ПРИЛОЗИ, Одделение за природно-математички и биотехнички науки, МАНУ, том **44**, бр. 1–2, стр. 205–214 (2023)
CONTRIBUTIONS, Section of Natural, Mathematical and Biotechnical Sciences, MASA, Vol. **44,** No. 1–2, pp. 205–214 (2023)

Received: January 12, 2025
Accepted: March 25, 2025

ISSN 1857–9027
e-ISSN 1857–9949
UDC:
DOI: 10.20903/masa/nmbsci.2023.44.56

Original scientific paper

CONTRIBUTION TO THE KNOWLEDGE ON ALLIANCE *TRIFOLION RESUPINATI* MICEVSKI 1957 OF THE REPUBLIC OF NORTH MACEDONIA

Renata Ćušterevska, Cvetanka Stojčevska, Mitko Kostadinovski, Sara V. Cvetanoska, Angela Š. Ivanova

Faculty of Natural Sciences and Mathematics, Ss Cyril and Methodius University in Skopje, RN Macedonia

e-mail: renatapmf@yahoo.com

This paper presents a syntaxonomic analysis of wet meadows within the *Trifolion resupinati* Micevski 1954 alliance (Class *Molinio-Arrenatheretea*) in the subarid continental regions of the Southern Balkans. The analysis includes eight original relevés from the Glajsho locality on Galichica Mountain (North Macedonia) and 422 literature and unpublished relevés from North Macedonia, Serbia, Kosovo, and Greece, totaling 430 relevés. Hierarchical cluster analysis revealed that these meadows belong to the newly described subassociation *Cynosuro-Caricetum hirtae galietosum macedoniceae subass. nova*. This subassociation, elaborated in detail in the paper, represents a gradual transition from meadows to pastures.

Keywords: meadow vegetation; *Molinio-Arrenatheretea*; *Trifolion resupinati*; *Cynosuro-Caricetum hirtae*; Galichica National Park

INTRODUCTION

Meadows are semi-natural vegetation formations that depend on continuous human influence and represent a significant agricultural resource. Their maintenance relies on human intervention, primarily through regular mowing and, in some cases, fertilization. Over centuries, these meadows have evolved into biodiversity "hot spots" with high conservation value within agroecosystems [1, 2]. In the European Union's Rural Development Program, they are recognized as High Nature Value Farming (HNVF) areas.

In North Macedonia, lowland meadows are classified within the alliance *Trifolion resupinati* Micevski 1957 [3, 4], under the order *Trifolio-Hordeetalia* H-ić 1963 and the class *Molinio-Arrhenatheretea* Br.-Bl. et Tx. 1943. These meadows exhibit unique characteristics shaped by the sub-Mediterranean climate. The climatic conditions in North Macedonia's lowland areas differ from those in the more northern, continental parts of the Balkan Peninsula, with pronounced aridity lasting over six months (from April to September). This extended dry period promotes the development of numerous therophytes within meadow communities.

Physiognomically, the lowland meadow communities of North Macedonia are dominated by therophytes, particularly species of the genus *Trifolium*. This distinguishes *Trifolium* meadows in this region from the graminoid-dominated meadows that are characteristic of northern parts of the Balkan Peninsula [4].

Within this alliance, the following plant communities have been recorded in North Macedonia [3–7]: *Hordeeto-Caricetum distantis* Micevski 1957, *Cynosuro-Caricetum hirtae* Micevski 1957, *Trifolietum resupinati-balansae* Micevski 1959, *Trifolietum nigrescentis-subterranei* Micevski 1957, and *Bromo-Alopecuretum* Micevski 1965.

Research on Galichica Mountain has been conducted by several authors in the past [8–13]. However, the application of modern phytosocio-

logical computer tools to pasture vegetation was introduced by Ćušterevska [14, 15]. To date, no research has specifically focused on the meadow vegetation of this area.

This paper presents the results of vegetation analyses conducted in Galichica National Park. The study aims to determine the syntaxonomic position of the meadow vegetation in the research area in relation to similar syntaxa described from North Macedonia, Serbia, Kosovo, and Greece. The findings contribute to a deeper understanding of meadow vegetation in North Macedonia.

MATERIALS AND METHODS

Field investigations were conducted in June 2009 in Galichica National Park, specifically at the Glajsho locality, at an average altitude of 1,020 m a.s.l. (Fig. 1). This area is subject to non-intensive cattle grazing. The study followed the principles and methods of the Zürich-Montpellier School [16].

A total of eight relevés were sampled in Galichica National Park (Glajsho locality), each covering an area of 100 m². For each plot, a complete list of plant species was recorded, along with their cover-abundance values. Vascular plant samples collected during the study are stored in the Macedonian National Herbarium (MKNH) within the Faculty of Natural Sciences and Mathematics in Skopje.

The identification of collected taxa was conducted using various floras, including the *Flora of the Republic of Macedonia* [17–24], *Flora Europaea* [25], *Flora of SR Serbia* [26], and *Flora of Bulgaria* [27]. Taxonomic harmonization was performed using the *EURO+MED PlantBase* database, which catalogs vascular plants from Europe and the Mediterranean region [28]. The nomenclature of higher-rank vegetation units follows the syntaxonomical system proposed by Mucina et al. [29] in the *EuroVegChecklist* [30].

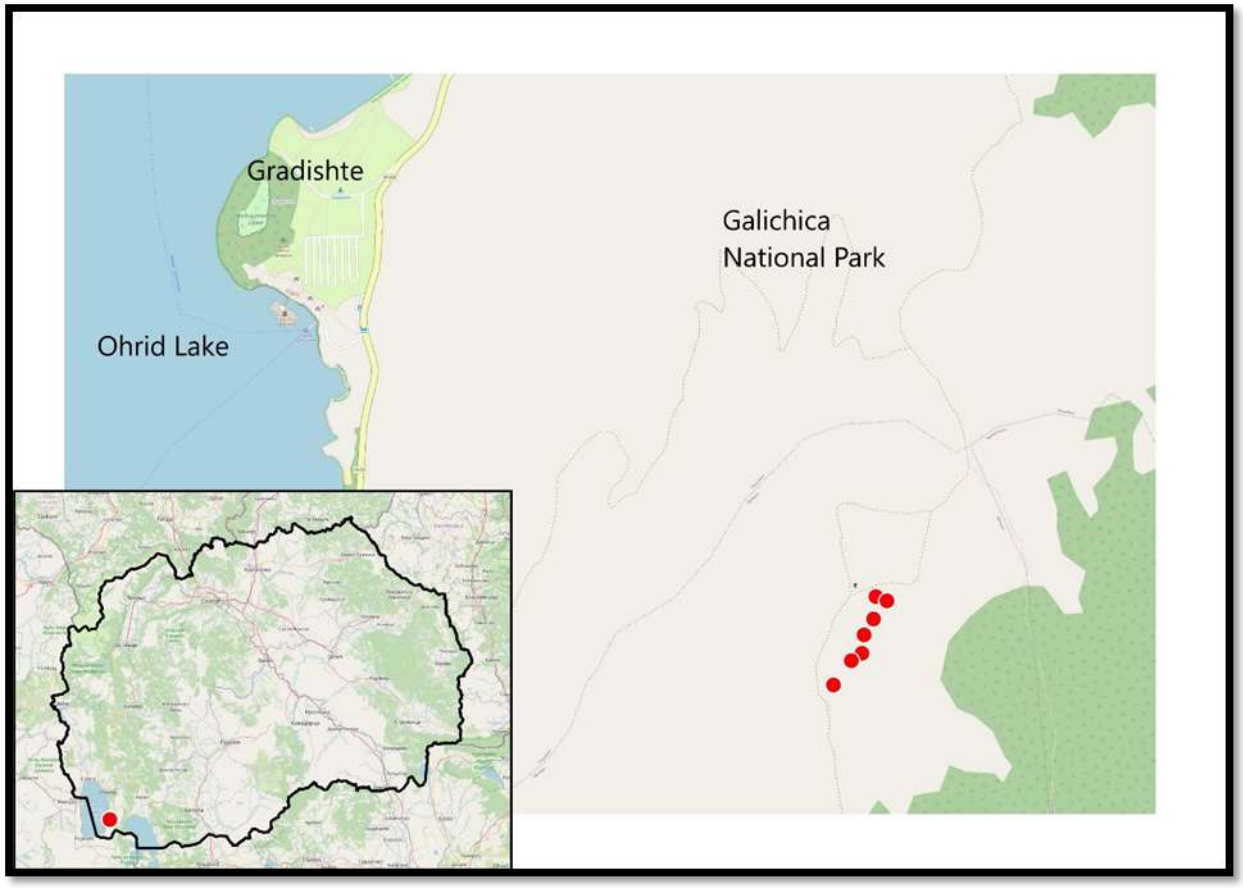

Figure 1. Study area (Glajsho) in Galichica National Park, North Macedonia.

The sampled relevés, along with those from the literature, were entered into TURBOVEG [31]. The final dataset consists of 430 relevés and 570 taxa from North Macedonia [3–7], Serbia [32],

Kosovo [33–35], and Greece [36]. Analyses were conducted on two datasets: 430 relevés of the *Trifolion resupinati* Micevski 1957 alliance and 96 relevés of the *Cynosuro-Caricetum hirtae* Micevski 1957 association. The data were then exported to JUICE software [37] for further analysis.

Plant community classification was conducted through agglomerative hierarchical cluster analysis using PC-ORD [38]. This analysis utilized a data transformation of b = log (xij +1), employed the Jaccard distance measure, and applied the Flexible Beta method (β = –0.25). Diagnostic species of clusters containing sampled relevés were determined in JUICE by calculating species fidelity to each group using the phi coefficient [39], with a fidelity threshold of 0.55. Diagnostic species were defined as those with a phi coefficient greater than 0.6.

Raunkiaer's system [40] was used for life-form classification, while chorological spectra were determined based on Gajić [41] and Pignatti [42]. Vegetation-environment relationships were analyzed using Detrended Correspondence Analysis (DCA) in R, with detrending by segments and square-root transformation of species cover values [43]. The primary environmental factors driving species composition variability were interpreted using non-weighted means of Ellenberg Indicator Values (EIV) for light, temperature, continentality, moisture, soil reaction, and nutrients [44].

RESULTS AND DISCUSSION

The entire dataset was analyzed using PC-ORD, which identified 17 clusters. The results are presented in the dendrogram (Figure 1).

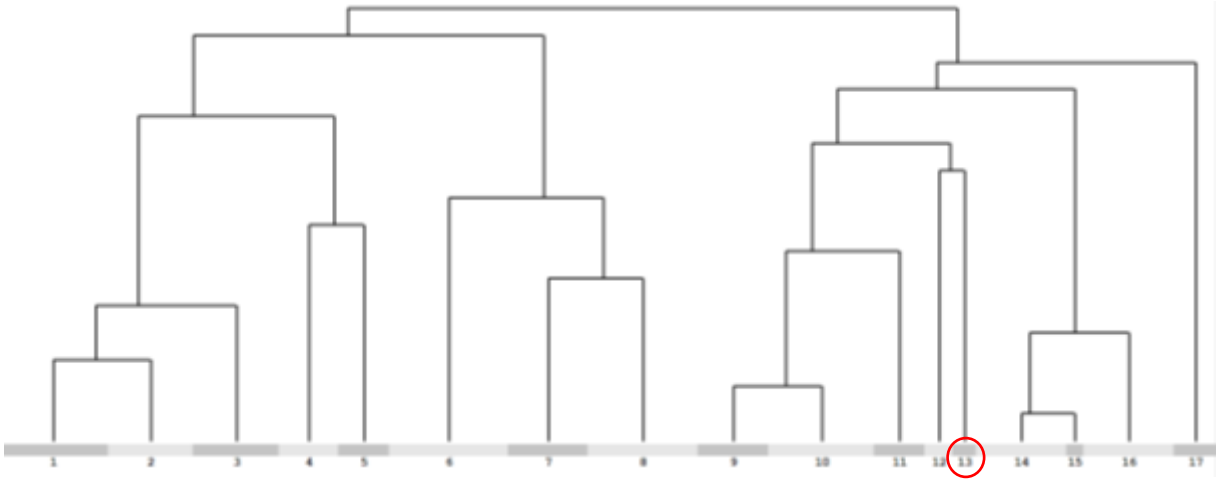

Figure 2. Hierarchical classification with 17 clusters of 430 relevés within the alliance *Trifolion resupinati* Micevski 1957. **Cluster 1**: *Trifolietum resupinati balansae,* and 4 releves of *Hordeeto-Caricetum distantis*; **Cluster 2**: *Hordeeto-Caricetum distantis;* **Cluster 3**: *Cynosuro - Caricetum hirtae;* **Cluster 4**: *Bromo-Alopecuretum*; **Cluster 5**: *Alopecuro-Ranunculetum marginati* and *Narcisso tazettae – Caricetum distantis*; **Cluster 6**: *Hordeeto-Caricetum distantis*, and 3 releves of *Cynosuro - Caricetum hirtae*; **Cluster 7**: *Festuceto - Hordeetum secalinum* and *Poeto - Alopecuretum pratensis*; **Cluster 8**: *Festuceto - Hordeetum secalinum* and *Poeto - Alopecuretum pratensis*; **Clusters 9, 10, 11, 12 and 13** *Cynosuro - Caricetum hirtae*; **Cluster 14**: *Trifolietum nigrescentis-subterranei*, **Clusters 15, 16 and 17** unpublished releves from Mariovo, North Macedonia.

According to the dendrogram results (Fig. 2), the relevés from the research area are located in the 13th cluster. When compared with neighboring clusters, it is evident that they belong to the *Cynosuro-Caricetum hirtae* association. The relevés recorded in this study show the highest floristic similarity to those previously published from Greece [36].

Historically, the *Cynosuro-Caricetum hirtae* association was widespread [4, 6, 7]. However, its extent has significantly decreased due to factors such as declining livestock populations, rural-to-urban migration, and deagrarianization. This has led to the degradation and disappearance of many of these meadows. The *Cynosuro-Caricetum hirtae* association typically develops in habitats that remain submerged during winter, where the groundwater level is relatively high. In North Macedonia, three subassociations have been identified within this association: *trifolietosum patentis* Micevski 1957 (Strumica), *ranunculetosum acris* Micevski 1957 (Prespa, Pehčevo, Polog), and *ranunculetosum velutini* Micevski 1957 (Pelagonija).

During the analysis of the entire dataset, some literature-referenced relevés associated with *Cynosuro-Caricetum hirtae* were grouped into clus-

ter 3. This cluster shows affinities with clusters 1 and 2, corresponding to *Trifolietum resupinati-balansae* and *Hordeeto-Caricetum distantis*, as well as cluster 6, which is also part of *Hordeeto-Caricetum distantis*. Inconsistencies were identified in certain relevés using both traditional methods and computer analysis, suggesting the need for further investigation to determine the underlying causes.

Therefore, in subsequent analyses, only relevés from clusters 9 to 13—including data from North Macedonia, Kosovo, and Greece—were considered. For the next cluster analysis in PC-ORD, 96 relevés from *Cynosuro-Caricetum hirtae* were analyzed, with the results presented in the dendrogram (Fig. 3).

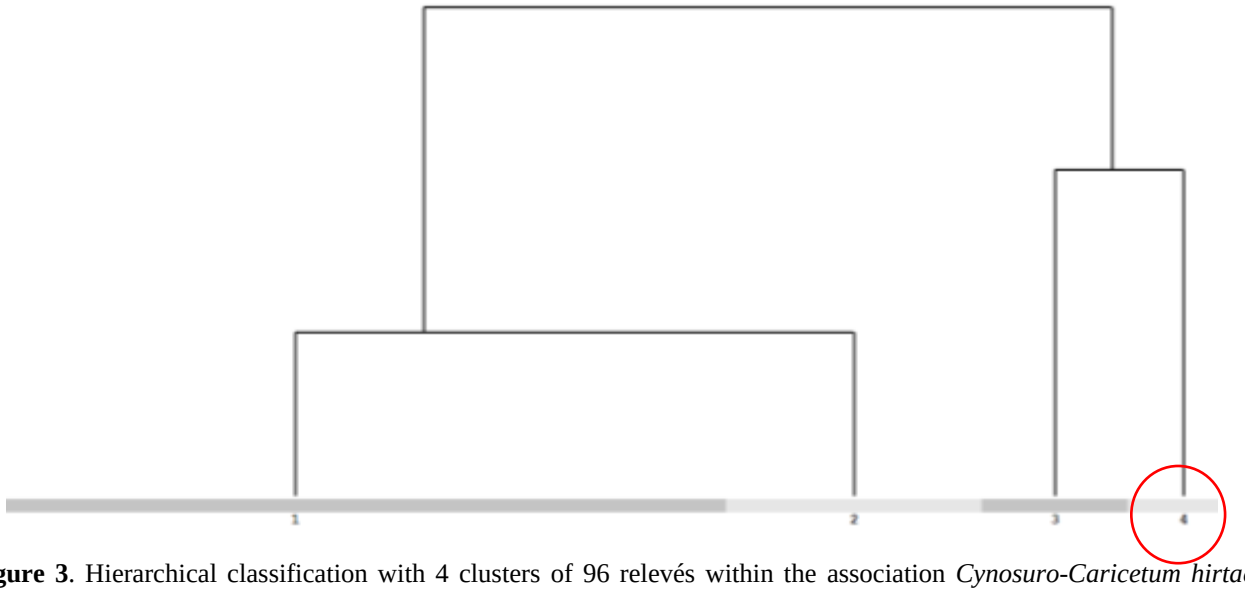

Figure 3. Hierarchical classification with 4 clusters of 96 relevés within the association *Cynosuro-Caricetum hirtae* Micevski 1957. **Cluster 1**: C*ynosuro-Caricetum hirtae typicum* and *Cynosuro-Caricetum hirtae ranunculetosum acris* (from Kosovo and North Macedonia); **Cluster 2**: *Cynosuro-Caricetum hirtae ranunculetosum acris* (North Macedonia); **Cluster 3**: *Cynosuro-Caricetum hirtae* (Greece); **Cluster 4**: *Cynosuro-Caricetum hirtae galietosum macedoniceae* subass. Nova

During the research on meadow vegetation on Galichica Mountain, the characteristic species of the *Cynosuro-Caricetum hirtae* association—*Cynosurus cristatus*, *Carex hirta*, and *Carex vulpina*—were analyzed within the floristic composition. Among these, only *Cynosurus cristatus* exhibited a high degree of constancy (V). None of the differential species from the three previously described subassociations (*trifolietosum patentis* Micevski 1957, *ranunculetosum acris* Micevski 1957, and *ranunculetosum velutini* Micevski 1957) were recorded. However, several species were identified that have not been previously documented in the meadow communities of North Macedonia.

In cluster 4 (Fig. 2), which includes the eight vegetation relevés from the Glajšo locality, an analysis using the "constancy columns in synoptic table" feature in the JUICE software package identified three groups of taxa: diagnostic, constant, and dominant species. This analysis suggests that the vegetation relevés in this cluster differ from those of other subassociations.

Analysis of synoptic table:

Cluster 4

Number of releves: 8

Threshold fidelity value for diagnostic species: 80 (70)

Threshold frequency value for constant species: 55 (60)

Threshold frequency value for dominant species with cover up to 65: 0 (100)

Diagnostic species: ***Bromus squarrosus, Convolvulus arvensis, Dichoropetalum oligophyllum, Elytrigia intermedia, Festuca valesiaca, Galium macedonicum, Geranium dissectum, Hordeum bulbosum, Phleum pratense, Podospermum canum, Potentilla detommasii, Ranunculus neapolitanus, Sanguisorba minor, Sherardia arvensis, Stellaria graminea, Trifolium campestre, Trifolium scabrum, Trifolium strictum***

Constant species: ***Alopecurus pratensis, Alopecurus utriculatus, Anthoxanthum odoratum, Cynosurus cristatus, Euphrasia pectinata, Lotus tenuis, Orlaya daucoides, Ornithogalum montanum, Pilosella bauhini, Plantago lanceolata, Poa trivialis, Rhinanthus minor, Rumex acetosella,***

Schedonorus pratensis, Trifolium incarnatum, Trifolium micranthum, Trifolium pratense

Dominant species: Additionally, DCA analysis was performed (Fig. 4). The ordination effectively illustrates the influence of environmental factors on species distribution, successfully differentiating vegetation groups based on their ecological parameters.

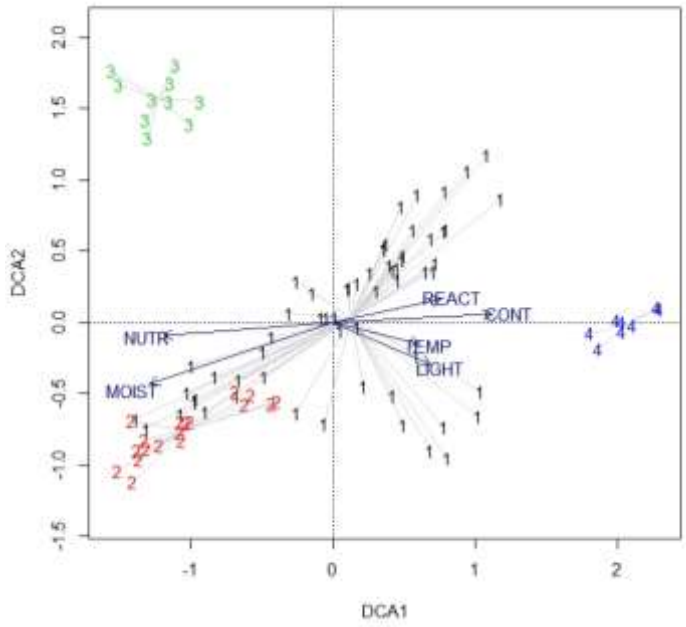

Figure 4. The detrended correspondence analysis (DCA) ordination diagrams with Ellenberg indicator values

Cluster 1, the most abundant group, is positioned near the center of the ordination diagram, reflecting its association with intermediate ecological conditions due to its broad floristic diversity.

Cluster 2 exhibits a strong correlation with moisture and nutrient availability, indicating vegetation that thrives in wetter habitats with higher nutrient input.

Cluster 3 is distinctly separated from the other groups, suggesting a unique floristic composition with specific ecological requirements that diverge from the main environmental gradients.

Cluster 4 shows a positive correlation with continentality, soil reaction (pH), and temperature, representing vegetation adapted to drier or more continental climatic conditions.

In this meadow complex, in addition to typical meadow species, taxa characteristic of mountain pastures—such as *Trifolium incarnatum, Festuca valesiaca, Bromus squarrosus, Pilosella bauhini,* and *Prunella laciniata*—are also present. Their occurrence in this community is attributed to the local ecological conditions. Soil moisture and groundwater levels fluctuate significantly throughout the year, and during drier periods (especially in late spring), species from neighboring mountain pastures may integrate into the meadow composition or become more competitive if already present. This shift alters the physiognomy of the meadow, giving it a more arid appearance.

These meadows are not mowed but are subjected to non-intensive cattle grazing, suggesting they represent a gradual transition from meadow to mountain pasture. Consequently, a new subassociation has been proposed: *Cynosuro-Caricetum hirtae galietosum macedoniceae subass. nova.*

The differential species of *galietosum macedoniceae subass. nova* include *Galium macedonicum, Trifolium scabrum, Phleum pratense, Ornithogalum montanum, Hordeum bulbosum,* and *Sherardia arvensis* (Tab. 1).

Galium macedonicum, a characteristic species of mountain pastures and forest edges, has been recorded in North Macedonia, Greece, and Bulgaria. This subassociation develops on deep soils derived from Devonian metasandstones as the parent substrate [45]. The habitat is further characterized by a dominance of hemicryptophytes (Fig. 5).

In the phytogeographic spectrum of the association (Fig. 6), the boreal floral element is the most dominant after widely distributed floral elements, accounting for 20 %. Meanwhile, Macedonian endemics comprise the largest portion of the Balkan floral element, representing 38 % (Fig. 7).

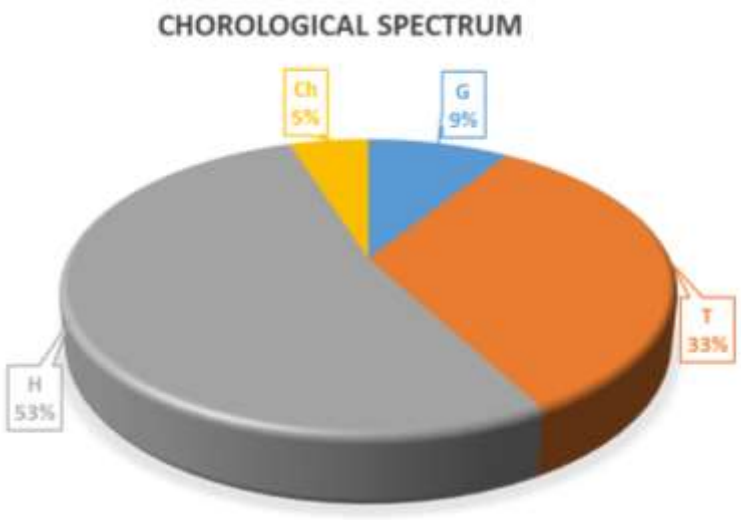

Figure 5. ass. *Cynosureto-Caricetum hirtae* subass. *galietosum macedoniceae* subass. *nova* – life forms spectrum

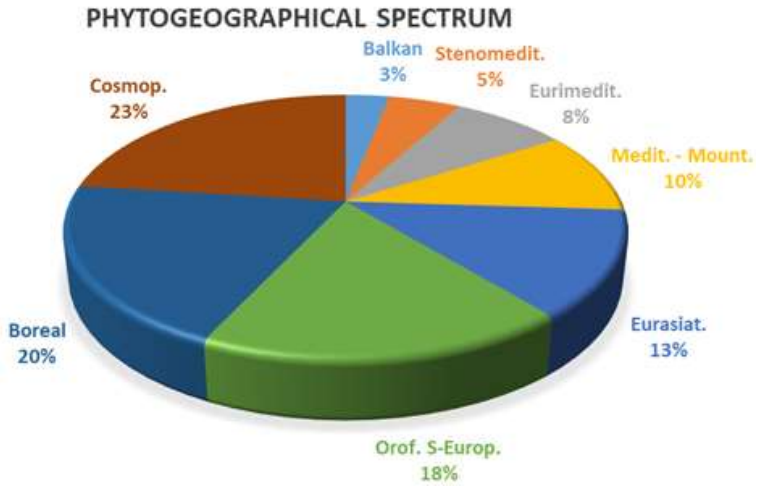

Figure 6. ass. *Cynosureto-Caricetum hirtae* subass. *galietosum macedoniceae* subass. *nova* – floral elements

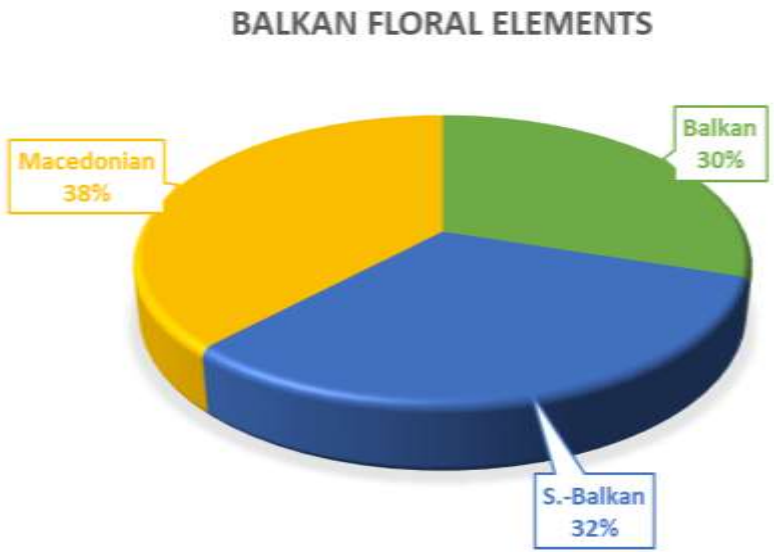

Figure 7. ass. *Cynosureto-Caricetum hirtae galietosum macedoniceae* subass. *nova* – Balkan floral elements

Table 1. Analytical table of *Cynosureto-Caricetum hirtae galietosum macedoniceae* subass. *nova.* The holotypus is marked with an asterisk (*).

Relevé Number	1*	2	3	4	5	6	7	8	Categorical Frequency	ranunculetosum acris	ranunculetosum acris	data from Greece
***galietosum macedoniceae* subass. nova**												
Galium macedonicum	3	2	2	1	1	1	+	1	V	.	.	.
Trifolium scabrum	3	2	1	1	1	1	+	+	V	.	.	.
Phleum pratense	1	1	+	1	+	+	+	+	V	I	.	.
Ornithogalum montanum	1	+	+	+	+	+	+	+	V	.	.	IV
Hordeum bulbosum	1	+	+	+	+	+	+	+	V	.	.	.
Sherardia arvensis	+	+	+	+	+	+	+	+	V	I	.	.
Cynosureto-Caricetum hirtae									.	.	.	.
Cynosurus cristatus	2	+	2	+	1	1	1	2	V	V	V	V
Trifolion resupinati									.	.	.	.
Trifolium micranthum	1	1	1	1	1	1	1	1	V	I	I	IV
Silene flos-cuculi	.	.	.	.	.	.	1	+	II	II	V	.
Trifolio-Hordeetalia									.	.	.	.
Ranunculus neapolitanus	1	1	1	1	1	1	1	2	V	I	.	.
Alopecurus utriculatus	.	.	1	+	+	1	+	+	IV	I	V	.
Plantago lanceolata	.	.	+	+	+	1	2	1	IV	V	V	III
Molinio-Arrhenatheretea									.	.	.	.
Anthoxanthum odoratum	2	1	2	1	1	1	2	1	V	V	V	V
Trifolium pratense	+	+	+	1	+	1	1	1	V	V	III	IV
Poa trivialis	+	+	1	+	+	+	+	+	V	IV	IV	.
Stellaria graminea	1	2	1	1	1	1	2	3	V	I	.	.
Alopecurus pratensis	.	1	1	1	1	1	2	+	V	I	II	V
Rhinanthus minor	.	.	2	1	1	2	1	1	IV	IV	.	.
Schedonorus pratensis	.	1	1	+	1	1	1	+	IV	III	V	III
Lotus tenuis	1	1	2	1	1	1	2	2	V	I	III	.
Carex filiformis	.	.	.	.	.	.	.	+	I	I	I	.
Other species									.	.	.	.
Trifolium strictum	2	2	3	2	2	1	1	1	V	I	.	.
Trifolium incarnatum	2	2	2	2	2	2	2	2	V	III	.	.
Festuca valesiaca	1	2	1	2	3	2	2	2	V	I	.	.
Bromus squarrosus	1	1	2	1	1	1	1	1	V	.	.	.
Trifolium campestre	+	+	1	2	1	1	2	2	V	I	.	.
Elytrigia intermedia	2	+	1	+	+	1	+	+	V	.	.	.
Potentilla detommasii	1	1	+	+	+	+	+	+	V	.	.	.
Sanguisorba minor	+	+	+	1	+	+	+	+	V	II	.	.
Geranium dissectum	+	+	+	+	+	+	+	+	V	II	.	.
Convolvulus arvensis	+	+	+	+	+	+	+	+	V	II	.	.
Dichoropetalum oligophyllum	.	+	+	1	+	2	2	+	V	.	.	.
Pilosella bauhini	.	+	+	1	1	1	1	+	V	III	.	.
Podospermum canum	.	+	+	+	+	+	+	+	V	.	.	.

Table 1. Continues

Orlaya daucoides	+	+	.	.	+	+	+	.	IV	I	.	.
Euphrasia pectinata	.	1	2	1	+	+	.	.	IV	I	.	.
Rumex acetosella	.	.	.	+	+	+	+	+	IV	II	.	I
Knautia integrifolia	+	+	+	+	.	.	.	.	III	·	·	·
Juncus bufonius	.	.	+	.	.	+	1	+	III	·	·	·
Ajuga genevensis	.	.	.	+	+	+	+	.	III	I	.	.
Prunella laciniata	.	.	.	.	+	+	+	+	III	I	.	.
Festuca hirtovaginata	1	1	+	.	.	.	.	.	II	·	·	·
Vulpia myuros	1	+	+	.	.	.	.	.	II	I	.	.
Cynosurus echinatus	+	2	.	.	.	.	.	.	II	I	.	.
Achillea setacea	+	+	.	.	.	.	.	.	II	III	II	.
Aira elegantissima	.	.	.	+	+	+	.	.	II	I	.	.
Carex praecox	.	.	.	.	.	.	1	1	II	·	·	·
Mentha pulegium	.	.	.	.	.	.	+	+	II	I	I	.
Myosotis laxa subsp. caespitosa	.	.	.	.	.	.	+	+	II	.	III	.
Dianthus viscidus	.	.	.	.	.	.	.	+	I	I	.	.
Vicia sativa	.	.	.	.	.	.	.	+	I	II	.	III

Descriptions of the reléves in the Table 1. Running number, original reléve number, locality, latitude, longitude, sampling date, area, altitude (m), aspect, inclination (%), cover.
89, **1**, Glajsho – wet meadow, 40.988500, 20,814554, 15.06.2009, 100, 1021, 0, 0, 100; 90, **2**, Glajsho-wet meadow, 40.988398, 20,814844, 15.06.2009, 100, 1018, 0, 0, 100; 91, **3**, Glajsho, 40.988277, 20,814921, 15.06.2009, 100, 1019, 0, 0, 100; 92, **4**, Glajsho, 40.988107, 20,814663, 15.06.2009, 100, 1018, 0, 0, 100; 93, **5**, Glajsho – wet meadow, 40.987774, 20,814451, 15.06.2009, 100, 1017, 0, 0, 100; 94, **6**, Glajsho – wet meadow, 40.987337, 20,814236, 15.06.2009, 100, 1017, 0, 0, 100; 95, **7**, Glajsho, 40.987104, 20,813909, 15.06.2009, 100, 1021, 0, 0, 100; 96, **8**, Glajsho, 40.986621, 20,813378, 15.06.2009, 100, 1022, 0, 0, 100.

Acknowledgment. I would like to express my sincere gratitude to the staff of Galichica National Park for their unwavering technical support throughout the field research. Special thanks are also extended to Academician Vlado Matevski for his invaluable assistance in the expert analysis of the data and interpretation of the results.

REFERENCES

[1] J. C. Habel, J. Dengler, M. Janišová, P. Török, C. Wellstein, M. Wiezik, European grassland ecosystems: threatened hotspots of biodiversity, *Biodivers. Conservation*, **22** (2013), pp. 2131–2138. https://doi.org/10.1007/s10531-013-0537-x

[2] M. F. Wallis DeVries, P. Poschlod, J. H. Willems, Challenges for the conservation of calcareous grasslands in northwestern Europe: integrating the requirements of flora and fauna, *Biological Conservation*, **104** (2002), pp. 265–273. https://doi.org/10.1016/S0006-3207(01)00191-4

[3] K. Micevski, Typologische Gliederung der Niederungswiesen- und Sumpfvegetation Mazedoniens, *Folia Balcanica*, Skopje, **1** (6) (1957), pp. 29–33.

[4] K. Micevski, Tipološki istrazuvanja na vegetacijata na nizinskite livadi vo Makedonija, *Godišen zbornik PMF-biologija*, Skopje, **15** (1964), pp. 121–174.

[5] K. Micevski, Halofitska vegetacija Ovčeg Polja, *Acta Musei Maced. Scient. Nat*., **10** (3) (1965), pp. 67–90.

[6] K. Micevski, Blatna i livadska vegetacija na Pološkata Kotlina, *God. Zbor. PMF-biol.*, Skopje, **16** (1966), pp. 43–52.

[7] K. Micevski, *Tipološki istrazuvanja na vegetacijata na livadite i pasištata vo Maleš i Pijanec*, MANU, posebni izd., 1978, pp. 9–41.

[8] I. Horvat, Istraživanje vegetacije planina Vardarske banovine I., *Ljet. Jug. Akad. Zn. Umj.*, Zagreb, **47** (1935), pp.142–160.

[9] I. Horvat, Istraživanje vegetacije planina Vardarske banovine II., *Ljet. Jug. Akad. Zn. Umj.*, Zagreb, **48** (1936), pp. 211–227.

[10] I. Horvat, Istraživanje vegetacije planina Vardarske banovine III., *Ljet. Jug. Akad. Zn. Umj.*, Zagreb, **49** (1937), pp. 175–180.

[11] I. Horvat, Istraživanje vegetacije planina Vardarske banovine IV., *Ljet. Jug. Akad. Zn. Umj.*, Zagreb, **50** (1938), pp. 136–142.

[12] I. Horvat, Istraživanje vegetacije planina Vardarske banovine V., *Ljet. Jug. Akad. Zn. Umj.*, Zagreb, **50** (1939), pp. 145–148.

[13] I. Horvat, Planinska vegetacija Makedonije u svijetu suvremenih istraživanja, *Acta Musei Maced. Scient. Nat.*, **6** (1960), pp. 163–203.

[14] R. Ćušterevska, Dry grassland vegetation on Galičica mountain (SW Macedonia), *Contributions, Section of Natural, Mathematical and Biotechnical Sciences*, **37** (2) (2016), pp. 107–127.

[15] R. Ćušterevska, *Armerio rumelicae-Potentillion* Micevski 1978 in South-Central Balkan with emphasis on Galičica Mountain vegetation, *Biologica Nyssana*, **8** (1) (2017), pp. 61–72.

[16] J. Braun-Blanquet, *Pflanzengesellschaft und Biozönose*, in: J. Braun-Blanquet, (Ed.), Pflanzensoziologie: Grundzüge der Vegetationskunde, Springer, Vienna, 1964, pp. 1–6. https://doi.org/10.1007/978-3-7091-8110-2_1

[17] K. Micevski, *Flora na SR. Makedonija*, MANU, Skopje, 1985, 1 (1), pp. 1–152.

[18] K. Micevski, *Flora na Republika Makedonija*, MANU, 1993, 1 (2), pp. 153–391.

[19] K. Micevski, *Flora na Republika Makedonija*, MANU, Skopje, 1995, 1 (3), pp. 397–778.

[20] K. Micevski, *Flora na Republika Makedonija*, MANU, Skopje, 1998, 1 (4), pp. 778–1114.

[21] K. Micevski, *Flora na Republika Makedonija*, MANU, Skopje, 2001, 1 (5), pp. 1121–1430.

[22] K. Micevski, *Flora na Republika Makedonija*, MANU, Skopje, 2005, 1 (6), pp. 1433–1715.

[23] V. Matevski, *Flora na Republika Makedonija*, MANU, Skopje, 2010, 2 (1), pp. 1–190.

[24] V. Matevski, *Flora na R.S. Makedonija*, MANU, Skopje, 2021, 2 (2), pp. 191–449.

[25] T. G. Tutin, V. H. Heywood, N. A. Burges, D. H. Valentine, S. M. Walters, & D. A. Webb, – *Flora europaea* 1–5, Cambridge University Press, Cambridge, 1964–1980.

[26] M. Josifović, *Flora SR Srbije*, SANU, Beograd, 1970–1986, I–IX.

[27] D. Jordanov, *Flora na Narodna Republika Blgarija*, Sofija, 1963–1976, 1–6.

[28] Euro+Med: Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity, 2006, Published on the Internet. http://ww2.bgbm.org/EuroPlusMed/[26.10.2014]

[29] L. Mucina, H. Bültmann, K. Dierßen, J.-P. Theurillat, T. Raus, A. Čarni, K. Šumberová, W. Willner, J. Dengler, R. G. García, M. Chytrý, M. Hájek, R. Di Pietro, D. Iakushenko, J. Pallas, F. J. A. Daniëls, E. Bergmeier, A. Santos Guerra, N. Ermakov, M. Valachovič, J. H. J. Schaminée, T. Lysenko, Y. P. Didukh, S. Pignatti, J. S. Rodwell, J. Capelo, H. E. Weber, A. Solomeshch, P. Dimopoulos, C. Aguiar, S. M. Hennekens, L. Tichý, Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities, *Applied Vegetation Science*, **19** (2016), pp. 3–264. https://doi.org/10.1111/avsc.12257

[30] M. Chytrý, M. Řezníčková, P. Novotný, D. Holubová, Z. Preislerová, F. Attorre, et al., FloraVeg.EU – An online database of European vegetation, habitats and flora, *Applied Vegetation Science*, **27** (2024), e12798. https://doi.org/10.1111/avsc.12798

[31] S. Hennekens, J. Schaminée, TURBOVEG, a comprehensive data base management system for vegetation data, *Journal of Vegetation Science*, **12** (2001). https://doi.org/10.2307/3237010

[32] R. Jovanović, Tipovi dolinskih livada Jasenice, *Archives of biological sciences*, **9** (1957), pp. 1–14.

[33] B. Hundozi, *Hordeo-Caricetum distantis* Mic. 1957 u vegetaciji Kosova, *Buletini shkencave i FSHMN-Prishtinë, Zbornik radova PMF-Priština*, **8** (1982), pp. 189–202.

[34] N. Ranđelović, F. Rexhepi, V. Jovanović, Plant communities of Southeast Kosovo, in: *Proceedings of the Second Congress of Ecologists of Yugoslavia*, 1979, pp. 957–995.

[35] K. Micevski, Livadska vegetacija na Kosovo Pole, *God. Zbor. PMF-biol.*, Skopje, **20** (1968), pp 135–146.

[36] Raus, T., Wechselnasse wiesen in Griechenland, *Tuexenia*, **3** (1983), pp. 259–270.

[37] L. Tichý, JUICE, software for vegetation classification, *Journal of Vegetation Science*, **13** (2002), pp. 451–453. https://doi.org/10.1111/j.1654-1103.2002.tb02069.x

[38] B. McCune, M. J. Mefford, PC-ORD: Multivariate Analysis of Ecological Data, Version 4 for Windows; [user' S Guide], MjM Software Design, 1999.

[39] M. Chytry, L. Tichý, J. Holt, Z. Botta-Dukat, Determination of diagnostic species with statistical fidelity measures, *Journal of Vegetation Science*, **13** (2002), pp. 79–90. https://doi.org/10.1658/1100-9233(2002)013[0079:DODSWS]2.0.CO;2

[40] C. Raunkiær, H. Gilbert-Carter, A. Fausbøll, A. G. Tansley, *The life forms of plants and statistical plant geography*, The Clarendon Press, Oxford, 1934.

[41] M. Gajic, Pregled vrsta flore SR Srbije sa biljnogeografskim oznakama, *Glasnik Šumarskog fakulteta, serija A, "Šumarstvo"*, Beograd, **54** (1980), pp.111–141.

[42] S. Pignatti, P. Menegoni, S. Pietrosanti, Indicazione attraverso le piante vascolari, Valori di indicazione secondo Ellenberg (Zeigerwerte) per le

specie della Flora d'Italia, *Braun-Blanquetia*, **3** (2005), pp. 91–97.

[43] L. Tichý, S. M. Hennekens, P. Novák, J. S. Rodwell, J. H. Schaminée, & M. Chytrý, Optimal transformation of species cover for vegetation classification, *Applied Vegetation Science*, **23** (4) (2020), pp. 710–717.

[44] H. Ellenberg, H. E. Weber, R. Düll, W. Wirth, W. Werner, D. Paulissen, Zeigerwerte von Pflanzen in Mitteleuropa, 2.und verbesserte Auflage, *Scripta Geobot.,* **18** (1992), pp. 1–258.

[45] N. Dumurdžanov & T. Ivanovski, *Osnovna geološka karta so tolkuvač* (1:100.000) Ohrid (K 34–102) i Pogradec (K 34–114), Geološki Zavod, Skopje, 1972.

ПРИДОНЕС КОН ПОЗНАВАЊАТА НА СОЈУЗОТ *TRIFOLION RESUPINATI* MICEVSKI 1957 ВО РЕПУБЛИКА СЕВЕРНА МАКЕДОНИЈА

Рената Ќуштеревска, Цветанка Стојчевска, Митко Костадиновски, Сара В. Цветаноска, Ангела Ш. Иванова

Природно-математички факултет, Универзитет „Св. Кирил и Методиј“ во Скопје, РС Македонија

Овој труд претставува синтаксономска анализа на влажните ливади во рамките на сојузот *Trifolion resupinati* Micevski 1954 (класа *Molinio-Arrenatheretea*) во субаридните континентални региони на јужниот дел од Балканскиот Полуостров. Анализата вклучува вкупно 430 фитоценолошки снимки, од кои осум оригинални фитоценолошки снимки се од локалитетот Глајшо на планината Галичица (РС Македонија) и 422 литературни и необјавени фитоценолошки снимки од РС Македонија, Србија, Косово и Грција. Хиерархиската кластерска анализа откри дека ливадите припаѓаат на асоцијацијата *Cynosuro-Caricetum hirtae, со доволно расшшелни видови да се издвои нова субасоцијација galietosum macedoniceae* subass. *nova*. Оваа субасоцијација, која е детално обработена во трудот, претставува постепен премин од ливади кон пасишта.

Клучни зборови: ливадска вегетација; *Molinio-Arrenatheretea*; *Trifolion resupinati*; *Cynosuro-Caricetum hirtae*; Национален парк „Галичица“