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PRESENCE OF THE SPECIES *NARDUS STRICTA* IN HIGH NATURE VALUE GRASSLANDS IN MUREȘ COUNTY

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Abstract: The precise delimitation of High Nature Value (HNV) grasslands is particularly important, because it can lead to a more effective application of measures for the maintenance of habitats and species that depend on agricultural management [20].

The *Nardus* grasslands studied are located in the mountain area of Mureș county (Călimani and Gurghiu Mountains). They were assigned to habitat 6230* Species-rich *Nardus* grasslands, on silicious substrates in mountain areas.

The phytocoenoses studied belong to four plant associations: *Violo declinatae-Nardetum* Simon 1966, *Hieracio pilosellae-Nardetum strictae* Pop et al. 1988, *Polygalo-Nardetum* (Preising 1953) Oberd. 1957, and *Festuco rubrae-Agrostietum capillaris* Horvat 1951 subass. *nardetosum strictae* Oroian 1998. In the composition of these phytocoenoses, a number of rare species were also identified, which are assigned to various zoological categories and are included in national and international Red Lists: *Campanula serrata* (Kit.) Hendrych, *Viola declinata* Waldst. et Kit., *Lycopodium clavatum* L., *Lycopodium alpinum* L. and *Gymnadenia conopsea* (L.) R. Br.

These grasslands are used as seasonal pastures, and transhumance is frequent.

The conservation status of habitat 6230* in the studied areas is unfavourable-inadequate. Field observations showed that the habitat has the structure and specific functions required for its long-term conservation and there is a high probability for the maintenance of the grasslands in the predictable future under the conditions of adequate management measures; the natural distribution area of the habitat and the surfaces covered by it within the studied territory are stable or slightly decreasing.

Keywords: grasslands, habitats, conservation status, Mureș county, Transylvania.

Introduction

Romania is characterized by extensive grassland surfaces rich in plant species, many of which have a high grazing value and are included in numerous NATURA 2000 habitat types, as well as many nationally and internationally protected species. These hay-meadows and pastures should be studied in detail, as they represent a habitat whose surface area has significantly decreased in Europe. The majority of the *High Nature Value (HNV) grasslands* are of secondary origin, having replaced former forest vegetation. The grasslands were created in order to extend agricultural fields and forage supplies for the livestock sector, which must meet the current food requirements of the population. There is currently a decrease of livestock, which has entailed a considerable reduction of grassland surfaces, through their abandonment. According to the Good Agricultural and Environmental Conditions established by the European Union Council Regulation, our country should pay particular attention to this grazing heritage by preserving the existing surfaces and ensuring a minimum level of their maintenance.

The *Nardus* (matgrass) grasslands studied, considered HNV grasslands, are located in the mountain area of Mureş county (Călimani and Gurghiu Mountains). The morphology of the landscape, along with the specific biopedoclimatic characteristics, favour the maintenance of their particularly valuable biodiversity.

Material and Methods

The *Nardus* (matgrass) grasslands in the Călimani-Gurghiu Mountains area were studied.

In this type of habitat, only grasslands with a mean abundance-dominance value of the species *Nardus stricta* of at least 37.5% and a representative number of species in their structure were included.

To describe habitat 6230*, the following works were used: *A handbook for interpreting NATURA 2000 habitats in Romania* (Gafta D., Mountford O. (coord.), 2008), *Habitats in Romania*, (Doniță, N., Popescu, A., Paucă-Comănescu, Mihaela, Mihăilescu, Simona, Biriș I.-A., 2005) and *Habitats in Romania, Changes according to amendments to the Habitats Directive (92/43/EEC) proposed by Romania and Bulgaria* (Doniță N., Popescu A., Paucă-Comănescu Mihaela, Mihăilescu Simona, Biriș I.-A., 2006).

The parameters used for calculating the conservation status of the habitat were: the natural distribution area, the surface covered by the habitat, the structure and specific function of the habitat, and future perspectives associated with it.

For the graphical representation of the conservation status, the following colour coding system was adopted: red for "unfavourable-bad"; orange for "unfavourable-inadequate"; green for "favourable".

Results and Discussions

Nardus grasslands in Romania, with mono-dominant *Nardus stricta* coenoses, frequent in the SE Carpathians, are of great scientific importance because they are different from the *Nardus* grasslands in the Tatra, Alps or Balkan Mountains, of which the floristic composition includes other characteristic species belonging to the *Potentillo-Nardion* alliance.

The *Nardus* grasslands studied were assigned to habitat 6230* Species-rich *Nardus* grasslands, on silicious substrates in mountain areas.

Phytocoenoses dominated by *Nardus stricta* occupy extensive surfaces in the studied territory, on mountain plateaux in particular, on silicious substrates.

These grasslands are most frequently used as pastures.

Pastures are strongly influenced by the change of land use, the intensification of agriculture and land abandonment, and are currently in the category of the most threatened habitats [21].

Following field work, habitat 6230* was identified in 60 sites situated within the administrative area of the localities Chiheru de Jos, Câmpul Cetății, Sovata, Ibănești, Lăpușna, Răstolița, Sălard, Deda, Neagra and Ciobotani.

The *Nardus stricta* phytocoenoses identified were assigned to four plant associations belonging to two classes, as follows:

Cls. **Calluno-Ulicetea** Br.-Bl. et R. Tx. ex Klika et Hadač 1944

Ord. Nardetalia Oberd. 1949

All. Potentillo-Nardion Simon 1958

Viola declinatae-Nardetum Simon 1966

Hieracio pilosellae-Nardetum strictae Pop et al. 1988

All. Violion caninae Schwickerath 1944

Polygalo-Nardetum (Preising 1953) Oberd. 1957

Cls. **Molinio-Arrhenatheretea** R. Tx. 1937

Ord. Arrhenatheretalia R. Tx. 1931

All. Cynosurion R. Tx. 1947

Festuco rubrae-Agrostietum capillaris Horvat 1951 subas.
nardetosum strictae Oroian 1998

Characterization of the plant associations

Viola declinatae-Nardetum Simon 1966

The phytocoenoses of this association were identified at six sites (Poiana Drăguș, Răstolița-Iod, Câmpu Cetații-Brădețel and Coța), at altitudes of over 1000 m, up to 1700 m. They prefer densely packed, poorly aerated, acid, low-nutrient soils of variable humidity.

Phytocoenoses are stratified, with a shrub layer – very reduced, represented by species such as *Vaccinium myrtillus* and *V. vitis-idaea*. In the grass layer, the characteristic Carpathian-Balkan species *Viola declinata* has low cover, particularly in groups where *Nardus stricta* has a percentage cover of up to 95%, it is mono-dominant and the number of species in the floristic composition is relatively small.

This association has a relatively high floristic richness, evidenced by the 101 species in its composition. In addition to the species characteristic of the association, *Viola declinata* and *Nardus stricta*, species belonging to coenotaxa subordinating this association are well represented: the Potentillo-Nardion alliance (*Carex pallescens* L., *Cruciata glabra* (L.) Ehrend., *Hieracium aurantiacum* L., *Lycopodium alpinum* L., *Polygala vulgaris* L., *Potentilla ternata* C. Koch, *Viola canina* L., etc.), Nardetalia order, Calluno-Ulicetea class, as well as a number of transgressive plants of the Molinio-Arrhenatheretea class.

In addition to these, the association composition includes species belonging to various zoological categories, present on national and international Red Lists, such as: *Lycopodium alpinum* L., *Lycopodium clavatum* L., *Viola declinata* Waldst. et Kit., *Leucanthemum waldsteinii* (Schultz Bip.) Pouzar, which increase the conservation value of these phytocoenoses.

Hieracio pilosellae-Nardetum strictae Pop et al. 1988

The phytocoenoses of this association were identified in the Călimani Mountains, north of the Bâta Peak, in Poiana Ferigelor, Piatra/Ciobotani, in the Niraj Valley, in Brădețel/Câmpul Cetații, and in the Gurghiu Mountains, in Fătăciunea/Ibănești and Poiana Căpităneasa/Toaca, at altitudes of 854–1328 m. They occupy low humidity biotopes, characteristic of plateaux and gentle slopes exposed to the sun. The soil is rich in acid humus, covering the rocky substrate. The flora of these phytocoenoses is poor in species (69 species), belonging to the Calluno-Ulicetea and Molinio-Arrhenatheretea classes. From a successional point of view, these grasslands were derived from *Viola declinatae-Nardetum* following aridization of the ecotope [29]. They have also originated from the phytocoenoses of the association *Festuco rubrae-Agrostietum capillaris* as a result of excessive grazing and an increase in soil aridity. These phytocoenoses are of secondary nature and their presence is due to the anthropo-zoogenic factor.

Along with the characteristic dominant species, *Nardus stricta* and *Hieracium pilosella*, species characteristic of higher coenotaxa are frequently found: *Alchemilla xanthochlora* Rothm., *Carex pallescens* L., *Festuca rubra* L., *Hypericum maculatum* Crantz, *Polygala vulgaris* L., *Carex leporina* L., *Genista tinctoria* L., *Hieracium umbellatum* L., *Luzula campestris* (L.) DC., *Lycopodium clavatum* L., *Potentilla erecta* (L.) Räuschel, *Veronica officinalis* L. and *Viola canina* L. A significant number of transgressive species of the Molinio-Arrhenatheretea class are also found.

The conservation value is moderate, due to the presence of rare species, included in national and international Red Lists: *Campanula serrata* (Kit.) Hendrych, *Lycopodium clavatum* L. and *Campanula patula* L. subsp. *abietina* (Griseb.) Simonkai.

Anthropogenic impact on these phytocoenoses favours their ruderalization; the presence of the species *Veratrum album*, which has a negative effect on these grasslands, as well as the presence of the invasive *Erigeron annuus* subsp. *annuus* species can be seen.

Polygalo-Nardetum (Preising 1953) Oberd. 1957

This association is found in the hill and mountain belts, in the Păuloaia Valley and in Glăjărie (Gurghiu Mountains), at altitudes of 430–600 m. From a syngenetic point of view, the association originated from the replacement of sessile oak and beech forests. As a result, transgressive species of the Vaccinio-Piceetalia order are absent from these grasslands. The link with the Violion caninae alliance is undoubtable; there is a difference regarding the floristic composition of *Nardus stricta* grasslands at higher Carpathian altitudes. These grasslands are formed on acid, brown, pseudo-gley soils, as well as on semi-podzolic and peaty soils, under wet and cool climatic conditions.

In addition to the characteristic dominant species *Nardus stricta* and *Polygala vulgaris*, species characteristic of the Nardetalia order: *Agrostis capillaris*, *Potentilla erecta*, *Hypericum maculatum*, *Luzula campestris*, *Stellaria graminea*, *Genista tinctoria*, *Deschampsia flexuosa* and *Carex pallescens*, as well as a number of transgressive species of the Molinio-Arrhenatheretea class, are frequently found.

Festuco rubrae-Agrostietum capillaris Horvat 1951 subass. ***nardetosum strictae*** Oroian 1998

The phytocoenoses of this association are frequently found in the territory studied, being dominant in the structure of habitat 6230*. These grasslands were identified at altitudes ranging between 657 and 1453 m.

They represent an intermediate stage between mountain hay-meadows and pure *Nardus* grasslands. Through overgrazing, these phytocoenoses evolve towards pure *Nardus* plant communities, which is also proven by the presence of a significant number of species belonging to the Potentillo-Nardion alliance, Nardetalia order, Calluno-Ulicetea class, in addition to species characteristic of higher coenotaxa: Arrhenatheretalia order, Molinio-Arrhenatheretea class. Due to anthropogenic pressure, the coenoses are also contaminated by ruderal populations belonging to the Rumicion alpini alliance, as well as by species from wet grasslands such as high weeds from the lower belts characteristic of the Molinietalia order. The coenoses of the association are well structured, stratified, with 90–100% cover. From a floristic point of view, these phytocoenoses are rich, including 206 species. A number of indicator species: *Agrostis capillaris*, *Festuca rubra*, *Nardus stricta*, *Potentilla erecta*, and characteristic species: *Veronica officinalis*, *Polygala vulgaris*, *Hieracium pilosella*, *Viola canina*, *Plantago lanceolata*, *Luzula*

campestris, *Carex pallescens*, *Carlina acaulis*, *Carex ovalis*, *Alchemilla xanthochlora* and *Hypericum maculatum*, are found.

The co-dominant species *Nardus stricta* has an extremely low forage value, which significantly reduces the economic importance of these grasslands (depending on the percentage cover of matgrass).

Conservation value is moderate.

Of invasive species, we should mention the presence of the species *Erigeron annuus* subsp. *annuus* and *Pteridium aquilinum*.

The floristic composition of these phytocoenoses also includes some rare species, which are assigned to various zoological categories and are present on national and international Red Lists: *Campanula serrata* (Kit.) Hendrych, *Viola declinata* Waldst. et Kit., *Lycopodium clavatum* L. and *Gymnadenia conopsea* (L.) R. Br.

The distribution of habitat 6230* in the territory studied is relatively wide. The grasslands included in this habitat are frequently close to mountain *Festuca rubra* and *Agrostis capillaris* hay-meadows and to *Deschampsia caespitosa* grasslands, evidencing the succession stages of vegetation from mountain hay-meadows affected by intensive grazing, which leads to the appearance in their floristic composition of acidophilic microtrophic species such as *Nardus stricta*, with an alteration of pedological factors in these areas. Following eutrophization, nitrophilic species such as *Deschampsia caespitosa* appear.

The presence in the habitat of highly acid-tolerant species such as *Agrostis capillaris*, *Festuca rubra* and *Anthoxanthum odoratum* is important from a synecological point of view, because these euri-ionic species have higher abundance-dominance values compared to *Nardus stricta* and tend to restore degraded grasslands to the detriment of the dominant species, by establishing associations with a higher productivity and forage value.

Nardus stricta grasslands are low-productivity grasslands, which persist due to extensive farming with low input. The intensification of agriculture has promoted their conversion to grasslands with a high biomass production. The grasslands are traditionally used as seasonal pastures, and transhumance is frequent. The marginalization of rural areas and the abandonment of land in mountain areas, where the majority of *Nardus* grasslands are found, have led to their deterioration and transformation into shrub communities or to forest succession [19].

The main pressures/threats estimated following the field study of the habitat are intensive grazing and habitat ruderalization. Also, the reduction of grazing in some grasslands included in this habitat has negative effects on the conservation status of the habitat, leading to the excessive development of tufted hair grass (*Deschampsia caespitosa*) and to the succession of vegetation towards grasslands dominated by it. Undergrazing favors the development of competitive ruderal species and invasive species, resulting in the elimination of autochthonous species, thus inducing a slow but major change in the habitat structure.

The presence of the invasive species *Erigeron annuus* subsp. *annuus* and *Pteridium aquilinum* is seen, which affect the habitat, leading to changes in its structure and composition through their proliferation. The appearance and development of *Veratrum album* populations in these grasslands have the same effect.

The conservation status

The field observations showed the following:

- the habitat has the structure and the specific functions required for its long-term conservation, and there is a high probability for their maintenance in the predictable future under the conditions of adequate management measures.

Evaluation matrix of the conservation status of habitat **6230*** – **species-rich *Nardus* grasslands, on silicious substrates**, from the point of view of the surface occupied:

Favourable	Unfavourable-Inadequate	Unfavourable-Bad	Unknown
The current trend of the surface of habitat type 6230 is stable			

Evaluation matrix of the conservation status of habitat **6230*** – **species-rich *Nardus* grasslands, on silicious substrates**, from the point of view of the structure and specific functions of the habitat:

Favourable	Unfavourable-Inadequate	Unfavourable-Bad	Unknown
	The structure and functions of the habitat type, including its typical species, are not in a good conservation state, a large part of the surfaces occupied by habitat 6230* have deteriorated structure and functions		

Management measures proposed:

1. Reconstruction of the habitat by grazing. Grazing is a complex ecological factor that plays an important role in the structuring (synstructure, horizontal and vertical spatial structure), functioning (production, protection and conservation function) and dynamics of grasslands. Thus, traditional grazing with the avoidance of overgrazing is recommended. Increased attention should be paid to outdoor animal confinement areas, which can lead to the replacement of grassland communities with other plant communities. We recommend **extensive grazing** with an optimal number of animals and mowing, which are part of the traditional management of mountain hay meadows [17]. Extensive sheep grazing facilitates the increase of the abundance of the species *Nardus stricta*. Cattle grazing is more beneficial than sheep or horse grazing, because these animals consume grass more selectively [17]. Consequently, the abundance-dominance and the extension of the species *Deschampsia caespitosa* will be reduced. **Encouraging cattle grazing is recommended.**
2. Control of application of calcium supplements. Due to the effect of calcium on the *Nardus stricta* species, the application of calcium supplements can lead to the ecological reconstruction of degraded habitats with a low specific richness due to the expansion of matgrass. As in the case of fertilizers, calcium supplements will be applied only after preliminary studies based on which the amount and the mode of application will be decided.

Conclusions

- The *Nardus* grasslands studied are located in the mountain area of Mureş county (Călimani and Gurghiu Mountains).
- They were assigned to habitat **6230*** Species-rich *Nardus* grasslands, on silicious substrates in mountain areas.
- Four plant associations were identified: ***Violo declinatae-Nardetum*** Simon 1966, ***Hieracio pilosellae-Nardetum strictae*** Pop et al. 1988, ***Polygalo-Nardetum*** (Preising 1953) Oberd. 1957, and ***Festuco rubrae-Agrostietum capillaris*** Horvat 1951 subass. ***nardetosum strictae*** Oroian 1998.
- In the composition of these phytocoenoses, a number of rare or endemic species were also identified: *Campanula serrata* (Photo 1), *Viola declinata*, *Lycopodium complanatum*, *Lycopodium clavatum*, *Lycopodium alpinum* (Photo 2) and *Gymnadenia conopsea*.
- Main pressures/threats: intensive grazing and habitat ruderalization.
- Conservation status: unfavourable-inadequate.
- Knowing their role in preserving biodiversity, in regulating microclimate, pedogenesis, the circuit of elements in nature, etc., *Nardus* grasslands should be identified, evaluated, monitored and protected throughout the country.



Photo 1: Habitat 6230, with *Campanula serrata* (photo: M. Sămărghițan)



Photo 2: *Lycopodium alpinum* in habitat 6230 (photo: M. Sămărghișan)

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PREZENȚA SPECIEI *NARDUS STRICTA* ÎN PAJIȘTI CU ÎNALTĂ VALOARE NATURALĂ DIN JUDEȚUL MUREȘ

(Rezumat)

Delimitarea precisă a pajiștilor cu o valoare naturală ridicată este deosebit de importantă, deoarece poate duce la aplicarea mai eficientă a măsurilor de întreținere a habitatelor și speciilor care depind de managementul agricol [20].

Pajiștile de *Nardus* studiate sunt localizate în zona montană a județului Mureș (Munții Călimani și Gurghiu). Ele au fost încadrate în habitatul **6230*** Pajiști montane de *Nardus* bogate în specii, pe substraturi silicioase.

Fitocenozele studiate aparțin la 4 asociații vegetale: *Violo declinatae-Nardetum* Simon 1966, *Hieracio pilosellae-Nardetum strictae* Pop et al. 1988, *Polygalo-Nardetum* (Preising 1953) Oberd.1957 și *Festuco rubrae-Agrostietum capillaris* Horvat 1951 subas. *nardetosum strictae* Oroian 1998. În compoziția acestor fitocenoze au fost identificate și o serie de specii rare, încadrate în diverse categorii sozologice și care figurează în listele roșii naționale și internaționale: *Campanula serrata* (Kit.) Hendrych, *Viola declinata* Waldst. et Kit., *Lycopodium clavatum* L., *Lycopodium alpinum* L., *Gymnadenia conopsea* (L.) R. Br.

Aceste pajiști sunt folosite ca pășuni sezoniere, iar transhumanța este frecventă. Starea de conservare a habitatului 6230* în zonele studiate este nefavorabilă-inadecvată, în urma observațiilor pe teren s-a constatat că: habitatul are structura și funcțiile specifice necesare pentru conservarea sa pe termen lung, iar probabilitatea menținerii acestora în viitorul previzibil este mare în condițiile aplicării unor măsuri de management adecvate; arealul natural al habitatului și suprafețele pe care le acoperă în cadrul ariei de studiu sunt stabile sau în ușoară descreștere.

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