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The syntaxonomical classification of the mat-grass swards on the crystalline bedrock in Veľká Fatra Mts

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Abstract: This contribution deals with the syntaxonomical evaluation of the mat-grass swards on the crystalline bedrock in northern part of the Veľká Fatra Mts, which were initially (KLIMENT 1992) assigned into the association *Homogyno alpinae-Nardetum* Mráz 1956, and subassociations *athyrietosum alpestris* Mráz 1956, *typicum* Mráz 1956 and *alchemilletosum crinitae* Kliment 1992 ined. The comparison of the original diagnoses of the associations *Homogyno alpinae-Nardetum* and *Phleo alpini-Nardetum* Klika 1934 proved the assumption (KLIMENT & UJHÁZY 2014) that the subassociation *alchemilletosum* should be assigned into the association *Phleo alpini-Nardetum*. It also showed that relevés from the subassociation *athyrietosum* (sensu KLIMENT 1992) should remain the part of the association *Homogyno alpinae-Nardetum*. Stands previously evaluated as the subassociation *typicum* (sensu KLIMENT 1992) are considered transitional between the two associations; however, the overall floristic composition is more similar to the association *Phleo alpini-Nardetum*. The current research also proved major decline of the mat-grass swards in the area. After abandonment of the traditional ways of management (mowing, grazing), they are consequently replaced either by stands with *Vaccinium myrtillus* or tall grasses.

Keywords: granodiorite, *Homogyno alpinae-Nardetum*, Mt. Malá Smrekovica, *Phleo alpini-Nardetum*, phytosociology, secondary succession.

Introduction

Mat-grass swards on crystalline rocks in the northern part of the Veľká Fatra Mts, mainly in the area of Mt. Malá Smrekovica (1 485 m a.s.l.) were studied in detail by KLIMENT (1992) for the first time. Based on the then knowledge, he assigned these stands to the association *Homogyno alpinae-Nardetum* Mráz 1956, which was described from crystalline part of the Martinské hole Mts (Lúčanská Malá Fatra Mts). The author divided them into three subassociations: *athyrietosum alpestris* Mráz 1956, *typicum* Mráz 1956 and *alchemilletosum crinitae* Kliment 1992 ined., on the basis of floristic differences caused e.g. by the different distance from the forest margin or different agricultural management. Later syntaxonomical revisions of the mat-grass swards from the whole area of Slovakia (UJHÁZY & KLIMENT 2007, KLIMENT & UJHÁZY 2014) revealed that the floristic composition of some of the studied stands in the Veľká Fatra (subass. *alchemilletosum*, partly also subass. *typicum*) are more similar to those from the association *Phleo alpini-Nardetum* Klika 1934, which was described from both, carbonates as well as from the crystalline part of the Veľká Fatra Mts and Malá Fatra Mts. However, most of the relevés, which were initially assigned to the association *Homogyno alpinae-Nardetum* (KLIMENT 1992) were gained in early September 1987, i.e. after flowering season. Thus, the author recently, after almost 30 years (in July 2015), examined particular stands with mat-grass swards and gained also some current relevés. In order to clarify their syntaxonomical classification, as well as to verify the presence of the association *Homogyno alpinae-Nardetum* in the northern, crystalline part of the Veľká Fatra Mts, the relevés from the studied area were subsequently compared with the original diagnoses of the associations *Homogyno alpinae-Nardetum* and *Phleo alpini-Nardetum*. The results of the comparison are presented in this study.

Material and methods

All relevés were gained following standard procedures of the Zürich-Montpellier School, using the modified 9-degree abundance and dominance sampling scale (BARKMAN et al. 1964). Older relevés of other authors (KLIKA 1934, MRÁZ 1956) were made using 7-degree Braun-Blanquet sampling scale. For the purposes of numerical classification, the relevés were transformed into the nine-degree ordinal scale (van der MAAREL 1979). Relevés were processed and the phytocoenological table (Tab. 1) was arranged in programme FYTOPACK (JAROLÍMEK & SCHLOSSER 1997). The numerical classification was performed with HierClus programme from SYN-TAX 2000 package (PODANI 2001). Ružička`s coefficient of similarity and β-flexible clustering method (β = - 0.25) were applied on the data. Cover values 2m, 2a, 2b are in Table 1 used in abbreviated form (m, a, b). The nomenclature of higher taxa and mosses follows the checklists of non-vascular and vascular plants of Slovakia (MARHOLD et al. 1998, KUBINSKÁ & JANOVICOVÁ 1998). In the table, the species names of subspecies are replaced by an asterisk (*). Regionally differential taxa of the associations *Homogyno alpinae-Nardetum* and *Phleo alpini-Nardetum* (Tab. 1) resulted from their mutual comparison. Differential taxa, as well as the diagnostic taxa of higher syntaxa were determined in accordance with current knowledge of

grassland vegetation of Slovakia (HEGEDÜŠOVÁ VANTAROVÁ & ŠKODOVÁ 2014). The upper index is used for an average cover of species in Braun-Blanquet scale. Where applicable, the coordinates of relevés were gained in WGS-84 system.

Results and discussion

Results of the comparison (Fig. 1, Tab. 1) confirmed that the association *Homogyno alpinae-Nardetum* is present in the Veľká Fatra Mts, on a vast clearing on the eastern part of Mt. Malá Smrekovica. The occurrence of the association is currently restricted to the northwest tip of mountain meadows around hiking trail (green mark) leading into surrounding spruce forest (as a part of National nature reserve Jánošíkova kolkáreň), 1 470–1 479 m a.s.l., ca 2–25 m from the forest margin (cluster A2). The occurrence of this association in the area is strongly proved mainly by the relevé No. 2, which was co-dominated by common bistort (*Bistorta major*) and encompassing also other diagnostic taxa of the association applicable for the whole area of Slovakia: *Calamagrostis villosa*, *Carex nigra*, *Juncus filiformis*, *Luzula sylvatica* (cf. KLIMENT & UJHÁZY 2014, Tab. 18). However, it is important to point out that the common bistort is an infrequent species in the whole mountain range, and on Mt. Malá Smrekovica it occurs only scarcely. Due to the occurrence of differential species and overall floristic composition, it is possible to assign also relevés previously classified (KLIMENT 1992, Tab. II.19) as the subassociation *H.-N. athyrietosum alpestris* (Tab. 1, cluster A3) into the association *Homogyno-Nardetum*. The original relevés of the association (cluster A1) are distinguished from those in Veľká Fatra Mts by numerous differential taxa (*Veratrum album* subsp. *lobelianum*, *Pilosella aurantiaca*, *Omalotheca norvegica*, *Pseudorchis albida*, *Hieracium murorum*, *H. bifidum*, *Trommsdorffia uniflora*, *Athyrium distentifolium*, *Ranunculus platanifolius*) and they represent the variant with *Veratrum* **lobelianum* (cf. KLIMENT & UJHÁZY 2014: 397).

The comparison of actual relevés with above listed original diagnoses also revealed that the floristic composition of other mat-grass swards from the Veľká Fatra Mts that were previously assigned into the association *Homogyno alpinae-Nardetum* suits more the composition of the association *Phleo alpini-Nardetum* (cf. KLIMENT & UJHÁZY 2014: 411). It is definitely valid for the relevés of the subassociation *H.-N. alchemilletosum crinitae* (cluster B2), which contain almost all regional differential taxa of the association *Phleo alpini-Nardetum* (Tab. 1). These relevés were gained mostly outside the area of Mt. Malá Smrekovica. On the other hand, the relevés, that were initially (KLIMENT 1992) evaluated as the part of the subassociation *H.-N. typicum* (cluster B2), might be due to their floristic composition evaluated as transitional between both associations. Almost all of the differential species of the association *Phleo alpini-Nardetum* (except *Poa alpina*) are absent, but the common occurrence of the species typical for the variant with *Acetosella vulgaris* (*Acetosella vulgaris*, *Stellaria graminea*, *Rumex obtusifolius* subsp. *subalpinus*, *Senecio subalpinus*, *Stellaria nemorum*) links both groups together. The original relevés of the association (cluster B3) are

distinguished from others by numerous differential, mainly grassland species (*Pilosella officinarum*, *Viola canina*, *Briza media*, *Antennaria dioica*, *Lotus corniculatus*, *Trifolium pratense*, *Carlina acaulis*, *Cruciata glabra*, *Botrychium lunaria*, *Leucanthemum vulgare* agg., *Coeloglossum viride*, *Galium anisophyllum*, *Trommsdorffia maculata*, *Pimpinella saxifraga*, *Prunella vulgaris*) and they represent the typical variant (cf. KLIMENT & UJHÁZY 2014: 411).

Moreover, repeated study after almost 30 years (1987, 2015) revealed current tendencies of mat-grass swards development after abandonment of the traditional ways of management (mowing, grazing). The mat-grass swards near forest margin, originally distinguished as the association *Homogyno alpinae-Nardetum*, almost completely disappeared. Only tiny fragments were retained within spreading and more or less consistent stands of *Vaccinium myrtillus*. The phytocoenoses in lower parts of the vast non-forest enclave retreated considerably in favour of tall grasses (*Poa chaixii*, *Deschampsia cespitosa*). As it was already suggested (cf. KLIMENT & JAROLÍMEK 2010: 61), this case confirms that the mat-grass swards, that used to be an inseparable part of the mountains of Slovakia in the past, are becoming endangered now (cf. STANOVÁ & VALACHOVIČ 2002: 55). The secondary succession after the abandonment of the traditional ways of management is therefore the main reason of a vast decline of these plant communities, which emerged after deforestation of the area and were managed and retained in the long term by agricultural activities.

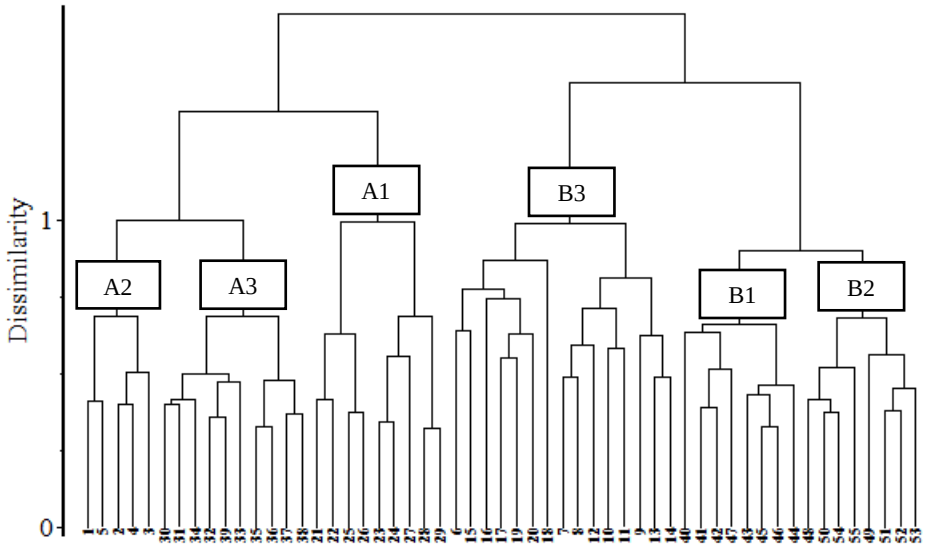

Fig. 1. Dendrogram of the relevés of mat-grass swards in the Veľká Fatra Mts. Beta-flexible method (β = -0,25) and Ruzicka's coefficient of simmilarity were used. Explanations: see the Tab. 1.

Tab. 1. Comparison of the relevés of mat-grass swards on crystalline bedrock in the Veľká Fatra Mts with original diagnoses of the associations *Homogyno alpinae-Nardetum* Mráz 1956 and *Phleo alpini-Nardetum* Klika 1934

A1: *Homogyno alpinae-Nardetum* (Mráz 1956), A2: *Homogyno alpinae-Nardetum* (Kliment 2015 ined.), A3: *H.-N. athyrietosum* sensu Kliment 1992

B1: *H.-N. typicum* sensu Kliment 1992, B2: *H.-N. alchemilletosum* Kliment 1992 ined., B3: *Phleo alpini-Nardetum* (Klika 1934)

		A1	A2	A3		B1	B2	B3	
	Relevé No.	222222222 125634789	15243	333333333333 014293567 8		4444 44444 0127 3564	45554555 80459123	111121 111 11 65679087820193 4	
	Number of taxa	433333211 498812043	22111 32863	22221122211 11028915 69	C_A %	1112 1112 0573 8832	22232222 66437422	21122112223322 1 12624475875760 7	C_B %
	Differential taxa of the associations								
	Gentiana asclepiadea	**1a1a11+..**	**+1+++**	**abbaaa33bb**	**92**^{2}	.....	.....	.....+....	3^{+}
na	*Poa chaixii*	**+aa1+r+..**	**1a...**	**b..1..11++**	**63**^{1}	.+.....	.....+..	.....	6^{+}
	Luzula sylvatica	**1a++aa+1.**	**111..**	**.....+++**	**58**^{1}	....++.+.	.....+..	.....+....	16^{+}
	Juncus filiformis	**rrrra4aa1**	**..aaa**	**.....1...**	**54**^{2}	..+.+...	.....	.....	6^{+}
NS	*Potentilla erecta*	**+a1arr+rr**	**.....**	**1.+..+....**	**50**$^{+}$	.....+	.....	.....	3^{+}
	Calamagrostis villosa	**r3..aa.a3**	**++1+b**	**.....**	**46**^{2}	.....	.....	.....	-
	Bistorta major	**rr1+a1aaa**	**..3..**	**.....**	**42**^{2}	.....	.....	.....	-
	Carex nigra	**rrrr++++1**	**..+..**	**.....**	**42**$^{+}$	.....+	.....	.....	3^{+}
	*Solidago *minuta*	**+1r1++.....**	**.....**	**r..r..r...**	**38**$^{+}$	.....	.....	.....	-
	Melampyrum sylvaticum	**11.....**	**+r+.+**	**....+.....**	**29**$^{+}$	.....	.....	.....	-
	Poa alpina	.....	1+...	++++...++.	33^{+}	.+++r+.	**1+11++1+**	**+1.aaa...a.+11.**	**74**^{1}
	Alchemilla sp. div.	..++.....	.....	.....	8^{+}	.....	**aab1aba**	**a..a+..+113a333**	**58**^{2}
	Campanula serrata	..1+.....	.+...	+.....	17^{+}	.....	**+1++++1+**	**.+..+aa...++.+.**	**48**^{1}
	Soldanella carpatica	..11.....	.....	.....	8^{1}	.....	**+.+..+.+**	**.++11..+1+aa...**	**42**^{1}
	Cerastium holosteoides	.....	.....	.....	-	.....	**+.r+..+r**	**+1.++.....+1.11.**	**42**$^{+}$
	Thymus alpestris	.....	.....	.....	-	.....	**.+..+.....1+3.+a+a1+..1**		**39**^{1}
	Veronica chamaedrys	.....	.....	.....	-	.....	**+r.+....**	**1.....++.a++.**	**29**$^{+}$
	Ranunculus pseudomontanus	.....	.....	.....	-	.....	**....+...**	**++.+.+.++..a...**	**26**$^{+}$
	Leontodon hispidus	.....	.....	.....	-	.....	**.r..+.++**	**....+...+...a..**	**23**$^{+}$

Tab. 1. – cont.

		A1	A2	A3		B1	B2	B3	
	Relevé No.	2222222222 1256347891	15243	3333333333 0142935678		4444 4444 0127 3564	45554555 80459123	111121 111 11 65679087820193 4	
	Number of taxa	4333332111 4988120432	22111 32863	2222112211 1102891569	C_A %	1112 1112 0573 8832	22232222 66437422	21122112223322 1 1262447587576 07	C_B %
vc	*Viola canina*	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . .	+. . . . +. **11a. . . a+**	**23^{1}**
	Briza media	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . .	. . . . . **++111. +a**	**23^{1}**
	Differential taxa of the variants								
	*Veratrum *lobelianum*	**r111a13a1**	. . . . .	. . . . .	38^{2}	. . . . .	. . . . .	. . . . . +++. . .	10^{+}
	Pilosella aurantiaca	**r++1rrr**. .	. . . . .	. . . . .	29^{+}	. . . . .	. . . . .	. . . . .	-
	Polygonatum verticillatum	**r+rr1+1**. .	. . . . .	. . . . .	29^{+}	. . . . .	. . . . .	. . . . .	-
	Omalotheca norvegica	**+r+1+r**. . .	. . . . .	. . . . .	25^{+}	. . . . .	. . . . .	. . . . . +.	3^{+}
	Pseudorchis albida	**rr+1+r**. . .	. . . . .	. . . . .	25^{+}	. . . . .	. . . . .	. . . . .	-
	Hieracium murorum	**++. 1. +. .** +	. . . . .	. . . . .	21^{+}	. . . . .	. . . . .	. . . . .	-
	Hieracium bifidum	**++. +r+**. . .	. . . . .	. . . . .	21^{+}	. . . . .	. . . . .	. . . . .	-
NS	*Trommsdorffia uniflora*	**r++1. r**. . .	. . . . .	. . . . .	21^{+}	. . . . .	. . . . .	. . . . .	-
	Athyrium distentifolium	**11. .** +. . . .	. . . . .	. . . . .	13^{1}	. . . . .	. . . . .	. . . . .	-
	Ranunculus platanifolius	**r +. +**. . . .	. . . . .	. . . . .	13^{+}	. . . . .	. . . . .	. . . . .	-
	Acetosella vulgaris	. . . . .	++++.	1a1+++1a. .	50^{1}	**3bbb1bba**	**bb3b+++**	. . . . .	52^{2}
	Stellaria graminea	+.	+. . . .	. +. ++. . . .	21^{2}	**++11 ++++**	**++++1+**	. . . . .	52^{+}
	*Rumex *subalpinus*	. . . . .	. . . . .	. . . . .	-	**+. +. . . .**	**r. +1. . . r**	. . . . .	19^{+}
	Senecio subalpinus	. . . . .	. . . . .	. . . . .	-	**. . . . . .**	**. r++++.**	. . . . .	19^{+}
	Stellaria nemorum	. . . . .	. . . . .	. . . . .	-	**. . +3r . . .**	**r. . +. . .**	. . . . .	16^{1}
	Pilosella officinarum	. . 11. . . .	. . . . .	. . . . .	8^{1}	. . . . .	. . . . . +	**+. +. +. a+++. +aa.**	35^{1}
	Antennaria dioica	. . +++r . . .	. . . . .	. . . . .	17^{+}	. . . . .	. . . . .	**. . +. +. . +. ++a+. .**	23^{+}
	Lotus corniculatus	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . .	**. . . . +. . ++. . +aa.**	19^{1}
	Trifolium pratense	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . .	**. . . . . +. . +3+. aa**	19^{2}
	Carlina acaulis	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . .	**. . . . . +++. . 1++**	19^{+}
	Cruciata glabra	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . .	**. . . . . 11a. a+. 1**	19^{2}
	Botrychium lunaria	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . .	**. . . . . ++++1+. .**	19^{+}

Tab. 1. – cont.

		A1	A2	A3		B1	B2	B3	
	Relevé No.	2222222222 1256347891	1524	3333333333 0142935678		4444444444 0127356480	4555455555 4591236565	111121 111 11 6790878201934	
	Number of taxa	4333332112 4988120432	2211112 3286	2222112211 1028915691	C_A %	1112111222 0573883266	2232222222 4374221262	2112211222332221 4475875760 7	C_B %
	Leucanthemum vulgare agg.	. . . . .	. . . .	. . . . .	-	. . . . .	. . . . .	. . . . . +++++. .	19^{+}
	Coeloglossum viride	. . . . .	. . . .	. . . . .	-	. . . . .	. . . . .	. . . . . +. . ++++	16^{+}
	Galium anisophyllon	. . . . .	. . . .	. . . . .	-	. . . . .	. . . . .	+. +. . . . +. . . . 1++	13^{+}
	Trommsdorffia maculata	. . . . .	. . . .	. . . . .	-	. . . . .	. . . . .	1. . . . . +. . ++. . .	13^{+}
	Pimpinella saxifraga	. . . . .	. . . .	. . . . .	-	. . . . .	. . . . .	. . . . . +. aa+. . .	13^{1}
	Prunella vulgaris	. . . . .	. . . .	. . . . .	-	. . . . .	. . . . .	. . . +. . . +. . . . . +.	10^{+}
	Nardo-Agrostion tenuis								
	Phleum rhaeticum	1+1. r r . . .	++. . .	11a++. +1. +	63^{+}	1aab1+11	babbaaaa	+. . aa1. . 11+a+a1	87^{2}
	Vaccinium myrtillus	331a11+++	a1111	33b3a3a1aa	100^{2}	. . . + ++++	+1.	1a++1. . 1+. +. . . .	48^{+}
	Homogyne alpina	r 111+1+1a	a1aaa	1bbbbbbb+b	100^{2}	. +1b +1. a	+11. a. . 1	. . 1. ++a.	48^{1}
	Acetosa arifolia	111+++. . .	1a11+	++11a1a1. +	83^{1}	a+++ 111b	++1baa1.	. . . . .	48^{3}
	Avenella flexuosa	r 1111a+11	b3baa	. . . . . +1++	75^{2}	. . . . +. +	 1	. . . aa3a. . . . +. . a	29^{2}
	Nardetalia strictae*, *Nardetea strictae								
	Nardus stricta	33434a343	43444	334454444 55	100^{4}	3554 5555	45445444	343344444344443 33	100^{4}
	Potentilla aurea	+1+++r ++.	a. . . .	+a1++1. +. .	67^{1}	1111 ++. +	1bbaba11	11a3aa. aaa3aaaa	94^{2}
	Luzula multiflora	r +111r . . .	+++1.	111++a++++	83^{+}	. +. . +111	. 1+.	a. ++. . 1aaa1aa. a	58^{2}
	Veronica officinalis	+. +1.	. . . . .	++. +.	25^{+}	. . . . . +	+++1++++	. . . +. . ++a. . +. . .	45^{+}
	Carex pilulifera	+r 1+. r +. .	+1. 1+	. . . . +. r +. .	54^{+}	. . . . .	. . . . .	1. . . . . +. a+++. .	19^{1}
vc	*Carex pallescens*	r +1+.	. +. . .	. . . . . +. +	29^{+}	. . . . .	. . . . .	. . . . a. a. . . . . +. .	10^{2}
	Luzula campestris	+. 11.	. . . . .	. . . . .	13^{1}	. . . . .	r	. . . . .	3^{r}
	Other taxa								
	Agrostis capillaris	1+a1r r 1. .	aa+1.	aab11a1111	88^{1}	aa1a1+1+	baba+ba1	. . . . a3311. . 11aa	81^{2}
	Carex ovalis	1+1.	a+++.	1111. ++1++	67^{1}	4111 b11b	ab1a111+	1. . 1. +11+. . . +. .	74^{2}
	Hypericum maculatum	+. 1.	. +. . .	11a+++++. +	50^{1}	. 1. + r 1+1	11111baa	. . +. . . a. 1++. +++	71^{1}
	*Luzula *rubella*	++11+r +++	+1. 1.	. 1. . . . ++++	71^{+}	. . . + ...	+. . +. . . .	. 3a. aa. . +. 1a+. .	35^{2}

Tab. 1. – cont.

	A1	A2	A3		B1	B2	B3	
Relevé No.	2222222222 1256347891	1524 3	3333333333 0142935678		4444 4444 4445 5554 5555 0127 3564 8045 9123	111121 111 11 6567908782 01934		
Number of taxa	4333332211 4988120431	2211 1 3286 3	2222112211 1102891569	C_A %	1112 1112 0573 8832	2223 2222 6643 7422	2112211222 3322 1 1262447587 57607	C_B %
Festuca rubra	. . . . . a .	+ . ++ . . . +++	29^{+}	. . r . . +++	++++r . . .	1+. 11 . . . 1+aa . . .	55^{+}
Deschampsia cespitosa	. . 1r . . +. .	+ . . . . . +1 . . . . . +	29^{+}	. +++ 1 . ++	. . +a+111	aa . . . . +. . . . . +. .	52^{1}
Anthoxanthum alpinum	a+a+a1a. .	. . . . .	29^{2}	. . . 3	a . +. . +. 1	11aaaa . . . . a3 . 1a	48^{2}
Luzula luzulina	. . . . .	. . . . .	1+1+1+1++1	42^{1}	. +. + . . . +	. +. . r . . .	. . . . .	16^{+}
Rubus idaeus	++. . ++. . .	. . . . r	. +. +++. . .	38^{+}	. . . .1r . . .	. . ++. . . .	. . . . .	13^{+}
Achillea millefolium	. . . . .	. . . . .	. . +.	4^{+}	. . . . .	. . . . . ++.	1 . . ++. +. . aa . . .	26^{1}
Agrostis stolonifera	. . . . .	. . . . .	. . 1+++. ++.	25^{+}	. . . . .	. . 1 . . +. .	. . . . .	6^{1}
Ranunculus acris	r ++. r r . . .	. . . . .	. . . . .	21^{r}	. . . . .	++.	. . . . .	6^{+}
Ligusticum mutellina	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . ++. .	. . +++. +.	19^{+}
Ranunculus nemorosus	. . . . .	. . . . .	. . . . .	-	. . . . .	r . . . . ++r	. . . . .	13^{+}
Trifolium repens	. . . . .	. . . . .	. . . . .	-	. . . . .	. . . . . +	. . . . . +aa	13^{2}
Bryophytes								
Rhytidiadelphus squarrosus	. . . . .	b11+. . . 1 . . +++. .	33^{1}	. . 11 . +. .	aaaa+. +.	. . . a . . . . . a . . .	35^{2}
Polytrichum formosum	. . . . .	. . . . . 1 . . . 11+1 .	21^{1}	. . . + . . . +	. . . 1	. . . . .	10^{+}
Pleurozium schreberi	. . . . .	+ . . . +	. . . . . a++. .	21^{1}	. . . . .	. . . 1	. . . . . 3	6^{2}

Taxa present in 1–4 relevés:

E_1: *Acer pseudoplatanus* r (55); *Anthyllis vulneraria* subsp. *alpestris* + (10, 11); *Athyrium filix-femina* + (47); *Calamagrostis arundinacea* + (38); *Carex canescens* r (2); *Carex flacca* subsp. *claviformis* r (47); *C. ornithopoda* + (10); *C. sempervirens* subsp. *tatrorum* (Zapał.) Pawł. + (6, 19); *Chaerophyllum hirsutum* + (49); *Crepis mollis* + (32); *Dryopteris dilatata* r (55); *Festuca supina* 2a (16); *Galeopsis tetrahit* + (30, 31); *Geranium sylvaticum* + (10, 11); *Gymnadenia conopsea* + (10, 11, 12); *Hieracium lachenalii* + (33); *Hieracium* sp. r (3); *Lathyrus vernus* + (10); *Luzula sudetica* 1 (20); *Maianthemum bifolium* 1 (21); *Omalotheca sylvatica* + (16, 39, 51, 55); *Oxalis acetosella* + (42, 49); *Phleum hirsutum* + (47, 49); *Phyteuma orbiculare* + (10); *Ph. spicatum* + (10, 12); *Picea abies* + (21, 22, 23); *Prenanthes purpurea* r (21), + (22); *Ranunculus repens* + (55); *Rumex alpinus* + (55); *Salix silesiaca* r (44, 50); *Senecio ovatus* + (50, 55); *Sorbus aucuparia* subsp. *glabrata* r (21), 1 (22); *Thesium alpinum* + (10); *Trientalis europaea* + (28), 1 (29); *Urtica dioica* + (55); *Vaccinium vitis-idaea* 1 (26); *Viola lutea* subsp. *sudetica* 1 (8), + (10), 2a (11); *V. saxatilis* subsp. *polychroma* + (40)

E_0: *Barbula* sp. + (17); *Brachythecium velutinum* + (52); *Dicranum scoparium* 2a (11); *Ditrichum flexicaule* + (47, 55); *Eurhynchium* sp. + (17); *Thuidium abietinum* 2a (11).

Explanations: na = *Nardo-Agrostion tenus*, NS = *Nardetalia strictae*, *Nardetea strictae*, vc = *Violion caninae*

Localities of the relevés

1. Veľká Fatra Mts, Mt. Malá Smrekovica (1 485 m a.s.l.), extensive non-forest enclave near Jánošíkova kolkáreň Nature reserve, north-western margin of meadows, western slope below the top part of a ridge, ca 10 m from forest margin; 49°00´27,3˝ N, 19°12´27,5˝ E, ± 6 m, 1 470 m a.s.l., W (260°), slope 5°, area 4 × 4 m, cover E_1 100 %, E_0 15 %, height E_1 20–30/60 (100) cm, 22. 7. 2015 (jkl2145).
2. As above, top part of a small ridge near the entrance into the Jánošíkova kolkáreň Nature reserve, ca 10 m from forest margin; 49°00´27,8˝ N, 19°12´28,3˝ E, ± 5 m, 1 472 m a.s.l., N (360°), slo pe 2°, area 6 × 3 m, cover E_1 100 %, E_0 5 %, height E_1 15–30/60 cm, 22. 7. 2015 (jkl2146).
3. As above, top part of a small ridge near southern boundary of Jánošíkova kolkáreň Nature reserve, ca 2 m from the forest margin; 49°00´28,5˝ N, 19°12´30,8˝ E, ± 5 m, 1 473 m a.s.l., -, slope 0°, area 3 × 5 m, cover E_1 90 % (litter), E_0 1 %, height E_1 20/50 cm, 22. 7. 2015 (jkl2147).
4. As above, top part of a small ridge near southern boundary of Jánošíkova kolkáreň Nature reserve, ca 25 m from forest margin; 49°00´25,2˝ N, 19°12´27,3˝ E, ± 8 m, 1 479 m a.s.l., NNE (20°), sl ope 2°, area 4 × 4 m, cover E_1 98 % (litter), E_0 1 %, height E_1 10/35/70 cm, 22. 7. 2015 (jkl2148).
5. As above, top part of a small ridge, ca 25 m from eastern forest margin; 49°00´25,2˝ N, 19°12´28,6˝ E, ±4 m, 1 475 m a.s.l., ENE (69°), slope 2°, area 4 × 4 m, cover E_1 98 % (litter), E_0 2 %, height E_1 25/45/70 cm, 22. 7. 2015 (jkl2149).

6.–14. *Nardus stricta-Phleum alpinum*-Ass. Klika 1934, Klika 1934, rels. 1–3, 7, 11–15, Veľká Fatra Mts.

15.–20. *Nardus stricta-Phleum alpinum*-Ass. Klika 1934, Klika 1934, rels. 4–6, 8–10, Krivánska Malá Fatra Mts.

21.–29. *Homogyno alpinae-Nardetum* Mráz 1956, Mráz 1956, Tab. 1, rels. 3, 4, 6–12, Lúčanská Malá Fatra Mts.

30.–39. *Homogyno alpinae-Nardetum athyrietosum alpestris* sensu Kliment 1992, Kliment 1992, tab. II.19, rels. 5–14, Veľká Fatra Mts.

40.–47. *Homogyno alpinae-Nardetum typicum* sensu Kliment 1992, Kliment 1992, Tab. II.19, rels. 5–14, 22–30, Veľká Fatra Mts.

48.–55. *Homogyno alpinae-Nardetum alchemilletosum crinitae* Kliment 1992 ined., Kliment 1992, Tab. II.19, rels. 31–37, Veľká Fatra Mts.

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