CONTRIBUTIONS TO THE PHYTOSOCIOLOGICAL STUDY OF THE MOUNTAIN MEADOWS OF *ARRHENATHERETALIA* R. TX. 1931 FROM NEAGRA BROŞTENILOR HYDROGRAPHIC BASIN

CONTRIBUŢII LA STUDIUL FITOSOCIOLOGIC AL PAJIŞTILOR MONTANE DIN ORDINUL *ARRHENATHERETALIA* R. TX. 1931 DIN BAZINUL HIDROGRAFIC AL NEGREI BROŞTENILOR

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Abstract. *The hydrographic basin of Neagra Broşteni river presents approximately 350 km^2 area and occupies, in its larger part, the central zone of Bistriţa Mountains, a reduced portion of the eastern slope of Călimani Mountains and the Drăgoiasa – Glodu depression (Eastern Carpathians). Geological, pedological and climate characteristics have determined the individualization of meadows depending on vegetation levels: mountain, sub-alpine and alpine meadows. Vegetal associations from the mountain meadows, included in Arrhenatheretalia R. Tx. 1931 order, identified in 2006 – 2007 period in this territory are: Festuco rubrae – Agrostietum capillaris Horvatic 1951, Lolio – Cynosuretum Br.-Bl. et de Leeuw 1936 and Pastinaco – Arrhenatheretum elatioris Passarge 1964. These are analyzed from the floristic elements, bio-forms, ecological and caryological indices perspectives.*

Rezumat. *Bazinul hidrografic al râului Neagra Broşteni prezintă o suprafaţă de aproximativ 350 km^2 şi ocupă, în cea mai mare parte a sa, zona centrală a Munţilor Bistriţei, o mică porţiune din flancul estic al Munţilor Călimani şi ulucul depresiunar Drăgoiasa - Glodu (Carpaţii Orientali). Condiţiile geologice, pedologice şi climatice au determinat individualizarea pajiştilor pe etaje de vegetaţie: etajul montan, subalpin şi alpin. Asociaţiile vegetale de pajişti montane aparţinând ordinului Arrhenatheretalia R. Tx. 1931 identificate in perioada 2006 – 2007 în acest teritoriu sunt următoarele: Festuco rubrae – Agrostietum capillaris Horvatic 1951, Lolio – Cynosuretum Br.-Bl. et de Leeuw 1936 şi Pastinaco – Arrhenatheretum elatioris Passarge 1964. Ele sunt analizate din punct de vedere al geoelementelor, bioformelor, al indicilor ecologici şi cariologici.*

MATERIAL AND METHOD

The phytosociological study has been realized using the classic methods specific to Central Europe Phytosociological School. Meadows vegetation has been characterized through phytocoenological relevées used as sampling method. Each vegetal species has been quantified in field (using Braun – Blanquet scale presenting the abundance – dominance indices from + to 5). Phytosociological relevées have been ordered and grouped in vegetal associations on the basis of characteristic, dominant and differential species [1], [3]. The biological forms and floristic elements for each species are those that have been given by V. Ciocarlan [2] and the values for ecological indices (T–temperature, U–humidity, R–soil pH) have been established by V. Sanda et al. [6] and Popescu et al. [5]. Information regarding the genetic type of

each species have been published by V. Ciocarlan [2] and the diploidy index has been calculated using the formula elaborated by S. Pignatti [4].

RESULTS AND DISCUSSIONS

According to speciality literature [1], [3] these plant communities are subordinated to: **MOLINIO – ARRHENATHERETEA** R. Tx. 1937, ARRHENATHERETALIA R. Tx. 1931, Cynosurion R. Tx. 1947: *Festuco rubrae – Agrostietum capillaris* Horvatic 1951, *Lolio – Cynosuretum* Br.-Bl. et de Leeuw 1936; Arrhenatherion Koch 1926: *Pastinaco – Arrhenatheretum elatioris* Passarge 1964.

Festuco rubrae – Agrostietum capillaris Horvatic 1951 (Table 1, rel. 1-4) includes the red fescue meadows, wide spread in the researched area, covering mountains versants with varied slopes and expositions, between 750 and 1100 m altitude. It is characterized by the dominance of the edifying species *Festuca rubra* and *Agrostis capillaris* that are realizing an average covering degree up to 75 – 80%. In some phytocoenosis, *Holcus lanatus*, *Trifolium pratense*, *Nardus stricta* are characterized by significant abundance – dominance indices (without becoming co-dominant or sub-dominant). 57% of the component species are characteristic to the superior coenotaxa. In the studied areas are also present representative species to Juncetea trifidi, Festuco – Brometea and Trifolio – Geranietea. The floristic elements spectrum points out the fact that in this vegetal association structure prevails the eurasiatic (52%) and european (20%) elements. The life-forms spectrum presents the preponderance of the hemicryptophytes species (82%) followed by geophytes and therophytes (4%) species. Ecological indices spectrum reveals the preponderance of mesophilous, (63%), mesothermophilous (35%) and microthermophilous (25%) species. Most of the component species (55%) are indifferent to soil pH. The caryological spectrum presents the increased proportion of the diploid species (42%). The diploidy index (D.I. = Σ_D / Σ_P) presents a value of 1,07.

Pastinaco – Arrhenatheretum elatioris Passarge 1964 (Table 1, rel. 5-8) includes the tall oat-grass meadows, sporadically spread in the researched area, covering small areas on Neagra Brosteni valley in places characterized by decresed slopes (3-5º) and varied expositions, up to 800 m altitude. It is characterized by the dominance of the edifying species *Arrhenatherum elatius* that are realizing an average covering degree up to 75%. The floristic composition includes preponderantly species characteristic to superior coenotaxa (63%). In the studied areas are also present representative species to Juncetea trifidi and Trifolio – Geranietea. The floristic elements spectrum points out the fact that in this vegetal association structure prevails the eurasiatic (54%), european (20%) and cosmopolite (13%) species. The bio-forms spectrum presents the preponderance of the hemicryptophytes species (76%) followed by geophytes (5%) and hemitherophytes (4%) species. Ecological indices spectrum reveals the preponderance of mesophilous (70%), and meso (29%) or microthermophilous (25%) species.

Most of the component species (60%) are indifferent to soil pH and approximate 32% are specific to weak acid to neutral soils. The caryological spectrum presents the increased proportion of the diploid species (43%). The diploidy index (D.I. = Σ_D / Σ_P) presents a value of 1,33.

Table 1

Vegetal associations from ARRHENATHERETALIA R. Tx. 1931 in Neagra Brostenilor river basin

U	T	R	Association	a				b				c				K
			No. of relevé	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
			Plot area (m^2)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**25**	**25**	**25**	**25**	
			Altitude (m)	**875**	**900**	**980**	**1100**	**700**	**750**	**800**	**800**	**1080**	**680**	**700**		
			Aspect	**SE**	**E**	**NV**	**SV**	**SE**	**NE**	**SV**	**SE**	**V**	**SE**	**-**	**S**	
			Slope (º)	**10**	**4-5**	**15**	**10**	**5**	**3-4**	**1-2**	**5**	**4-5**	**10**	**-**	**7-8**	
			Vegetation covering (%)	**100**	**100**	**100**	**90**	**95**	**90**	**95**	**95**	**95**	**100**	**100**	**100**	
Car. ass.																
3	0	0	Festuca rubra	3	3	2	3	+	-	1	1	+	-	+	+	V
0	0	0	Agrostis capillaris	2	3	3	1	+	+	+	+	+	1	+	+	V
3	3	3	Cynosurus cristatus	+	+	-	+	+	+	+	-	1	2	2	+	V
3	3	4	Arrhenatherum elatius	+	+	+	-	3	4	3	3	-	-	-	-	III
2,5	4	4,5	Lolium perenne	-	-	-	-	-	-	-	-	3	2	2	4	II
Cynosurion																
3,5	0	0	Phleum pratense	+	+	+	-	-	+	-	+	-	-	-	+	III
3	0	0	Leontodon autumnalis	+	+	+	+	+	-	+	-	+	+	+	-	IV
3	2,5	0	Bellis perennis	-	-	-	-	+	+	-	+	+	+	+	-	III
Arrhenatherion et Arrhenatheretalia																
3	2,5	3	Centaurea phrygia	+	1	+	+	-	+	+	-	-	-	+	-	III
0	3	0	Briza media	+	+	+	+	+	-	-	+	-	+	-	-	III
3,5	3	0	Holcus lanatus	+	-	1	-	+	-	+	+	-	-	-	-	III
3	0	0	Leucanthemum vulgare	+	+	+	+	+	-	-	+	+	+	-	+	IV
3	0	0	Achillea millefolium	+	+	-	+	+	+	-	-	+	+	+	+	IV
2	3	3	Thymus pulegioides	+	+	+	+	-	+	-	+	+	-	+	-	IV
2,5	3	0	Knautia arvensis	+	-	-	-	-	+	+	-	-	-	-	-	II
2,5	2	3	Stellaria graminea	+	+	+	+	1	+	-	+	+	-	-	-	IV
3	0	4	Dactylis glomerata	+	+	+	-	+	+	+	-	+	-	-	+	IV
3,5	3	3	Carum carvi	-	+	-	-	+	-	-	-	-	+	+	-	II

3	0	0	Taraxacum officinale	-	+	+	-	+	+	-	-	+	+	-	-	III
3	2,5	3	Campanula patula	-	+	+	-	+	+	-	+	-	-	+	-	III
0	0	0	Plantago lanceolata	-	-	-	+	+	-	-	+	+	+	-	-	III
Deschampsion																
3	3	0	Stachys officinalis	+	+	+	-	-	+	+	-	-	-	-	+	III
4	0	0	Deschampsia caespitosa	+	+	+	-	+	+	-	-	+	-	-	-	III
Calthion																
4	3	3	Angelica sylvestris	+	-	+	-	-	-	-	+	-	-	-	-	II
Alopecurion																
3,5	0	0	Festuca pratensis	+	+	+	-	+	+	-	+	-	-	-	-	III
Molinietalia caeruleae																
4	0	4,5	Gymnadenia conopsea	+	-	+	+	-	-	-	-	-	-	-	-	II
3,5	2,5	0	Lychnis flos - cuculi	-	-	+	+	-	+	+	+	-	-	-	-	III
3,5	3	4	Colchicum autumnale	-	-	-	-	+	+	+	-	-	-	-	-	III
3	2	4	Linum catharticum	-	-	-	-	+	+	+	-	-	-	-	-	III
Molinio – Arrhenatheretea																
3	0	0	Trifolium pratense	1	+	+	+	+	-	+	-	-	-	+	+	IV
4,5	3	3,5	Trollius europaeus	+	-	+	-	-	-	-	-	-	+	-	-	II
3,5	0	0	Ranunculus acris	+	-	-	-	-	+	-	-	+	+	-	-	II
0	0	0	Rhinanthus angustifolius	+	-	1	+	-	-	-	-	-	-	-	-	II
0	0	0	Anthoxanthum odoratum	+	+	-	+	+	+	-	+	-	-	-	-	III
3	0	0	Centaurea jacea	+	+	+	-	1	+	-	+	-	-	-	-	III
3	0	0	Rumex acetosa	+	-	-	-	+	+	-	-	-	-	-	-	II
2,5	0	0	Lotus corniculatus	+	+	+	-	+	+	+	-	-	-	-	+	III
3,5	2	2	Alchemilla xanthochlora	1	+	-	-	-	-	-	-	-	+	-	-	II
3	3	0	Prunella vulgaris	+	-	+	-	+	+	+	-	-	+	+	+	IV
3	3	3	Polygala vulgaris	+	+	-	+	+	+	-	-	-	-	-	-	IV

3,5	0	0	Trifolium repens	-	1	+	-	+	+	-	+	+	+	+	+	IV
3	2	0	Viola tricolor	-	+	-	-	-	+	-	-	-	+	+	+	III
3	0	3	Vicia cracca	-	+	+	-	-	+	-	-	-	-	-	-	II
3	0	0	Poa pratensis	-	+	+	-	+	-	-	-	1	1	+	+	III
Juncetea trifidi																
0	0	1,5	Nardus stricta	+	+	-	1	-	+	+	-	-	-	+	-	III
0	2,5	0	Campanula serrata	+	+	+	-	-	+	-	-	-	-	-	-	II
3	1	2,5	Arnica montana	+	-	+	+	-	-	-	-	-	-	-	-	II
4	3	2	Hypericum maculatum	+	+	+	-	-	-	-	+	-	-	-	-	II
2,5	0	0	Carlina acaulis	+	-	+	-	-	+	-	-	-	+	-	-	II
3,5	2	4	Hieracium aurantiacum	-	+	+	-	+	-	-	-	-	-	-	-	II
Trifolio – Geranietea s. l.																
2	3	3	Trifolium ochroleucon	+	+	+	-	-	-	-	-	-	-	-	-	II
3	0	0	Veronica chamaedrys	-	+	-	+	+	-	-	-	-	-	-	-	II
Variae syntaxa																
3	2	2	Cruciata glabra	+	+	+	+	-	-	-	+	-	+	-	-	III
3	3	0	Pteridium aquilinum	+	-	+	-	-	+	-	-	-	-	-	-	II

Species met in 1-2 relevés: Carex pallescens +, I (rel. 1) $U_{3,5}T_3R_3$; Succisa pratensis +, I (rel. 1) $U_4T_{2,5}R_0$; Potentilla recta +, I (rel. 1) $U_{1,5}T_{3,5}R_4$; Trifolium montanum +, I (rel. 1) $U_{2,5}T_2R_4$; Gentianella austriaca +, I (rel. 1) $U_3T_2R_4$; Digitalis grandiflora +,I (rel. 1) $U_3T_3R_3$; Trifolium medium +, I (rel. 1) $U_3T_3R_0$; Gentiana cruciata +, I (rel. 1, 3) $U_3T_3R_4$; Pimpinella saxifraga +, I (rel. 1, 3) $U_{2,5}T_0R_3$; Achillea stricta +, I (rel. 1, 4) $U_{2,5}T_2R_3$; Thalictrum aquilegiifolium +, I (rel. 1, 6) $U_{2,5}T_{2,5}R_4$; Astrantia major +, I (rel. 1, 8) $U_{3,5}T_{2,5}R_{4,5}$; Myosotis scorpioides +, I (rel. 2) $U_5T_3R_0$; Cirsium arvense +, I (rel. 2) $U_0T_0R_0$; Fragaria vesca +, I (rel. 2) $U_3T_{2,5}R_0$; Geum rivale +, I (rel. 2) $U_{4,5}T_0R_{4,5}$; Trifolium campestre +, I (rel. 2, 4) $U_3T_3R_0$; Luzula campestris +, I (rel. 3) $U_3T_0R_3$; Hypochoeris uniflora +, I (rel. 3, 4) $U_3T_{2,5}R_2$; Lathyrus pratensis +, I (rel. 3, 5) $U_{3,5}T_3R_4$; Trisetum flavescens +, I (rel. 5, 8) $U_0T_2R_0$; Equisetum arvense +, I (rel. 5, 9) $U_3T_3R_0$; Heracleum sphondylium +, I (rel. 5, 11) $U_3T_{2,5}R_5$; Euphrasia stricta +, I (rel. 4) $U_3T_3R_0$; Convolvulus arvensis +, I (rel. 6) $U_0T_0R_0$; Pastinaca sativa +, I (rel. 6,8) $U_3T_4R_4$; Filipendula vulgaris +, I (rel. 9, 10) $U_{2,5}T_3R_0$; Hieracium pilosella +, I (rel. 10) $U_2T_0R_2$; Urtica dioica +, I (re. 10) $U_3T_3R_4$; Stellaria media +, I (rel. 10, 11) $U_3T_0R_0$; Juncus effusus +, I (rel. 11) $U_{4,5}T_3R_3$; Potentilla anserina +, I (rel. 11) $U_4T_3R_4$; Plantago media +, I (rel. 9, 11) $U_{2,5}T_0R_{4,5}$; Echium vulgare +, I (rel. 11) $U_2T_3R_4$; Lysimachia nummularia +,I (rel. 12) $U_4T_3R_0$; Cirsium vulgare +, I (rel. 12) $U_3T_3R_0$; Lamium maculatum +, I (rel. 12) $U_{3,5}T_0R_4$.
Place and date of relevées: Neagra Broşteni (rel. 1, 2, 6, 11): 9.07.2007; Drăgoiasa (rel. 3, 9): 10.07.2007; Păltiniş (rel. 4):11.07.2007; Broşteni (rel. 5, 10): 9.07.2007; Budacu (rel. 7, 8): 2.09.2007; Arsurii rivulet (rel. 12): 3.09.2007.

Lolio – Cynosuretum Br.-Bl. et de Leeuw 1936 (Table 1, rel. 9-12) includes the perennial ryegrass and crested dogstail grass meadows, sporadically spread in the researched area, covering flat to weak inclined terrains, between 680 and 1100 m altitude. It is characterized by the dominance of the edifying species *Lolium perenne* and *Cynosurus cristatus* that are realizing an average covering degree up to 80%. The floristic composition includes numerous species characteristic to superior coenotaxa (62%). In the studied areas are also present representative species to Festuco – Brometea. The floristic elements spectrum points out the fact that in this vegetal association structure prevails the eurasiatic (58%) and cosmopolite (16%) elements. The life-forms spectrum presents the preponderance of the hemicryptophytes (74%). Ecological indices spectrum reveals the presence and preponderance of mesophilous (63%), indifferent to temperature (46%) and mesothermophilous (33%) species. Most of the component species (63%) are indifferent to soil pH. The caryological spectrum presents the approximate equal proportions between diploid (42%) and polyploid species (38%). The diploidy index (D.I. = Σ_D / Σ_P) presents a value of 1,11.

CONCLUSIONS

- Floristic composition of the analyzed vegetal associations is characterized by an increased similarity degree.
- Phytogeographical analysis points out the fact that these phytocoenosis are specific to Eurasiatic region. The European character is suggested by the significant proportion of European and central European elements.
- Bioforms spectrum analysis reveals the preponderance of hemicryptophytes species, these semi-natural grasslands being edified by perennial gramineae.
- Ecological analysis presents the mesophilous and mesothermophilous character of these meadows.
- Genetic types analysis reveals reduced differences between the number of diploid and polyploid species. The diploidy index (in all three cases) is supraunitary suggesting the middle altitude and the relative stabile ecological conditions background of these phytocoenosis development.

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