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NARDUS STRICTA L. MEADOW PHYTOCOENOLOGY, SYNECOLOGY AND CHOROLOGY IN THE TIMIŞ RIVER BASIN

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Abstract: The *Violo declinatae – Nardetum* Simon 1966 association meadows are widely spread in the Timişului River Basin both as area and especially as altitude (1000 m). The most compact ones are on the Ţarcu Peak. On the Semenic and Mic Mountains, the *Nardus stricta* species is frequently co-dominant with *Festuca rubra*, and *Festuca nigrescens*. In this paper we present some aspects concerning the floristic composition of the association, its syn-ecology, chorology, and syn-dynamics, to which we have also added biodiversity indices.

The *Nardus stricta* meadows spread on the four mountains under study are presented under the form of a species constant table. Association syn-ecology is rendered through spectra done both depending on number and on species abundance-dominance in order to emphasise the phyto-coenoses character determined by edifying species and also by possible evolving trends reflected in the floristic composition.

Introduction

The *Violo declinatae – Nardetum* Simon 1966 meadows are the most widespread as altitude in the Timişului River Basin. As area, the *Nardus stricta* meadows represent the 2nd type of meadow after that identified by the *Festuco rubrae – Agrostietum capillaris* Horv. 1951. The upper and mid basins of the Timişului River include the Semenic Mountains, the Ţarcu Peak, the Mic Mountain, and the Rusca Peak. The association meadows are spread particularly on the upper level but on the sub-alpine level too, especially on the Ţarcu Peak. The lowest phyto-coenoses edified by the *Nardus stricta* were identified in the Poiana Mărului, on limited areas. Between the different mountains, there are, despite the homogeneity and stability in time of the *Nardus stricta* meadows, variations in the floristic composition of the association, engendered particularly by altitude and by their geographical location determining climate factors (the Semenic Mountain, in the south, shows the highest amount of rainfall in the region).

Method

The analysis of vegetal associations was done using the method of the Central-European phyto-coenological school. The ecological characterisation of the association (bio-form spectra, geo-elements, moisture, temperature, and soil reaction), the calculus of bio-diversity indices and of pastoral value was made on the ground of species abundance-dominance. The bio-diversity indices we used are Shannon-Wiener and Simpson. Their relative values are related to the following scale: 0-0.2: very low; 0.21-0.4: low; 0.41-0.6: medium; 0.61-0.8: high; 0.81-1: very high [11].

The *Violo declinatae – Nardetum* meadows spread on the four mountains under study are presented under the form of a table showing species constancy, in which one can see the differences in floristic composition, determined particularly by altitude. For each mountain we analysed 10 samples; *Nardus stricta* meadows in the Poiana Mărului are not included in the table as a consequence of the low number of samples.

Results and Discussions

Chorology. The phyto-coenoses of the *Violo declinatae – Nardetum* Simon 1966 association are spread on large areas in the higher area of the Semenic Mountains, on the Mic

Mountain, at Cuntu - Țarcu and less on the Rusca Peak, at altitudes between 820 and 1800 m. The lowest *Nardus stricta* meadows were identified at Poiana Mărului and in the Semenic Mountains. At the upper altitude limit, these meadows mingle with phyto-coenoses edified by *Vaccinium myrtillus, Juniperus communis, Festuca nigrescens* or *Festuca airoides*, on the Țarcu.

Syn-morphology and floristic composition. The *Violo declinatae – Nardetum* Simon 1966 association contains long-lasting, compact, almost mono-dominant phyto-coenoses without obvious stratification [8]. They are considered to have appeared at the upper limit of spruce fir forests after their deforestation.

The meadows under analysis in different stations of the Timişului River Basin have a relatively uniform physiognomy and a small number of species. The synthesis table shows the dominance of *Poaceae* (15), *Cyperaceae* and *Juncaceae* (11 species), the number of *Fabaceae* being low (5). Biodiversity specific to the association is low after Shannon's index (0.31) and medium after Simpson's index (0.43).

General covering by phyto-coenoses is between 85 and 100%, of which edifying species represents 40-100%. Stratification is not usually obvious; there is a layer about 30 cm thick edified by taller species (*Festuca rubra, F. nigrescens, Deschampsia flexuosa, Luzula luzuloides, Vaccinium myrtillus*) and a lower layer formed of *Nardus stricta* together with numerous short species (*Potentilla erecta, Cerastium fontanum, Galium vernum, Hieracium lactucella, H. pilosella, Polygala vulgaris, Omalotheca sylvatica, Potentilla aurea* subsp. *chrysocraspeda, Stellaria graminea, Thymus pulegioides, Veronica chamaedrys, V. officinalis, Viola canina* subsp. *montana, V. reichenbachiana*). In moister stations there are species such as *Deschampsia caespitosa, Veratrum album, Juncus conglomeratus, Polygonum bistorta* that cover significant areas in these phyto-coenoses. Such stations with uneven relief in which there are, beside the species already mentioned, peat moss and moor grass are frequent on the Semenicului Plateau and at the basis of some slopes on the Țarcu. On the Rusca Peak these meadows are sometimes invaded by 120-150 cm tall *Juniperus communis*.

Besides edifying *Nardus stricta* there are also some species that frequently grow higher (20-40%): *Deschampsia flexuosa, Agrostis capillaris, Festuca rubra, Vaccinium myrtillus, Juniperus communis*. In the mountain hollow of the Semenic association meadows have the form of a dense carpet formed almost exclusively by *Nardus stricta* or in co-dominance with red fescue. On the Rusca Peak and on the Mic Mountain *Nardus stricta* meadows are frequently invaded by *Vaccinium myrtillus* and *Juniperus communis*.

Violo declinatae – Nardetum meadows on the Cuntu have a particular aspect due to the existence of „dolines", portions of higher micro-relief colonised by *Nardus stricta* and *Vaccinium vitis-idaea* together with different lichen species. They consider [17] that these formations are a kind of relics of moss hills existing in spruce fir forests and which through their strong development and high water reserves have hindered the air-water balance of the ecosystems, leading to a rarefaction of woody vegetation and, in time, to its disappearance. Great variations in temperature and grazing by sheep that favour the deepening of the paths already existent in these circular colonies play an important role in creating and maintaining these hills.

At Cuntu, *Nardus stricta* meadows cover the western slopes and plateaus, while, at the same altitudes, *Festuca nigrescens* meadows are spread on the southern abrupt slopes. The latter appears in numerous samples belonging to the *Violo declinatae – Nardetum* association, but with a lower share. This species is up to 5 % [24] covered by *Nardus stricta*.

To the Țarcu Peak and the Mic Mountain, between 1700 and 1800 m, *Nardus stricta* meadows contain numerous species that prefer climatic and soil conditions characteristic to higher mountains and particularly to the sub-alpine level (Table 1): *Agrostis rupestris, Antennaria dioica, Bruckenthalia spiculifolia, Campanula serrata, Festuca airoides, Geum montanum, Homogyne alpina, Juncus trifidus, Luzula sudetica, Potentilla aurea* subsp. *chrysocraspeda, Rhododendron myrtifolium, Scorzonera purpurea* subsp. *rosea, Sesleria*

coerulans, Solidago virgaurea subsp. *alpestris, Avenula versicolor* and lichens (*Cetraria islandica, Cladonia rangiferina, Thamnolia vermicularis*). Floristic composition of these meadows is very much like that of phyto-coenoses in the Rodnei, Făgăraş, and Retezat Mountains [20] and are part of the *Nardetum strictae alpinum* association. Phytocoenoses with *Nardus stricta* reaching alpine meadows can be ranged under the *festucetosum airoidis* sub-association [6].

Table 1: Constancy (K) of species in the association on the four mountains under study

Mountain	**Semenic**	**Rusca**	**M. Mic**	**Ţarcu**
Altitude interval	**820-1440**	**1300-1350**	**1740-1800**	**1600-1800**
Mean number of species per sample	**17**	**14**	**14**	**19**
Exposition	**S,V,NV,N**	**S,V**	**S,V**	**S,V**
	Constancy (K) of species			
Achillea millefolium L.	I		I	
Agrostis capillaris L.	IV	IV		I
Agrostis rupestris All.			II	III
Anemone nemorosa L.	I			
Antennaria dioica (L.) Gaertner	I	II	III	III
Anthoxanthum odoratum L.	III	II	III	II
Avenula versicolor (Vill.) Lainz		I		
Briza media L.	II			
Bruckenthalia spiculifolia (Salisb.) Reichenb.		IV	II	II
Campanula patula L. ssp. abietina (Griseb.) Simonk.	III	I	III	III
Campanula serrata (Kit.) Hendrych	I	I		III
Carex brizoides L.	I			
Carex lasiocarpa Ehrh.	I			
Carex ovalis Good.	III			
Carex pallescens L.			I	
Carex rostrata Stokes	I			
Cerastium fontanum Baumg.	II			I
Cetraria islandica			I	IV
Chamaespartium sagittale (L.) P. Gibbs	I			
Cladonia rangiferina			I	II
Danthonia decumbens (L.) DC	I	II		
Deschampsia caespitosa (L.) P. Beauv.	I			
Deschampsia flexuosa (L.) Trin	IV	V	IV	V
Epipactis helleborine (L.) Crantz				I
Festuca airoides Lam.			I	II
Festuca nigrescens Lam.	I	II	IV	IV
Festuca rubra L.	V			
Galium vernum Scop.	I			
Geum montanum L.			III	II
Hieracium lactucella Wallr.	II			
Hieracium pilosella L.	I	I		
Holcus lanatus L.	I			
Homogyne alpina (L.) Cass.	II		I	I
Hypericum maculatum Crantz.	III	II		
Hypnum cupressiforme				I
Juncus conglomeratus L.	I			
Juncus trifidus L.				I
Juniperus communis L.	I	IV	I	
Leontodon hispidus L. ssp. danubialis (Jacq.) Simonk.	I			
Leucanthemum vulgare Lam.	I			
Luzula campestris (L.) DC	I			
Luzula luzuloides (Lam.) Dandy et Willmott	IV	IV	II	II
Luzula multiflora (Retz.) Lej.				I
Luzula sudetica (Willd.) DC				I

Lychnis viscaria L.	II			
Nardus stricta L.	V	V	V	V
Omalotheca sylvatica (L.) Sch. Bip. F. W. Schultz	I	I	II	II
Picea abies (L.) Karst.				I
Plantago lanceolata L.	I		I	
Poa trivialis L.		I		
Polygala vulgaris L.	I	I		I
Polygonum bistorta L.	I			
Polytrichum commune	I	I		I
Polytrichum juniperinum				I
Potentilla aurea L. ssp. chrysocraspeda (Lehm.) Nyman				II
Potentilla erecta (L.) Rausch.	V	IV	II	I
Ranunculus acris L.	I			
Ranunculus crenatus Waldst. & Kit.				I
Rhododendron myrtifolium Schott & Kotschy				I
Rumex acetosella L.	II			
Scorzonera purpurea L. ssp. rosea (Waldst. & Kit.) Nyman				I
Sesleria coerulans Friv.				I
Solidago virgaurea L. ssp. Alpestris		I		
Sphagnum sp.	I			I
Stellaria graminea L.	I			
Thamnolia vermicularis				II
Thymus pulegioides L.	I	I		
Trifolium pratense L.	I			
Trifolium repens L.	II			
Vaccinium myrtillus L.	II	IV	IV	IV
Vaccinium vitis-idaea L.	I	IV	III	III
Veratrum album L.	II			
Veronica chamaedrys L.	I			
Veronica officinalis L.	II			
Viola canina L. subsp. montana (L.) Hartm.	II			
Viola declinata Waldst. et Kit.	I	I	I	

In the stations at Poiana Mărului, floristic composition is more varied due to lower altitude; *Nardus stricta* meadows settle instead of meadows of *Festuca rubra* intensely grazed on poor acid soils. The number of meso-philous species characteristic of red fescue meadows is high. These are young phyto-coenoses where the cover is less compact.

Association species with high constancy are, besides *Nardus stricta*: *Deschampsia flexuosa, Agrostis capillaris, Luzula luzuloides, Potentilla erecta, Vaccinium myrtillus, Anthoxanthum odoratum, Festuca nigrescens, F. rubra, Campanula patula* subsp. *abietina, Vaccinium vitis-idaea, Antennaria dioica* and *Bruckenthalia spiculifolia*. Within different mountains, species constancy changes with ecological factors, change that favours certain plant groups such as the xero-meso-philous, micro-thermal, and acido-philous on the Țarcu.

On the Rusca Peak are frequent the species characteristic to bushes and acid superficial soils: *Bruckentalia spiculifolia, Deschampsia flexuosa, Juniperus communis, Luzula luzuloides, Potentilla erecta, Vaccinium sp., Antennaria dioica, Danthonia decumbens, Avenula versicolor, Omalotheca sylvatica, Solidago virgaurea* ssp. *alpestris*. On the Rusca Peak and on the Semenic Mountain, at altitudes about 1400 m, there are no spruce fir forests, potential vegetation being constituted of beech forests. *Nardus stricta* together with *Festuca rubra*, on the Semenic, and species of *Vaccinium* together with *Juniperus communis*, on the Rusca, cover the mountain hollows at the upper limit of beech forests. Here, blueberry and juniper bushes seem to have settled on the *Nardus stricta* meadows fund.

The species characteristic to this association is *Viola declinata* that appears sporadically. As species characteristic to the association authors mention [8] besides *Viola declinata*, *Campanula patula* subsp. *abietina, Carex pallescens, Hieracium auricula* and *Cerastium*

fontanum. Species characteristic to the class are *Nardus stricta, Homogyne alpina, Luzula sudetica, Potentilla erecta, Deschampsia flexuosa, Antennaria dioica, Danthonia decumbens* [24]. Are characteristic of the order the following species: *Nardus stricta, Hieracium auricula, Campanula patula* subsp. *abietina, Hypericum maculatum, Campanula serrata, Avenula versicolor, Geum montanum* and for alliance, *Potentilla aurea* subsp. *chrysocraspeda, Poa media, Scorzonera purpurea* subsp. *rosea, Campanula patula* subsp. *abietina, Campanula serrata, Thymus balcanus* [25].

The species characteristic of the association is characterised by a wide spectrum of ecological requirements. It develops well in high moisture conditions as well, when it is accompanied by species such as *Carex ovalis, Deschampsia caespitosa, Polytrichum commune, P. juniperinum, Sphagnum sp.,* and *Eriophorum latifolium,* making up hygrophilous phyto-coenoses. In the sample from the Poiana Mărului we identified two orchids, *Listera ovata* and *Epipactis helleborine*, and in the meadows on the Semenic, *Anemone nemorosa*, a species characteristic to beech forests. The presence of some woody species such as *Picea abies, Juniperus communis, Vaccinium myrtillus* and *Vaccinium vitis-idaea* show a possible trend to reforestation or proves the formation of *Nardus stricta* meadows on places once covered by forests or bushes characteristic to high mountains. These species often cover micro-stations with a skeleton soil, contributing to their fixation.

Syn-ecology. The *Violo declinatae – Nardetum* Simon 1966 association prefers acid and very acid soils (pH = 3.5-4.5), poorly aerated, rich in raw humus and poor in nutrients. It can be seen at high altitudes, between 1400-1900 m [1, 3], but they get down up to 700-800 m due to their high degree of adjustment. The key factor in *Nardus stricta* meadows distribution is soil reaction [22]. In the floristic composition of the association the dominant species is accompanied by a small number of species, most of which are acido-philous or euriionic. *Nardus stricta* phyto-coenoses settling is also favoured by over-grazing [15], by the particular ecological plasticity of the edifying species [19] and by its high capacity of mating [4]. It presents ectotrophic mycorises that protects it from soil acidity making it an advantage compared to other species [20].

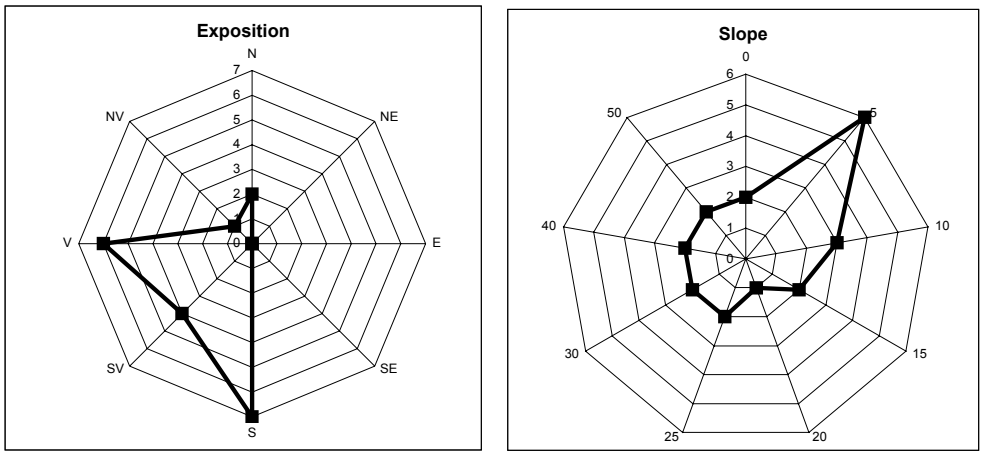

Fig. 1: Plant community chorology in relation to exposition and slope

Nardus stricta meadows in the Timişului River Basin are predominantly spread on southern and western slopes (77%), more rarely on northern slopes and on plateaus (Fig. 1). Slopes are usually smooth to moderate ($5\text{-}50^0$). From the soil reaction spectrum one can see that most species are euriionic (29). To these acido-philous (23) and acido-neutrophilous species come to add (15). Highly acido-philous species are: *Nardus stricta, Vaccinium myrtillus, Vaccinium vitis-idaea, Bruckenthalia spiculifolia, Deschampsia flexuosa, Agrostis rupestris, Geum montanum*. According to abundance-dominance index, one can see the strongly

acidophilus character of meadows with *Nardus stricta*. The temperature spectrum shows the existence of numerous eurithermal species (25) and that of micro-thermal and meso-thermal ones. As for soil moisture, the meso-philous species are dominant (35), followed by xero-philous and eurihydric ones. According to the ADm index, these meadows are indifferent to soil moisture and temperature, a characteristic of the dominant species (Fig. 2).

Bio-form spectrum is dominated by hemi-cryptophytes; among geo-elements, there is a great number of Eurasian, circumpolar, European, Carpathian, and Alpine species. After the species ADm, phyto-coenoses are edified by European elements (48.11% of the total ADm).

Coeno-taxonomy. Phyto-coenoses edified by *Nardus stricta* have undergone different coeno-taxonomic groupings. Samples synthesised in the synthetic table belong to the *Violo declinatae – Nardetum* Simon 1966 association that groups *Nardus stricta* meadows in Eastern Europe and that is ranked in the *Nardo – Callunetea* Prsg. 1949 class, order *Nardetalia* Oberd. 1949, and the *Potentillo – Nardion* Simon 1959 alliance. It is identified [7] with other coeno-taxons described in Romania: *Nardetum strictae montanum* Resm. et Csűrös 1963, *Nardetum strictae subalpinum* Buia et al. 1962, *Nardetum strictae alpinum* Buia et al. 1962, *Nardetum alpigenum austro - carpaticum* Borza 1959.

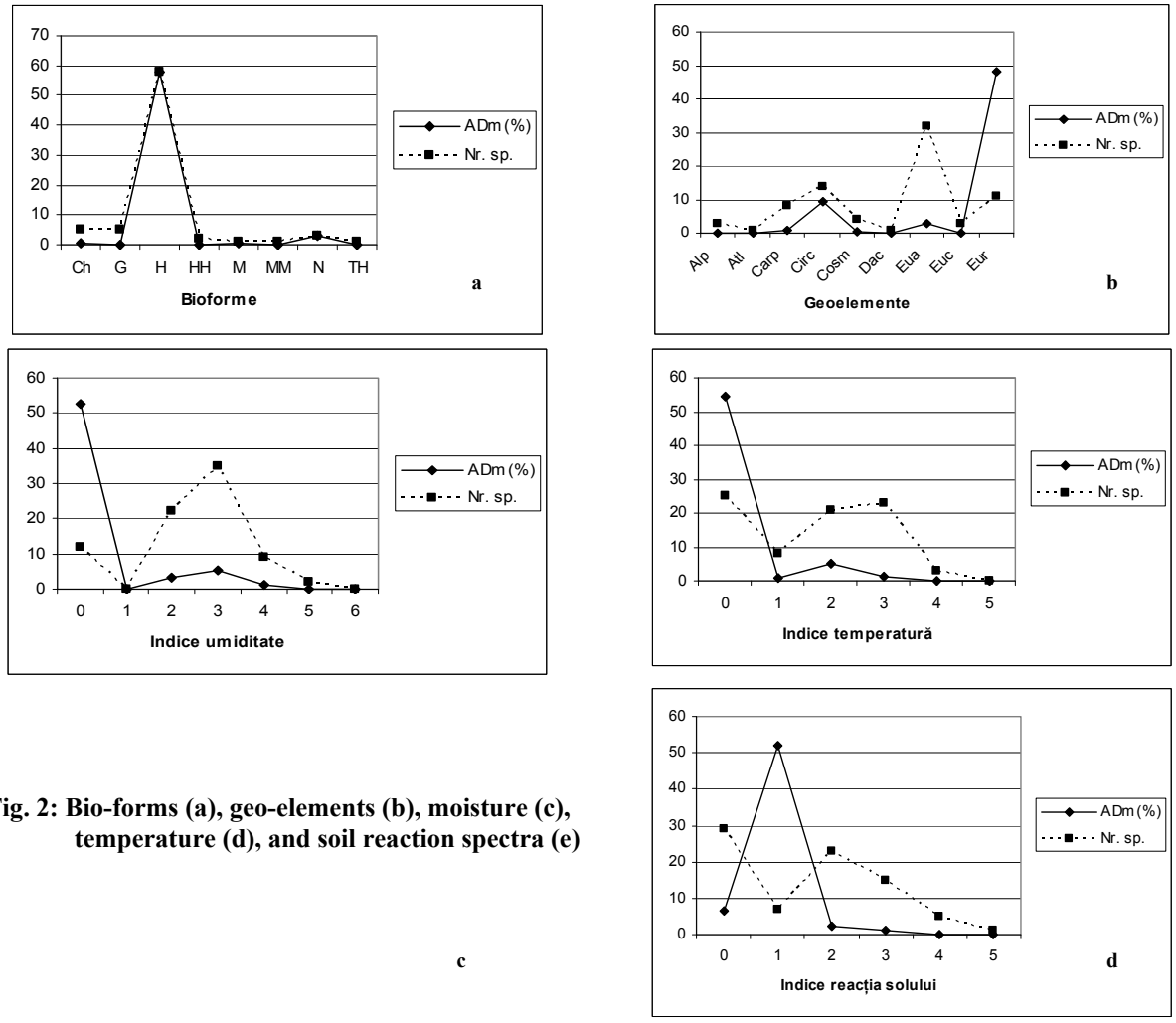

Fig. 2: Bio-forms (a), geo-elements (b), moisture (c), temperature (d), and soil reaction spectra (e)

Following syngenetic and floristic criteria, *Nardus stricta* phytocoenoses were grouped [7] in the *Juncetea trifidi* Hadač in Klika et Hadač 1944 class, order *Caricetalia curvulae* Br.-Bl. in Jenny 1926 em. Krajina 1933, the *Potentillo (ternatae) – Nardion* Simon 1957 alliance. In the *Nardo – Callunetea* Prsg. 1949 class, order *Nardetalia* (Oberd. 1949) Prsg. 1949, the *Nardion*

strictae alpinum Br.-Bl. 1926 alliance the other authors include only hygrophilous phyto-coenoses.

The meadows of *Nardus stricta* identified at higher altitudes were included [2] in the *Nardetum alpigenum* Br.-Bl. 1949 subas. *austro - carpaticum* Borza 1959 association, having as characteristic species *Nardus stricta, Festuca rubra, Hieracium auricula, Carex leporina, C. pallescens, Viola canina, Omalotheca sylvatica*. Due to the presence of Alpine and sub-Alpine species, the association was included in the *Caricetea curvulae* Br.-Bl. 1948 class, order *Caricetalia curvulae* Br.-Bl. 1948, the *Nardion strictae* Br.-Bl. 26 alliance.

For Transylvania they proposed [17, 23] the *Nardetalia strictae* formation, divided into two groups of associations or alliances depending on altitude (*Nardion strictae alpinum* and *Nardion strictae montanum*). Phytocoenoses with species from *Caricetalia curvulae* could be grouped in *Juncetea trifidi, Caricetalia curvulae* [7]. Due to the presence of the species *Festuca nigrescens* in the *Nardus stricta* meadows, some authors have preferred to put them in *Campanulo (abietinae) – Nardo – Festucetum commutatae* Boşcaiu 1971, an association synonymous of *Festuceto – Nardetum strictae montanum* Csűrös et Resmeriţă, 1960; *Nardus stricta – Festuca rubra fallax* Puşcaru *et al.*, 1959; *Nardo – Festucetum rubrae* Maloch, 1932.

The relatively uniform floristic composition, the presence of numerous species characteristic for *Nardetalia* and *Potentillo - Nardion*, the categorical dominance of the *Nardus stricta* species that also determines the constant physiognomy of the association, and particularly the presence in small amounts and with low frequency of species in the sub-Alpine associations, together with the idea of grouping this species meadows resulted in their inclusion in *Violo declinatae – Nardetum* Simon 1966, class *Nardo – Callunetea* Prsg. 1949, order *Nardetalia* Oberd. 1949, and the *Potentillo – Nardion* Simon 1959 alliance.

Syn-dynamics. In the area under study, the spreading area of *Nardus stricta* meadows is at the upper limit of spruce fir and juniper forests. These are considered secondary meadows formed after deforestation, the vegetation dynamics being very much influenced by altitude and pedo-climatic factors. After deforestation, at lower altitudes, there are *Festuca rubra* with *Agrostis capillaris* meadows and, at higher altitudes, meadows of *Festuca nigrescens*. Oligo-trophic ones, one of the decisive factors being over-grazing, have gradually replaced these productive phyto-coenoses.

With soil loosing nutrients and becoming acid, good forage species are replaced by *Nardus stricta*, a species with great ecological plasticity and preferences for acid soils. Such an evolving series was noticed in the Semenic Mountains, near Prislop, where, during five years, a large meadow of *Festuca rubra* has almost completely been replaced by *Nardus stricta* while on others the two species are co-dominant. Annual variations in gradual covering by the two species were noticed on the Semenic Plateau; besides soil acidification and impoverishing, annual hydric regime seems to influence the ratio between the two species.

The existence in some samples of blueberry and juniper show a trend to reinstall woody vegetation through the intermediary of these phyto-coenoses grouped in *Campanulo abietinae – Vaccinietum* (Buia *et al.*, 1962) Boşcaiu 1971. This phenomenon is quite obvious on the Rusca Peak where *Nardus stricta* meadows are replaced by blueberry and juniper, a phenomenon favoured by a low grazing level. Soil acidity is also underlined by the presence of *Bruckenthalia spiculifolia*, which here and there covers a lot of space. Woody vegetation regenerates with great difficulty because of climatic and soil factors but, in good weather, juniper bushes recover quickly, usually through the intermediary of blueberry bushes.

They consider [3] that rapid spreading of *Nardus stricta* meadows was favoured by secondary podzolisation processes engendered by juniper bushes and woody vegetation deforestation in the sub-Alpine level (*Junipero - Bruckenthalion*). Deforestation favoured the edification, for a while, of productive meadows of *Festuca nigrescens*, which afterwards evolved to *Nardus stricta* meadows. Thus, these meadows constitute semi-natural associations in a state

of disclimax complementary to the disclimax of juniper bushes and even of sub-Alpine deforested spruce fir forests [3].

Some authors [7, 19] consider *Nardus stricta* meadows as derivates of primary vegetation edified by juniper and blueberry. The sense of evolution seems to be bogging and their change into hygrophilous phyto-coenoses or their invasion by shrubs (particularly on slope lands, where pressure from grazing is decreasing). Under the influence of manure, *Nardus stricta* meadows can evolve to dominant phyto-coenoses dominated by *Rumex alpinus* [21].

Despite these evolving trends, *Nardus stricta* meadows show great stability in time. Through pastoral management measures (reasonable grazing, amendments, fertilising) the share of *Festuca rubra* and *Agrostis capillaris* and green pasture yield increase [23, 12, 5].

Typology and economic value. *Nardus stricta* meadows represent the main forage source in the sub-Alpine level. The edifying species, though with no forage value, is eaten by cattle grazing in early stages and by sheep in more advanced stages. Plant consumption decreases with age, from about 60 % before spiking to 15-25 % after spiking [14]. Among forage species on these meadows there are *Agrostis capillaris, Festuca rubra, F. nigrescens, Anthoxanthum odoratum, Briza media, Trifolium pratense, T. repens, Achillea millefolium, Plantago lanceolata*.

On these meadows mean yield is of 4.5 - 5 t/ha green forage and in over-grazing conditions it is of only 2 t/ha. Of the total yield animals eat les than half. Sheep grazing maintains *Nardus stricta* meadows for a longer time due to the choice by animals of forage species and to avoiding edifying species. Cattle and equine grazing can determine withdrawal of *Nardus stricta* by preferential consumption of its buds and shoots [17].

Pastoral value calculated after ADm of species inventoried is of 0.15 which includes these meadows in the degraded ones category, with very low forage value, ensuring a grazing capacity below 0.2 U.V.M./ha.

Nardus stricta meadows studied in the Timişului River basin can be differently grouped from a pastoral point of view, depending on altitude and station characteristics [26]: in the deciduous trees belt the beech forest and beech and evergreen forest, the *Nardus stricta* series, the *Nardus stricta* type characteristic to oligo-trophic soils, with the *Bruckenthalia spiculifolia* sub-types (xerophilous phyto-coenoses on acid soils) and *Juniperus communis* (skeleton soils) as is the case for the Rusca Peak, in the deciduous trees belt, the beech and beech + evergreen forests sub-belt, the *Agrostis capillaris – Festuca rubra* series, the *Agrostis capillaris – Festuca rubra* type, the *Nardus stricta* sub-type; in the boreal belt (that of spruce fir forests), the *Festuca rubra* series, the *Nardus stricta* type (stations with oligo-trophic soils), with the *Deschampsia caespitosa* sub-type (hygrophilous phyto-coenoses, soils with raw hydro-morphous humus); in the boreal belt (that of spruce fir forests), the *Festuca rubra* series, the *Festuca rubra* type, the *Nardus stricta* sub-type; in the boreal belt (that of spruce fir forests), the *Festuca rubra* series, the *Festuca nigrescens* - *Nardus stricta* type (stations with strongly acid soils), and in the sub-Alpine belt (that of juniper bushes), the *Nardus stricta* series, the *Festuca nigrescens – Nardus stricta* type (stations with strongly acid soils) to which the Cuntu – Ţarcu meadows also belong; in the sub-Alpine belt (that of juniper bushes), the *Nardus stricta* series, the *Nardus stricta – Potentilla aurea* subsp. *chrysocraspeda* type (oligo-trophic biota).

Conclusions

Violo declinatae – Nardetum in the mid and upper Timiş River basin are the most widespread meadows, after the *Festuca rubra* ones, having the widest altitude amplitude (980m).

Though homogenous, compact, and edified almost exclusively by *Nardus stricta* or by it together with *Festuca rubra*, these meadows in the mountains of the region under study show variations concerning floristic composition and syn-morphology because of pedo-climatic changes with altitude, or because of their different geographical and orographic location characteristic to these mountains. More abundant rainfall on the Semenic Mountains result in a

change of the ratio of the two co-dominant species during fried summers compared to moister summers; the ADm variation of the two species under the influence of climate factors (*Festuca rubra*, a meso-philous species, is favoured by rainy years) require a longer study.

Variations at the level of each floristic composition of phyto-coenoses are obvious in the number of species per sample. The Semenic Mountains has compact *Nardus stricta* meadows or meadows edified by it in co-dominance with red fescue. On the Rusca Peak, bushes of blueberry and juniper are dominant as they are edified on *Nardus stricta* meadows fund, the succession following the red fescue - *Nardus stricta* – blueberry and juniper bushes, as a trend towards recovering forest vegetation favoured by abandoning meadows. On the Mic Mountain up to 1800 m blueberry bushes frequently replace *Nardus stricta* meadows, but juniper appears more rarely and does not form tall bushes, characteristic to the Rusca Peak. At Cuntu *Nardus* meadows differentiate through the existence of dolines, forming compact phyto-coenoses, and towards the Țarcu Peak in the floristic composition of the association there are more and more species with an Alpine and sub-Alpine area, which explains the higher number of species per sample.

Nradus stricta meadows are spread on plateaus and moderate slopes with predominant southern and western exposition. Ecological spectra of the association show the dominance of European, Euro-Asian, and circumpolar elements. Depending on species ADm, the association is strongly acidophilus and indifferent to moisture and temperature. Most species in the phyto-coenoses are not too demanding, being yet characteristic to acid soils or indifferent to this factor.

Syn-dynamically, the *Nardus stricta* meadows are very stable in time, as they constitute on ex-red fescue phytocoenoses following grazing. On rocky areas, *Nardus stricta* meadows are gradually occupied by blueberry and juniper species, as a trend to recovering woody vegetation.

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FITOCENOLOGIA, SINECOLOGIA ŞI CHOROLOGIA PAJIŞTILOR DE *NARDUS STRICTA* L. DIN BAZINUL TIMIŞULUI

(**Rezumat**)

Pajiştile de ţepoşică (asociaţia *Violo declinatae – Nardetum* Simon 1966) sunt larg răspândite în bazinul Timişului atât ca suprafaţă dar mai ales ca amplitudine altitudinală (1000 m). Cele mai compacte nardete se găsesc pe Vârful Ţarcu. Pe Semenic şi Muntele Mic, specia *Nardus stricta* este frecvent codominantă cu *Festuca rubra*, respectiv *Festuca nigrescens*. Lucrarea prezintă aspecte referitoare la compoziţia floristică a asociaţiei, sinecologia, corologia şi sindinamica acesteia, la care se adaugă indici de biodiversitate (Shannon – Wiener şi Simpson).

Compoziţia floristică a nardetelor, răspândite în cele patru masive muntoase studiate este prezentată sub forma unui tabel cu constanţa speciilor. Sinecologia asociaţiei este redată prin spectre efectuate atât după numărul, cât şi după abundenţa-dominanţa medie a speciilor, astfel încât să evidenţieze caracterul fitocenozelor determinat de specia edificatoare dar şi posibilele tendinţe evolutive care se reflectă în compoziţia floristică.