+	.	+	III
H	Eua	3.5	0	0	*Trifolium repens* subsp. *repens*	+	.	.	1	3	III
H	Cosm	4.5	3	3	*Juncus effusus*	+	.	.	.	+	II
H	Eua	3	0	0	*Leucanthemum vulgare*	.	+	+	.	.	II
H	Eua	2.5	0	0	*Lotus corniculatus*	.	.	+	.	+	II
H	Eua	0	0	0	*Plantago lanceolata*	.	+	.	.	+	II
H	Eua	3.5	0	4	*Potentilla reptans*	.	.	+	.	+	II
H	Eua(M)	3.5	0	0	*Ranunculus acris*	+	.	.	+	.	II
H	Eua	3	0	0	*Taraxacum officinale*	.	+	.	.	+	II
H	Cp	5	2	0	*Juncus articulatus*	.	.	.	.	+	I
Th-TH	Eua	2.5	3	4	*Medicago lupulina*	+	.	.	.	.	I
					Variae syntaxa						
H	Eua	3	3	0	*Hypericum perforatum*	+	+	.	.	+	III
G	Cp	0	0	0	*Elymus repens*	.	.	+	+	.	II
H	Eua	4.5	3	0	*Mentha longifolia*	+	.	+	.	.	II
H	Eua	3.5	0	0	*Stachys sylvatica*	.	+	.	+	.	II
G	Eua	3.5	0	4.5	*Tussilago farfara*	.	.	1	.	+	II
Th-TH	Cosm	3.5	3	3	*Geranium robertianum*	+	.	.	.	.	I

where: L.f. - life forms; MPh - Megaphanerophytes; mPh - Mezophanerophytes; nPh - Nanophanerophytes; Ch - Chamaephytes; H - Hemicryptophytes; G - Geophytes; Th - Annual terophytes; TH – Biennial terophytes
F.e. - floristic elements; Cp - Circumpolar; Eua - Eurasian; E - European; Ec - Central European; B – Balkanian; Cosm - Cosmopolitan.
Ecological indices: U - humidity, T - temperature, R - the chemical reaction of the soil. Synthetic phytosociological indices: K – constancy.
Place and date of mapping: 1 – 5 Grădiştea de Munte (19.07.2011, 25.07.2011, 15.07.2012)

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natural evolution of the association towards *Alnetum glutinosae-incana* [8].

The conservational status of the *Myricaria germanica* in România seems favourable but unclear in evolution [17]. The Dacian *Myricaria germanica* underbrushes in the Orăştie river basin represent an important habitat of great conservational value (3230) [10, 11, 16, 31] belonging with the Natural Reserve Grădiştea Muncelului-Cioclovina [33], and that is why we deem it is necessary that its Administration along with other local decision makers should take action in order to raise the interest of the people and to keep watch over this important habitat [8].

It calls for the banning of industrial gravel extraction from the river beds and the cessation of the *Myricaria germanica* underbrush cutting off activities (Fig. 6).

The ecological importance of this kind of habitat 3230 [8] "is due to the ability of *Myricaria germnaica* species of colonising fresh alluvial deposits and of setting the ground for new phytocoenoses" [8].

Figure. 6. Shrubs of *Myricaria germanica* cut off (15.07.2012, the Grădiştei Valley)

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