VEGETATION OF MESOPHILE MEADOWS FROM ORADEA HILLS

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Abstract

Research conducted in Oradea Hills, Bihor county, aimed at highlighting the characteristics and peculiarities of mesophilic meadows that grow on land with slight to moderate sloping, fertile moist, wet soils used as meadows or pastures.

Phytocoenosis of these meadows are subordinated to the Anthoxantho - Agrostietum capillaris plant association, Sillinger 1933 and they are scientifically analyzed and characterized in the chapter dedicated to scientific research findings, in terms of biodiversity, bioforms spectrum, floristic elements spectrum, evolution from syndinamic point of view, and economic importance.

Key words: Anthoxanthum - Agrostis mesophilic meadows

INTRODUCTION

The plants communities within this area are poorly studied, and no research was conducted in Oradea Hills before our research presented in the paper herein.

In order to compare the results we obtained in characterizing the phytocoenoses of red fescue meadows (*Agrostis capillaris*) with sweet vernal grass (*Anthoxanthum odoratum*) with those obtained in other geographic regions in western Romania, and we have studied the scientific papers of the following researchers: Ardelean (1999, 2006), Coldea (1972), Coldea et al., (2012), Czirják (2014), Doniță et al., (2005), Groza (2008), Karácsonyi (2011), Lacatoș (2012), Păşcuț (2012), Pop et al., (2002).

MATERIAL AND METHOD

In researching the mesophilic meadows of Oradea Hills, Bihor county, we employed the phyto-sociological research methods of the Central European school developed by Braun - Blanquet (1964) and adapted by Borza et Boşcaiu (1965) to the specific vegetation in Romania.

We conducted a large number of field study visits to record in the worksheets the information about the national habitat conditions where the phytocenoses of the meadows aforementioned with reference to rock, soil, altitude, exposure, slope gradient, soil coverage with vegetation.

Along with noting in the worksheets the plants which is included in the surveys the quantitative assessment of the participation of each species in terms of abundance - dominance after the Braun - Blanquet (1928) system

completed by Tüxen (1937) and the of indications Borza et Boşcaiu (1965) Emberger (1968).

Information from worksheets was used in preparing the association table structured after the methodology Braun - Blanquet (1964), Ellenberg (1963, 1979).

Grouping the species by sintaxons within the association table was made by the intermediate of characteristic (true), relevant (dominant), differential, recognition, indicating species taking into account information about the sintaxons categories of Gillet et al., (1991), in the case of the cenotic categories of species established across the European continent, Rodwell et al., (1995) Mucin (1997).

Histograms were drawn on the bioforms spectrum, floristic elements spectrum, ecological indicators diagram, humidity (U), temperature (T), chemical soil reaction (R).

RESULTS AND DISCUSSIONS

Mesophilic meadows consisting of phytocoenoses of the *Agrostio - Festucetum valesiacae* plant association shows a very high biodiversity, given by their floristic composition totalling 102 species mostly mesophilic (see Table 1 below).

Physiognomy of the association is given by the characteristic and relevant species of *Agrostis capillaris* with a general coverage of 65.62%, maximum constant (K = V) and *Anthoxanthum odoratum* with an overall coverage of 7.56%, the maximum constant (K = V). Out of the total 102 species, 57 are characteristic of the ***Cynosurion*** alliance*: Cynosurus cristatus, Centaurium erythraea, Trifolium repens, Hypochoeris radicata,* ***Arrhenatheretalia*** order: *Achillea millefolium, Cichorium intybus, Leontodon hispidus, Plantago lanceolata, Holcus lanatus, Centaurea phrygia, Trifolium campestre, Phleum pratense, Stellaria graminea, Polygala vulgaris, Bromus inermis, Briza media, Tragopogon orientalis, etc.,* ***Molinio – Arrhenatheretea*** *class: Lotus corniculatus, Festuca pratensis, Daucus carota, Poa pratensis, Trifolium hybridum, Cerastium holosteoides, Danthonia decumbens, Prunella vulgaris, Odontites serotina, Trifolium pratense, Plantago media, Stachys officinalis, Inula salicina, Juncus effusus, Juncus tenuis, Galium molugo, Sanguisorba officinalis, Danthonia provincialis, Centaurea jacea*, etc.

The remaining species i.e. 39 species trans-gresive and belong to the following classes: ***Festuco - Brometea****: Ononis spinosa, Festuca valesiaca, Hypericum perforatum, Eryngium campestre, Agrimonia eupatoria, Galium verum, Euphorbia cyparissias, Asperula cynanchica, Dorycnium herbaceum, Cynodon dactylon, Filipendula vulgaris, Andropogon ischaemum, Thymus glabrescens, Sanguisorba minor, Koeleria macrantha, Veronica orchidea, Teucrium chamaedrys, Astragalus monspessulanus, etc.,* ***Koelerio - Corynephoretea****: Vulpia myuros, Trifolium arvense,* ***Artemisietea vulgaris****: Erigeron annuus, Carduus acanthoides* etc., ***Stellarietea mediae****: Convolvulus arvensis, Matricaria inodora,* ***Epilobietea angustifolii:*** *Rubus sulcatus, Fragaria vesca,* ***Rhamno - Prunetea****: Crataegus monogyna, Prunus spinosa,* ***Querco - Fagetea :*** *Malus sylvestris, Pyrus pyraster, Rubus caesius,* etc.

Table 1

Anthoxantho-Agrostietum capillaris Sillinger 1933

L.f.	F.e.	U	T	S.r.	2n	No. Land Surveys	1	2	3	4	5	6	7	8	K	ADm
						Altitude (m.s.m.)	220	206	170	250	190	180	180	180		
						Exposition	N-V	N	N	E	V	–	S	V		
						Slope (°)	10	2	7	14	2	–	14	2		
						Area (m^2)	100	100	100	100	100	80	80	100		
						The coverage of grass layer (%)	100	100	100	100	100	100	100	100		
H	Eua	0	0	0	D.P	As. *Anthoxanthum odoratum*	1	1	1	1	2	+	2	1	V	7.56
H	Cp-Bo	0	0	0	P	As. *Agrostis capillaris*	4	4	4	4	4	5	4	4	V	65.62
						Cynosurion										
H	E	3	3	3	D	*Cynosurus cristatus*	+	+	+	+	.	.	.	+	IV	0.31
Th	Eua	3	3	2	P	*Centaurium erythraea*	.	+	.	+	+	.	.	+	III	0.25
H	Eua	3.5	0	0	P	*Trifolium repens*	+	.	.	+	.	.	.	.	II	0.12
H	Eua	3	3	2.5	D	*Hypochoeris radicata*	+	.	.	+	.	.	.	.	II	0.12
H	Cp-Bo	3	0	0	D.P	*Festuca rubra*	+	.	.	.	.	.	.	.	I	0.06
H	Eua(M)	2.5	4	4.5	D	*Lolium perenne*	+	.	.	.	.	.	.	.	I	0.06
H	Eua	3	0	0	D.P	*Leontodon autumnalis*	.	.	.	+	.	.	.	.	I	0.06
						Arrhenatheretalia										
H	Eua	3	0	0	P	*Achillea millefolium*	1	+	+	.	+	+	+	+	V	1
H-TH	Eua	2.5	3.5	4.5	D	*Cichorium intybus*	+	+	+	+	+	+	+	+	V	0.5
H	Eua	2.5	0	0	D	*Leontodon hispidus*	+	+	.	.	+	.	+	.	III	0.25
H	Eua	0	0	0	D	*Plantago lanceolata*	+	.	.	.	.	+	+	+	III	0.25
H	Eua	3.5	3	0	D	*Holcus lanatus*	+	+	+	.	+	.	.	.	III	0.25
H	Ec	3	2.5	3	D	*Centaurea phrygia*	+	+	+	.	.	.	.	.	II	0.18
Th-TH	E	3	3	0	D	*Trifolium campestre*	+	+	.	.	.	.	.	.	II	0.12
H	Eua(M)	3.5	0	0	P	*Phleum pratense*	+	+	.	.	.	.	+	.	II	0.18
H	Eua(M)	2.5	2	3	D	*Stellaria graminea*	+	.	.	.	.	.	.	.	I	0.06
Th-H	Eua	3	4	4	D	*Pastinaca sativa*	+	.	.	.	.	.	.	.	I	0.06
H	Eua	3	3	3	P	*Polygala vulgaris*	.	.	.	+	.	.	.	.	I	0.06
H	Eua(C)	2.5	4	4	P	*Bromus inermis*	.	.	.	.	.	.	.	+	I	0.06
H	Eua	0	3	0	D.P	*Briza media*	.	.	.	+	.	.	.	.	I	0.06
TH-H	Eua	3	3	4	D	*Tragopogon orientalis*	.	.	+	.	.	.	.	.	I	0.06
H	Eua	4	3	0	P	*Alopecurus pratensis*	.	.	+	.	.	.	.	.	I	0.06

H	Eua	3	2.5	0	D	*Heracleum sphondylium*	.	.	+	.	.	.	.	.	I	0.06
Th	E	3	0	0	D	*Rhinanthus minor*	.	.	.	+	.	.	.	.	I	0.06
Ch	Ec	2.5	3	3	D.P	*Thymus pulegioides*	.	.	.	+	.	.	.	.	I	0.06
						Molinio-Arrhenatheretea										
L.f.	**F.e.**	**U**	**T**	**S.r.**	**2n**	**No. Land Surveys**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**K**	**ADm**
H	Eua	2.5	0	0	P	*Lotus corniculatus*	+	+	+	+	+	.	+	+	V	0.43
H	Eua	3.5	0	0	D	*Festuca pratensis*	+	.	+	+	+	+	+	1	V	1
TH-H	Eua(M)	2.5	3	0	D	*Daucus carota ssp. carota*	+	+	+	+	+	+	.	+	V	0.43
H	Cp	3	0	0	P	*Poa pratensis*	+	+	.	+	.	+	+	+	IV	0.37
H	E(M)	3.5	3	4	D	*Trifolium hybridum*	+	+	.	+	+	.	+	+	IV	0.37
H-Ch	Cosm	3	0	0	P	*Cerastium holosteoides*	+	.	.	.	.	+	+	+	III	0.25
H	E	0	3	2	P	*Danthonia decumbens*	+	+	.	.	.	.	.	1	II	0.75
H	Cosm	4.5	3	3	D	*Juncus effusus*	.	.	.	.	+	.	.	1	II	0.68
H	Cp-Bo	3	3	0	P	*Prunella vulgaris*	+	.	.	.	+	.	.	.	II	0.12
Th	Eua	3	3	0	P	*Odontites serotina*	+	.	.	.	.	.	+	.	II	0.12
H-TH	Eua	3	0	0	D	*Trifolium pratense*	+	.	1	.	.	.	.	.	II	0.68
H	Eua	2.5	0	4.5	D.P	*Plantago media*	+	.	+	.	.	.	.	.	II	0.12
H	Adv	3.5	3	4	P	*Juncus tenuis*	+	.	.	.	+	.	.	.	II	0.12
H	Eua(M)	3	3	0	D	*Stachys officinalis*	+	.	+	.	.	.	.	.	II	0.12
H	Eua	2.5	3	3	D	*Inula salicina*	.	.	+	.	.	.	+	.	II	0.12
H-Hh	Eua	5	0	0	P	*Lysimachia vulgaris*	+	.	.	.	.	.	.	.	I	0.06
H	Eua	4	3	0	P	*Rumex crispus*	+	.	.	.	.	.	.	.	I	0.06
H	Eua	2.5	3	3	D	*Ranunculus polyanthemos*	+	.	.	.	.	.	.	.	I	0.06
H	Eua	3	0	3	D	*Galium mollugo*	.	.	.	.	.	.	+	.	I	0.06
H-Hh	Cosm	4	3	0	P	*Lythrum salicaria*	+	.	.	.	.	.	.	.	I	0.06
Th-TH	Eua	3	3	4	D	*Ranunculus sardous*	.	.	+	.	.	.	.	.	I	0.06
H	Eua	3	3	0	P	*Sanguisorba officinalis*	.	.	+	.	.	.	.	.	I	0.06
H	Cp	4	4	4	D	*Rumex conglomeratus*	.	.	+	.	.	.	.	.	I	0.06
H	Eua	3.5	3	4	D.P	*Lathyrus pratensis*	.	.	+	.	.	.	.	.	I	0.06
TH-H	Eua(M)	3	3	0	P	*Inula britannica*	.	.	+	.	.	.	.	.	I	0.06
H	M	2.5	4	3	P	*Danthonia provincialis*	.	.	.	.	.	+	.	.	I	0.06

H	Eua	3	0	0	D.P	*Centaurea jacea*	.	.	.	.	.	+	.	.	I	0.06
H	Eua(M)	4	3	0	D.P	*Eupatorium cannabinum*	.	.	.	.	.	.	+	.	I	0.06
H	Eua(M)	3	0	4	P	*Dactylis glomerata*	.	.	.	.	.	.	.	+	I	0.06
G	Eua	0	0	0	P	*Agropyron repens*	.	.	.	.	.	.	.	+	I	0.06
H(G)	Eua(M)	0	3	0	P	*Calamagrostis epigeios*	.	.	.	.	.	.	.	+	I	0.06
Th-H	Cosm	3	3	4	D	*Verbena officinalis*	.	.	.	.	.	.	.	+	I	0.06
						Festuco-Brometea										
L.f.	**F.e.**	**U**	**T**	**S.r.**	**2n**	**No. Land Surveys**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**K**	**ADm**
Ch-H	E(M)	0	3.5	0	D.P	*Ononis spinosa*	+	+	1	1	.	+	+	+	V	1.56
H	Eua(C)	1.5	4	4	D	*Festuca valesiaca*	+	+	.	+	+	+	+	.	IV	0.37
H	Eua	3	3	0	P	*Hypericum perforatum*	+	.	.	+	+	+	+	+	IV	0.37
H	P	1	5	4	D.P	*Eryngium campestre*	+	.	.	+	.	+	+	+	IV	0.31
H	Eua	2.5	3	4	P	*Agrimonia eupatoria*	+	.	+	+	.	+	.	+	IV	0.31
H	Eua	2.5	2.5	0	D	*Galium verum*	+	+	.	+	.	+	+	+	IV	0.37
H	Eua	2	3	4	D.P	*Euphorbia cyparissias*	+	.	.	+	+	+	.	.	III	0.25
H	Mp	2	3.5	4.5	D.P	*Asperula cynanchica*	.	.	.	+	.	+	+	+	III	0.25
Ch-H	Ec	2	5	4	D	*Dorycnium herbaceum*	+	.	.	+	.	.	+	.	II	0.18
G(H)	Cosm	2	3.5	0	D.P	*Cynodon dactylon*	.	.	+	+	.	.	.	.	II	0.12
H	Eua	2.5	3	0	D	*Filipendula vulgaris*	.	.	+	+	.	.	.	.	II	0.12
H	Eua	1.5	5	3	P	*Andropogon ischaemum*	.	.	.	+	+	+	.	.	II	0.18
Ch	Ppn	2	4	0	P	*Thymus glabrescens*	.	.	.	.	.	+	1	+	II	0.75
H	Eua	2	3.5	4	P	*Sanguisorba minor*	.	.	.	.	.	+	.	+	II	0.12
H	Cp	2	4	5	D.P	*Koeleria macrantha*	.	.	.	+	.	+	.	.	II	0.12
H	Ec	2.5	0	3	P	*Pimpinella saxifraga*	.	.	+	.	.	.	.	.	I	0.06
H	P-M	1.5	5	4	D	*Veronica orchidea*	.	.	.	+	.	.	.	.	I	0.06
H	Eua(C)	2	4	4	D	*Scabiosa ochroleuca*	.	.	.	+	.	.	.	.	I	0.06
H	E(M)	2.5	0	0	D.P	*Hieracium pilosella*	.	.	.	.	+	.	.	.	I	0.06
H	M	1.5	4	4	D	*Astragalus monspessulanus*	.	.	.	.	.	+	.	.	I	0.06
Ch	M-Ec	2	3	4	P	*Teucrium chamaedrys*	.	.	.	.	.	.	+	.	I	0.06
H	E(C)	2	4	3	D	*Fragaria viridis*	+	.	.	.	.	.	.	.	I	0.06

Th	Eua	1.5	4	4	P	*Bromus squarrosus*	.	.	.	.	.	.	.	+	I	0.06
H	Eua(M)	2.5	0	4	D.P	*Centaurea scabiosa*	.	.	.	+	.	.	.	.	I	0.06
						Koelerio-Corynephoretea										
Th	Eua(C)	1	3.5	2	P	*Vulpia myorus*	+	1	.	.	.	.	.	+	II	0.75
Th	Eua(M)	1.5	3	4	D	*Trifolium arvense*	+	.	.	.	+	.	+	.	II	0.18
Th	Eua(M)	2	3.5	0	P	*Filago arvensis*	+	.	.	.	.	.	.	.	I	0.06
						Artemisietea vulgaris										
Th	Adv	4	0	4	P	*Erigeron annuus*	.	+	.	+	+	.	+	+	IV	0.31
TH	Eua(M)	2	3	0	D	*Carduus acanthoides*	.	+	.	.	.	.	+	.	II	0.12
H	Eua	3	3	0	D	*Tanacetum vulgare*	+	.	.	.	.	.	.	.	I	0.06
TH(Th)	Eua(C)	1.5	0	4.5	D	*Carduus nutans*	.	.	.	.	.	.	.	+	I	0.06
						Stellarietea mediae										
H-G	Cosm	0	0	0	P	*Convolvulus arvensis*	+	.	+	.	.	.	.	+	II	0.18
Th-TH	Eua	0	3	3.5	D.P	*Matricaria inodora*	+	.	.	.	.	.	.	.	I	0.06
						Epilobietea angustifolii										
nPh	Ec	3.5	3	2.5	P	*Rubus sulcatus*	+	1	.	.	+	.	.	.	II	0.75
H	Eua	3	2.5	0	D	*Fragaria vesca*	.	.	.	+	1	.	.	.	II	0.68
						Rhamno-Prunetea										
mPh	E	2.5	3	3	D	*Crataegus monogyna*	+	1	1	+	.	+	.	.	IV	1.43
nPh	E	2	3	3	P	*Rosa canina*	+	1	+	1	1	.	.	+	IV	2.06
mPh	Eua	2	3	3	P	*Prunus spinosa*	.	+	+	1	.	+	.	.	III	0.81
						Querco-Fagetea										
mPh	E	3.5	3	4	D	*Malus sylvestris*	+	.	+	.	.	.	.	.	II	0.12
MPh	E	2	3	4	D	*Pyrus pyraster*	+	+	+	.	.	.	.	.	II	0.18
nPh	Eua(M)	4.5	3	4	P	*Rubus caesius*	+	.	.	.	.	.	.	.	I	0.06
H	E	2.5	3	3	P	*Festuca heterophylla*	.	+	.	.	.	.	.	.	I	0.06
H	Eua	3	2	2	D.P	*Cruciata glabra*	.	.	+	.	.	.	.	.	I	0.06

Place and date of surveys: 1 – Săldăbagiu de Munte locality (Bihor county) 19.07.2010; 2 – Cetariu locality (Bihor county) 19.07.2010; 3 – Husasău de Criș locality (Bihor county) 21.07.2010; 4 – Bălaia locality (Bihor county) 13.07.2011; 5 – Burzuc locality (Bihor county) 13.07.2011; 6 – Nădar locality (Bihor county) 16.07.2011; 7 – Sarcăului Hill (Bihor county) 16.07.2011; 8 – Fegernic locality (Bihor county) 16.07.2011.

Regarding the ecological characterization of phytocoenoses of mesophilic meadows in the *Anthoxantho - Agrostietum capillaris* association regarding the spectrum of biological forms (see Chart 1 below), we find that the largest group is represented by the hemicrypthopytes species (66.6%) followed by annual therophytes (12, 47%) and phanerophytes (6.86).

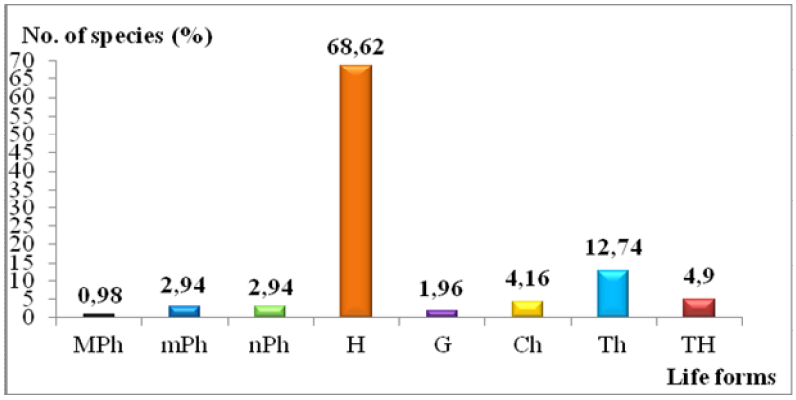

Chart no. 1 – Spectrum of life forms for the phytocoenoses of the Association *Anthoxantho-Agrostietum capillaris*, where: Mph, mPh, nPh – Phanerophytes; H – Hemicrypthopytes; G – Geophytes; Ch – Chamaephytes; Th – Annual therophytes; TH – Biannual terophytes.

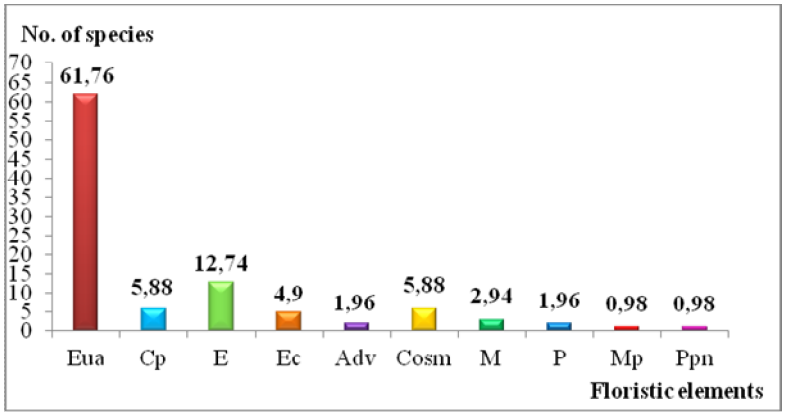

Chart no. 2 – Spectrum of floristic elements for the phytocoenoses of the Association *Anthoxantho-Agrostietum capillaris*, where: Eua – Eurasian; Cp – Circumpolar; E – European; Ec – Central European; Adv – Adventive; Cosm – Cosmopolitan; M – Mediterranean; P – Pontic; Mp – Mediterranean-Pontic; Ppn – Ponto-Pannonian.

The spectrum of floristic elements (see Chart no. 2 below) indicates the overwhelming dominance of Eurasian plant species (61.76%), followed by the European and Central Europe species (17.63%), South Europe species (Mediterranean, Mediterranean – Pontic, Pontic, Pontic – Pannonian) (7.84%), and the circumpolar plant species (5.88%).

Ecological indices chart (see Chart no. 3 below) shows that in relation to humidity environmental factor, the mesophilic species prevail in the meadows (39.21%) followed closely by the xero - mesophilic species (34.3%) and amfi-tolerant species (8.82%).

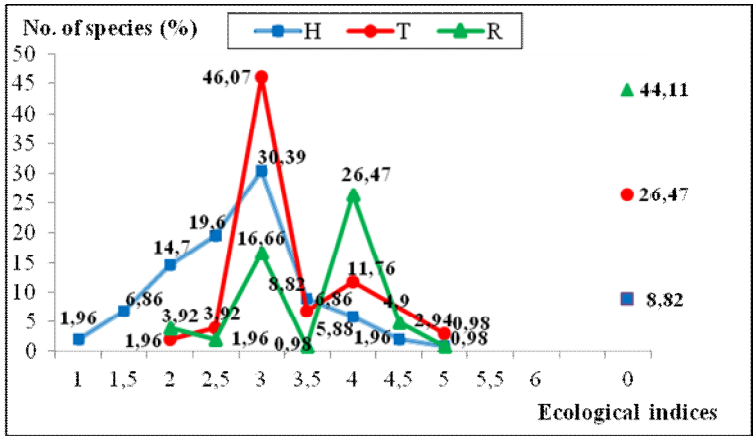

Fig. 3 – Diagram of ecological indices for the association *Anthoxantho-Agrostietum capillaris*, where: H – Humidity; T – Temperature; R –Chemical reaction of soil

In terms of thermal preferences, meadows are mostly formed by micro - mesothermal species (52.93%), followed by euri-thermal species (26.47%) and slightly thermophilic (11.67%). Regarding the behaviour of plants to soil chemical reaction, the euriionic species prevail (amfi-tolerant to pH, 44.11%), followed by weakly acid - neutrophils (31.37%) and acid - neutrophils (17.64%) species.

Vegetation dynamics: Succession of phytocoenoses of the *Anthoxantho - Agrostietum capillaris* plant association depending on environmental factors action - global warming, increased aridity, soil drought, atmosphere drought, influence of zoo - anthropical factor, grazing abandonment may run hypothetically in two directions :

- In case of increase of global warming linked to excessive soil and atmospheric drought, evolution would be towards xero – mesophils phytocoenoses of *Festuco - Brometea, Festucetalia valesiacae, Brachypodio – Chrysopogonetalia s*intaxons*;*
- In case of meadows ageing and non-grazing, the evolution could be oriented towards wood phytocoenoses of *Rhamno - Prunetea* and *Querco - Fagetea* sintaxons;

The economic importance

Mesophilic meadows across the Oradea Hills are used by the inhabitants of the villages either as pasture during summer season or as hay for animal feeding, thus creating a large green mass production, with an average pratology value.

CONCLUSIONS

1. *Anthoxanto - Agrostietum capillaries* mesophilic meadows shows a very rich biodiversity certified floristic composition totalling 102 species of plants.
2. From the statistical analysis of bioforms that highlight specific characteristics of the habitat and influences exerted on them by ecological factors it results the dominance of hemicrypthopytes (66.6%) which is the main component of mesophilic meadows and the belonging of the researched territory to a moderate - temperate climate.
3. Floristic elements stock shows a wide range of species with different geographical origins, dominated by Eurasian species (61.76%) whose genesis was spread over the vast territory of Europe and Asia territory, and also on the territory of ancient Dacia, over which various species interfered in different phyto-historical periods: European, Central –European (17.63%), Southern – European (Mediterranean, Mediterranean – Pontic, Pontic, Pontic – Panonian) (7.84%) and circumpolar (5.88%).
4. Ecological indices chart highlights the ecological peculiarities of all mesophilic meadows species and allows for the identification of ecological specificity in accordance with the local pedo-climatic complex factors.

Thus in terms of humidity related requirements, it results that mesophilic species are dominant (39.21%) as they are favoured by soil and atmospheric humidity, followed by xero - mesophilic species (34.3%) favoured by soil aridity phenomenon in some places, steepness and southern exposure exhibition of the slopes.

In terms of the requirements for the thermal regime, mesophilic meadows of Oradea Hills plants consist mainly of micro - mesothermal (52.93%), followed by thermal amfi-tolerant species (26.47%) and moderately thermophilic ones (11.67%).

In terms of edaphic preferences with particular reference to soil chemical reaction it is highlighted the euriionic species (44.11%), weakly - acid neutrophilic species (31.37%), and acid – neutrophilic species (17.64%), their distribution throughout the studied area being consistent with soil types.

Phytocoenoses of mesophilic meadows belonging to *Anthoxantho - Agrostietum capillaris* plant association is a rare natural habitat of community interest whose conservation requires the designation within the

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