

VEGETATION OF TRAMPLED HABITATS IN THE PREKMURJE REGION (NE SLOVENIA)

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Abstract

The work deals with the vegetation growing along and on roads, footpaths and wheel tracks in the Prekmurje region. The author concludes that the communities appearing in these habitats can be classified into several syntaxa. The most characteristic associations are classified into the class *Polygono-Poëtea annuae*. On less trampled sites one can find also the communities that are otherwise partly adapted to trampling, however, they are classified into other syntaxonomic units, for example into the alliance *Sisymbriion* or *Malvion* (both from the class *Stellarietea mediae*) or into the alliance *Plantagini-Prunellion* from the class *Molinio-Arrhenatheretea*. The following plant communities were established *Matricarietum discoideae-recutitae* Jarolímek et al. 1997 (*Malvion neglectae*), *Polygono arenastri-Lepidietum ruderalis* Mucina 1993 (*Sisymbriion*) and *Poëtum annuae* Felföldy 1942 (*Polygono-Poëtea annuae*) and *Prunello vulgaris-Ranunculetum repentis* Winterhoff 1963 (*Molinio-Arrhenatheretea*).

Izveleček

Delo obravnava vegetacijo na cestah in ob njih, ob poteh in kolovozih v Prekmurju. Avtor ugotavlja, da lahko združbe, ki se pojavljajo na teh habitatih, uvrstimo v več sintaksonov. Najbolj značilne asociacije uvrščamo v razred *Polygono-Poëtea annuae*. Na manj pohojenih rastiščih pa najdemo tudi združbe, ki so sicer delno prilagojene na teptanje, vendar pa jih uvrščamo v druge sintaksonomske enote, na primer zvezi *Sisymbriion* ali *Malvion* (obe iz razreda *Stellarietea mediae*) ali v zvezo *Plantagini-Prunellion* iz razreda *Molinio-Arrhenatheretea*. Ugotovljene so bile naslednje rastlinske združbe *Matricarietum discoideae-recutitae* Jarolímek et al. 1997 (*Malvion neglectae*), *Polygono arenastri-Lepidietum ruderalis* Mucina 1993 (*Sisymbriion*), *Poëtum annuae* Felföldy 1942 (*Polygono-Poëtea annuae*) in *Prunello vulgaris-Ranunculetum repentis* Winterhoff 1963 (*Molinio-Arrhenatheretea*).

Key words: trampled habitat, *Polygono-Poëtea annuae*, *Stellarietea mediae*, *Molinio-Arrhenatheretea*, wheel track, vegetation, Prekmurje, Slovenia

Ključne besede: pohojeni habitat, *Polygono-Poëtea annuae*, *Stellarietea mediae*, *Molinio-Arrhenatheretea*, kolovoz, vegetacija, Prekmurje, Slovenija

1. INTRODUCTION

The vegetation developing along and on roads, footpaths and wheel tracks is subject to a greater or smaller effect of soil trampling. The main selective pressure that facilitates the development of communities on trampled soils is man's or animal's walking and vehicle driving that acts vertically on the soil and at the same time on the vegetation.

There are several factors connected with this activity. Among others, there are mechanical damages of plant parts and soil compaction resulting in reduced soil aeration and limited soil water content. However, such activities have a specific effect on the plants that are adjusted to this type of activities, and at the same time, they have a negative selective pressure on the competitive plant species. Due to walking and driving, the plants have devel-

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oped typical growing forms, for instance rosettes (*Plantago*), creeping stems (*Trifolium*) or tussocks (*Gramineae*). (Čarni & al. 2002)

In Europe, the pioneer plant communities appearing on trampled soils are mainly classified into the class *Polygono-Poëtea annuae* (Rivas-Martínez 1972). The communities are built mostly by therophytes (for instance, *Chamomilla suaveolens*, *Poa annua*) reaching their optimal phase of development in late spring and in early summer. Later on, those species occur that are adjusted to high temperatures and are known for their C4 photosynthetic pathway. They reach their optimum of development in the second half of the summer (Čarni & Mucina 1998). These communities are not dealt with in this research.

Moreover, certain other communities can also be considered as trampled communities. However, they are classified into other syntaxa, for instance, into the class of weed and ruderal communities *Stellarietea mediae* and the class of anthropogenic meadows on deeper, more or less fertile soils of lowland regions *Molinio-Arrhenatheretea*.

The association *Martiacrietum discoideae-recutitae* has been classified into *Malvion*, the alliance of annual, ruderal and therophytic communities that reach their phenological optimum in summer. The communities are found in lowlands with a warm climate. They grow on waste material and on loose soils rich in organic substances, very often rich in nitrates from organic material or from liquid manure. The communities from the alliance *Malvion* appear in planar and collin vegetation belts. The area of distribution of the alliance spreads in subcontinental central Europe and in the eastern part of the Balkan peninsula (Mucina 1993).

The association *Polygono-Lepidietum* has been classified into *Sisymbriion*, the alliance of annual ruderal communities that develop on open, nitrophilic sites in settlements and also elsewhere in the cultural landscape. Mostly these are species poor communities. The soils are loose and they dry out very quickly since they are rich in bedrock and therefore permeable (Pott 1995, Mucina 1993).

The community that is found on forest footpaths is classified into the order *Plantagini-Prunellitalia* of the class *Molinio-Arrhenathereta*. The order of *Plantagini-Prunellitalia* comprises hemicyptophytic trampled communities that grow on shady sites. In the communities, there are numerous broad-leaved and low herb species whereas the

mezzophyllous grasses are of lower importance. The typical sites for this vegetation are forest footpaths where usually the association *Prunello-Ranunculetum repentis* appears. In these communities, relatively few plant species appear (Ellmauer & Mucina 1993).

2. DESCRIPTION OF THE AREA AND METHODS

The Prekmurje region lies in the northerneast of Slovenia (Fig. 1). Geographically, it is limited by the Austrian, Hungarian and Coatian border and the Mura river. It measures 948 km². The geological bedrock consists mainly of miocenic and pliocenic, and partly also of holocenic sediments. On this bedrock the eutric and dystric leptosol develops and eutric and dystric cambisols that proceed one type of soil into another one under man's influence (Stepančič 1984). The climate can be classified into the moderate continental climate of eastern Slovenia (Subpannonic climate). It is characterized by more a pronounced continental precipitation regime with an annual quantity of precipitation between 1000 and 800 mm, and by the fact that April temperatures equal or exceed the October ones. Figure 2 shows the climadiagram for Lendava, where the annual quantity of precipitation equals 811 mm with a maximum in July and November (Ogrin 1996). In this area, the most frequent community is *Castaneo-Fagetum* that could be found on hilly sites in the northern part of the region. The plains are mostly cultivated, here and there, there are individual hornbeam tree forests (*Pruno padi-Carpinetum*). On the plains, larger forest surfaces appear along water currents and in marshy regions, particularly the forests dominated by oak, alder and willow trees (Marinček & Čarni 2002).

The vegetation was sampled and studied according to the standard Central European method (Braun-Blanquet 1964, Westhoff & van der Maarel 1973) whereas the nomenclature of plant species follows Ehrendorfer (1973) and Martinčič (2003).

In Slovenia, the vegetation of trampled sites has been researched by a few researchers, like for example Čarni (1996) in the Submediterranean area, Markovič (1984) in the Predinarc and Dinarc region, Šilc (2001, 2002) in Central Slovenia, and Markovič (2000) in the Subpannonian region.

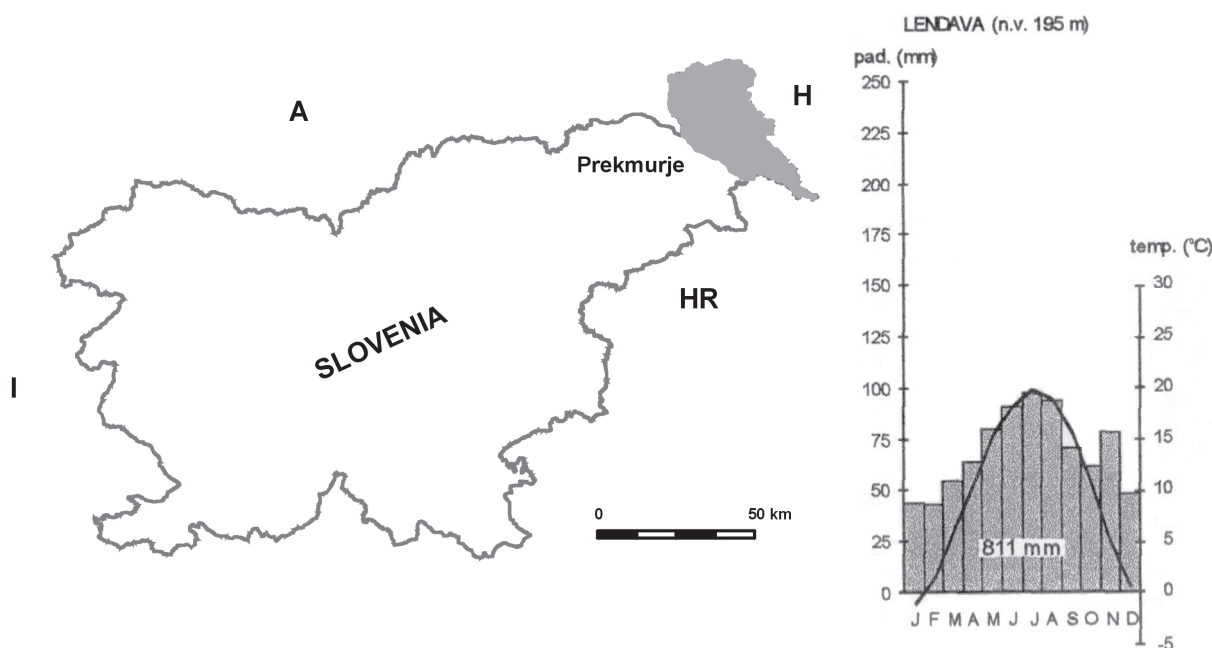


Figure 1: Research area (left); Figure 2: Climadiagram for Lendava (after Ogrin 1996) (right).
Slika 1: Področje raziskav (levo); Slika 2: Klimadiagram Lendave (po Ogrinu 1996) (desno).

3. RESULTS

a) Syntaxonomical scheme

Stellarietea mediae R.Tx. Lohmeyer et Preising in R. Tx. ex Rochow 1951

Sisymbrietalia J. Tx. in Lohmeyer et al. 1962

Malvion neglectae (Gutte 1966) Hejný 1978

Matricarietum discoideae-recutitae

Jarolímek et al. 1997

Sisymbrium officinale R. Tx., Lohmeyer et Preising in R. Tx. 1950

Polygono arenastri-Lepidietum ruderalis
Mucina 1993

Polygono arenastri-Poëtea annuae Rivas-Martínez 1975 corr. Rivas-Martínez et al. 1991

Polygono arenastri-Poëtalía annae R. Tx. in Géhu et al. 1972

Marticulario matricarioidis-Polygonion arenastri
Rivas-Martínez 1975 corr. Rivas-Martínez et al. 1991

Poëtum annuae Felföldy 1942

Molinio-Arrhenatheretea R. Tx. 1937 em. R. Tx. 1970

Plantagini-Prunellétalia Ellmauer et Mucina 1993

Plantagini-Prunellion Eliáš 1980

Prunello-Ranunculetum repentis Winterhoff 1963

b) Description of plant communities

3.1. *Matricarietum discoideae-recutitae* Jarolímek et al. 1997 (Tab. 1)

The community, classified into the alliance *Malvion* was described by Jarolímek and coauthors (1997) in Slovakia. The community appears on holding yards where the poultry is pastured from time to time. The sites are sunny or partly shady, fresh to dry, rich in nitrogen and only moderately trampled (Jarolímek & al. 1997).

In the Prekmurje region, the community frequently appears in courtyards that are still traditionally managed although such sites are in the process of gradual disappearance. The community was sampled on wheel tracks between fields where working machinery and equipment are utilized, so that the vegetation on these sites is only moderately trampled. The sites are rather eutrophic. The vegetation was classified into the alliance of *Malvion*, although there are several species from the alliance *Marticulario-Polygonion* representing the transitional character of this association between two alliances and classes at the same time as was already quoted by Jarolímek & al. (1997).

The community is poorly developed due to the small surface area between wheels on wheel tracks. The community is species poor; there appear less than ten species, whereas more than 20 (Jarolímek & al. 1997) can be found in the optimally developed community. The dominant species in stands is *Chamomilla recutita* and there appear with higher cover values also *Polygonum arenastrum* and *Matricaria suaveolens*.

Table 1: Analytical table of the community *Matricarietum discoideae-recutitae*.

Tabela 1: Analitična tabela združbe *Matricarietum discoideae-recutitae*.

Relevé number	1	2
Surface (m ²)	5	4
Coverage (%)	80	80
Inclination (°)	0	0
<i>Chamomilla recutita</i>	3	2
<i>Matricaria suaveolens</i>	2	1
<i>Polygonum arenastrum</i>	3	2
<i>Bromus hordeaceus</i>	+	.
<i>Agropyron repens</i>	+	2
<i>Digitaria sanguinalis</i>	+	.
<i>Dactylis glomerata</i>	+	+
<i>Capsella bursa-pastoris</i>	.	+
<i>Plantago major</i>	.	+
<i>Conyza canadensis</i>	.	+
<i>Chenopodium album</i>	.	+
<i>Achillea collina</i>	.	+

Localities: 1. Pince Marof, in wheel tracks between fields, 5. 7. 2001, altitude 155 m, lat. 46°30'48", long. 163°0'46"; 2. Pince Marof, in wheel tracks between fields, 5. 7. 2001, 150 m, 46°31'30", 16°29'30".

3.2. *Polygono arenastrum-Lepidietum ruderalis* Mucina 1993 (Tab. 2)

As described by Mucina (1993), the community appears relatively frequently in Austria where it is found on road verges, along railways and along house walls. Within this community, many species can be found that are resistant to trampling, which results in the transitional character of the community between the alliances of *Sisymbrium* and *Matricario-Polygonion arenastrum*. Certain authors (for example, Jarolímek & al. 1997) classify it into the alliance of *Matricario-Polygonion*.

Besides the dominant species *Lepidium ruderalis* there often appear also *Poa annua* and *Dactylis glomerata*. The community does not appear very often

in the area concerned, however, it can be found along road verges and on sandy parking places. The community is poor in species, which is characteristic of the communities from the alliance *Sisymbrium* (Mucina 1993).

Table 2: Analytical table of the community *Polygono-Lepidietum*.

Tabela 2: Analitična tabela združbe *Polygono-Lepidietum*.

Relevé number	1	2	3
Surface (m ²)	4	2	3
Coverage (%)	40	60	50
Inclination (°)	0	0	0
<i>Lepidium ruderalis</i>	3	4	3
<i>Poa annua</i>	1	1	+
<i>Dactylis glomerata</i>	+	+	2
<i>Plantago major</i>	1	1	.
<i>Matricaria discoidea</i>	+	1	.
<i>Capsella bursa-pastoris</i>	+	+	.
<i>Plantago major</i>	+	.	+
<i>Agropyron repens</i>	+	.	.
<i>Rumex crispus</i>	+	.	.
<i>Poa compressa</i>	+	.	.
<i>Polygonum arenastrum</i>	.	+	.

Localities: 1. Kobilje, on the parking places, 26.5.2000, 180 m, 2. Pince, on the filled gravel near the cemetery, 26.5.2000, 163 m, 3. Pince Marof, on the filled gravel, 26.5.2000, 155 m.

3.3. *Poëtum annuae* Felföldy 1942 (Tab. 3)

The community from the alliance *Matricario-Polygonion*, dominated by the therophytic species *Poa annua* appears across the entire area studied. It can be ranked among the most frequent ruderal communities. The stands appear on different sites, on footpaths, on parking places, along roads, in front of buildings and similar. The community reaches its optimum in late spring, whereas the therophytic species decay in peak summer months. In addition to the dominant species, there are other species like *Plantago major*, *Lolium perenne*, *Matricaria discoidea* and *Polygonum arenastrum* growing in this community more or less constantly.

The community was considered as *Lolio-Plantaginetum* Berger 1930 *poëtosum* Krippelová 1972 by some authors or as the community with a species *Poa annua* [*Polygono-Poëtea annuae*] (Mucina 1993) in compliance with the deductive method of Kopecký (Kopecký & Hejný 1974).

Table 3: Analytical table of the community *Poëtum annuae*.

Tabela 3: Analitična tabela združbe *Poëtum annuae*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	
Surface (m ²)	4	10	10	-	5	5	8	8	8	8	8	
Coverage (%)	80	80	60	80	80	80	70	80	80	80	80	
Aspect	S	-	S	-	-	-	-	-	-	-	-	
Inclination (°)	2	-	2	-	-	-	-	-	-	-	-	
Number of species	13	13	11	9	15	12	17	10	9	10	17	Presence
Ass. char. species												
<i>Poa annua</i>	4	3	3	4	3	4	3	4	4	4	4	11
PP POLYGONO-POËTEA ANNUAE												
<i>Matricaria discoidea</i>	+	.	.	+	+	1	+	+	1	+	+	9
<i>Polygonum arenastrum</i>	+	+	+	+	+	+	+	.	.	.	+	8
<i>Spergularia rubra</i>	.	.	.	.	.	.	.	1	+	+	+	4
<i>Sagina procumbens</i>	.	.	.	.	.	.	+	+	.	+	.	3
Other species												
<i>Lolium perenne</i>	+	+	1	2	2	+	+	2	2	1	2	11
<i>Plantago major</i>	3	3	2	3	3	1	2	1	+	2	1	11
<i>Trifolium repens</i>	1	2	+	.	1	+	+	1	.	.	+	8
<i>Taraxacum officinale</i>	+	+	+	+	1	+	.	.	.	.	+	7
<i>Medicago lupulina</i>	+	+	.	.	.	+	+	+	.	.	.	5
<i>Dactylis glomerata</i>	.	.	+	.	+	.	.	+	+	.	+	5
<i>Plantago lanceolata</i>	+	+	.	.	1	.	.	.	.	.	+	4
<i>Capsella bursa-pastoris</i>	.	+	+	.	+	1	.	.	.	.	.	4
<i>Carex hirta</i>	.	+	+	+	.	.	+	.	.	.	.	4
<i>Veronica arvensis</i>	.	.	.	.	.	.	+	.	1	+	+	4
<i>Cerastium glomeratum</i>	1	+	.	.	.	.	.	.	.	.	+	3
<i>Achillea collina</i>	.	+	.	.	+	.	.	.	+	.	.	3
<i>Juncus tenuis</i>	.	+	.	.	.	+	+	.	.	.	.	3
<i>Ranunculus repens</i>	.	.	.	+	.	.	+	.	+	.	.	3
<i>Poa trivialis</i>	.	.	.	.	+	.	+	.	.	.	.	2
<i>Aphanes arvensis</i>	.	.	.	.	.	.	.	+	.	+	.	2
<i>Festuca arundinacea</i>	.	.	.	.	.	.	.	.	.	+	+	2

Localities: 1. Veščica, 8.6.1999, 195 m, on the filled gravel, 2. Veščica, 8.6.1999, 195 m, at the entrance into the cemetery, on the gravel, 3. Bukovniško jezero, 8.6. 1999, 190 m, on the filled gravel at the parking place along the lake, 4. Gornji Slaveči, 9.6.1999, 250 m, on the filled gravel in front of the fire station, 5. Ižakovci, 8.6.1999, 180 m, in the middle of wheel tracks, 6. Dokležovje, 8.6.1999, 180 m, on the gravel near the football field NK Dokležovje, 7. Moravci, 8.6.1999, 190 m, on the parking place near a store, on the filled gravel, 8. Moravci, 8.6.1999, 190 m, on the filled gravel near a store, 9. Moravci, 8.6.1999, 190 m, on the gravel on the parking place in front of a store, 10. Moravci, 8.6.1999, 190 m, on the filled gravel on the parking place in front of a store, 11. Moravci, 8.6.1999, 190 m, on the filled gravel on the parking place in front of a store.

Less common species: 1. *Festuca* sp. +, *Rorippa sylvestris* +, *Trifolium campestre* +, 3. *Epilobium montanum* +, *Hypericum perforatum* +, 5. *Apera spica-venti* +, *Artemisia vulgaris* +, *Erigeron annuus* +, 6. *Lepidium virginicum* 1, *Arenaria serpyllifolia* +, 7. *Bellis perennis* +, *Filaginella uliginosa* +, *Trifolium dubium* +, 10. *Scleranthus annuus* +, 11. *Diplotaxis tenuifolia* +, *Papaver rhoeas* +, *Sagina apetala* +, *Vulpia myuros* +.

3.4. *Prunello-Ranunculetum repentis* Winterhoff 1963 (Tab. 4)

The community thrives on less trampled soils, in forest wheel tracks, located on partly shady sites. This community is dominated by the hemicyptophytic species that are resistant to a definite extent of trampling like *Prunella major*, *Plantago major*, *Juncus tenuis* joined by therophytic species like *Poa annua*, *Oxalis stricta*, *Stellaria media*. The forest species also appear frequently like *Carex sylvatica*, *Poa nemoralis*, *Stachys sylvatica* and numerous other ones. The species from the class *Galio-Urticetea* (e.g. *Urtica dioica*, *Impatiens parviflora*) and class *Bidentetea* (e.g. *Polygonum hidropiper*, *P. mite*) appear frequently as well.

The communities were not classified into lower syntaxons, since Faliński (1963) distinguishes the variant with *Juncus tenuis* and Jarolímek (1980) the subassociation *veronicetosum serpyllifoliae*. However, the community growing in the area studied could hardly be classified into one of the already described lower units. Consequently, the classification into lower units was not carried out.

The association was designated as *Prunello-Ranunculetum repentis* Winterhoff 1963 and *Prunello-vulgaris-Plantaginetum* Faliński 1963 or *Prunella vulgaris-Agrostietea* Gesellschaft (Schall 1988) was taken as synonym in accordance with Ellmayer & Mucina (1993) as well as Jarolímek & Zaliberová (1995).

Table 4: Analytical table of the community *Prunello-Ranunculetum repentis*.

Tabela 4: Analitična tabela združbe *Prunello-Ranunculetum repentis*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	
Surface (m ²)	10	20	20	20	15	15	20	20	15	20	20	
Coverage (%)	90	70	60	70	70	90	70	70	70	70	70	
Layer C	80	65	60	70	60	90	70	70	70	65	70	
Layer D	20	5	10	30	20	5	0	0	1	5	1	
Aspect	-	W	SE	E	-	-	-	-	-	W	-	
Inclination (°)	0	2	2	1	0	0	0	0	0	2	0	
Number of species	36	33	29	30	37	28	12	22	31	26	25	Presence
Ass. char. and diff. species												
<i>Prunella vulgaris</i>	3	2	3	2	1	1	2	2	3	2	1	11
<i>Plantago major</i>	+	+	1	2	1	1	2	2	2	+	+	11
<i>Juncus tenuis</i>	1	+	2	2	+	1	+	1	.	+	+	10
MA MOLINIO-ARRHNETHERETEA												
<i>Ranunculus repens</i>	1	1	1	+	2	1	.	.	2	2	2	9
<i>Veronica serpyllifolia</i>	+	+	+	+	+	+	+	+	+	+	.	10
<i>Taraxacum officinale</i>	+	.	+	+	.	+	.	+	+	.	.	6
<i>Cerastium holosteoides</i>	.	+	+	+	+	.	.	+	+	.	.	6
<i>Lysimachia nummularia</i>	+	.	+	.	.	.	.	.	+	2	1	5
<i>Poa trivialis</i>	.	+	+	+	.	+	.	.	+	.	.	5
<i>Trifolium repens</i>	.	.	.	+	+	1	+	+	.	.	.	5
<i>Campanula patula</i>	.	+	+	.	+	.	.	.	.	+	.	4
<i>Achillea millefolium</i>	.	.	.	+	+	+	.	.	.	.	.	3
<i>Dactylis glomerata</i>	+	.	.	.	+	.	.	+	.	.	.	3
<i>Ranunculus acris</i>	+	.	.	+	.	.	.	.	.	.	+	3
<i>Holcus lanatus</i>	.	+	+	.	.	.	.	.	.	.	+	3
<i>Agrostis stolonifera</i>	.	.	.	.	+	1	.	.	1	.	.	3
QF QUERCO-FAGETEA												
<i>Carex sylvatica</i>	+	+	+	.	.	+	+	+	.	+	+	8
<i>Poa nemoralis</i>	2	.	+	+	1	.	+	.	+	.	+	7

Relevé number	1	2	3	4	5	6	7	8	9	10	11	
<i>Stachys sylvatica</i>	+	+	.	.	.	.	.	.	.	+	+	4
<i>Viola reichenbachiana</i>	+	+	+	.	+	.	.	.	.	.	.	4
<i>Rumex sanguineus</i>	+	.	.	.	+	+	.	.	.	.	.	3
<i>Carex remota</i>	.	+	.	+	.	.	.	.	.	.	1	3
<i>Lycopus europaeus</i>	.	.	.	+	.	.	.	.	1	.	2	3
<i>Carpinus betulus juv.</i>	+	.	.	.	.	+	.	.	.	.	.	2
<i>Lamium montanum</i>	+	.	.	.	.	.	.	.	.	+	.	2
<i>Agrostis capillaris</i>	.	+	.	.	+	.	.	.	.	.	.	2
<i>Anemone nemorosa</i>	.	+	.	.	.	.	.	+	.	.	.	2
<i>Mycelis muralis</i>	.	+	.	.	.	.	.	+	.	.	.	2
<i>Asperula odorata</i>	.	+	.	.	.	.	.	.	.	+	.	2
<i>Stachys palustris</i>	.	.	+	.	.	.	.	.	.	+	.	2
Other species												
<i>Poa annua</i>	1	2	2	1	1	2	3	2	1	+	.	10
<i>Oxalis stricta</i>	+	.	+	+	1	1	+	+	+	+	+	10
<i>Stellaria media</i>	2	+	+	+	+	+	.	+	1	+	.	9
<i>Eurynchium hians</i> var. <i>hians</i> *	+	+	2	1	2	+	.	.	.	+	+	8
<i>Ajuga reptans</i>	+	.	.	+	1	+	.	.	+	.	3	6
<i>Cardamine impatiens</i>	+	.	.	.	1	+	+	+	.	.	+	6
<i>Polygonum hidopiper</i>	+	1	+	.	.	.	.	+	+	+	.	6
<i>Erigeron annuus</i>	+	.	.	+	+	.	+	.	.	.	+	5
<i>Sagina procumbens</i>	+	.	1	+	+	.	.	.	.	.	.	4
<i>Brachythecium mildeanum</i>*	+	.	+	+	+	.	.	.	.	.	.	4
<i>Atrichum undulatum</i> *	.	1	+	+	.	.	.	.	.	+	.	4
<i>Urtica dioica</i>	.	.	+	.	+	.	.	+	+	.	.	4
<i>Agropyron repens</i>	.	.	+	.	.	.	.	+	+	1	.	4
<i>Cerastium glomeratum</i>	+	.	1	.	+	.	.	.	.	.	.	3
<i>Geum urbanum</i>	+	.	.	.	.	+	.	.	+	.	.	3
<i>Impatiens parviflora</i>	+	.	.	.	+	.	.	+	.	.	.	3
<i>Veronica chamaedrys</i>	.	1	+	.	.	.	.	.	.	+	.	3
<i>Plagiomnium affine</i> *	.	+	.	.	.	+	.	.	.	+	.	3
<i>Lapsana communis</i>	.	.	+	.	+	.	.	.	.	.	+	3
<i>Galeopsis speciosa</i>	.	.	.	.	+	+	.	.	.	+	.	3
<i>Glechoma hederacea</i>	.	.	.	.	.	+	.	+	.	.	2	3
<i>Polygonum mite</i>	.	.	.	.	.	+	.	.	+	.	+	3
<i>Alliaria petiolata</i>	+	.	.	.	.	.	+	.	.	.	.	2
<i>Chenopodium album</i>	+	.	.	.	.	.	.	.	+	.	.	2
<i>Moehringia trinervia</i>	.	+	.	+	.	.	.	.	.	.	.	2
<i>Clinopodium vulgare</i>	.	+	.	.	.	.	.	.	.	1	.	2
<i>Prunella laciniata</i>	.	+	.	.	.	.	.	.	.	+	.	2
<i>Fragaria vesca</i>	.	+	.	.	.	.	.	.	.	+	.	2
<i>Solidago virgaurea</i>	.	+	.	.	.	.	.	.	.	+	.	2
<i>Calliergonella lindbegii</i> *	.	.	.	2	+	.	.	.	.	.	.	2
<i>Polygonum hidopiper</i>	.	.	.	.	+	+	.	.	.	.	.	2

Localities: 1. Hraščica, 14.6.2000, 180 m, wheel tracks, 2. Bukovnica, 15.6.2000, 200 m, forest footpath, 3. Kobilje, 14.6.2000, 205 m, forest footpath, 4. Kobilje, 14.6.2000, 205 m, forest footpath, 5. Hraščica, 14.6.2000, 180 m, forest footpath, 6. Trnjavski log, 15.6.2000, 170 m, forest footpath, 7. Renkovci (Hraščica), 15.6.2000, 180 m, forest footpath, 8. Renkovci, 15.6.2000, 180 m, forest footpath, 9. Trnjavski log, 15.6.2000, 170 m, forest footpath, 10. Bukovnica, 15.6.2000, 200 m, forest footpath, 11. Bogojina, close to Bogojina hunting lodge, 15.6.2000, 240 m, forest footpath.

Less common species: 1. *Aegopodium podagraria* +, *Anthiscus sylvestris* +, *Circaea lutetiana* +, *Geranium phaeum* +, *Myosotis sparsiflora* +; 2. *Luzula pilosa* +, *Milium effusum* +, *Solidago serotina* +, *Veronica montana* +; 3. *Geranium robertianum* +; 4. *Amblystegium serpens** +, *Hypericum perforatum* +, *Polygonum aviculare* agg. +, *Schrophularia nodosa* +, *Trifolium dubium* +; 5. *Filagenella uliginosa* 1, *Stellaria neglecta* 1, *Juncus bufonius* +, *Petrorhagia saxifraga* +, *Pimpinella major* +; 6. *Agrostis canina* +, *Lolium perenne* +, *Potentilla reptans* +; 8. *Rubus fruticosus* +, *Torilis japonica* +; 9. *Amaranthus blitum* +, *Arctium lappa* +, *Bidens tripartita* +, *Calystegia sepium* +, *Cruciata levipes* +, *Galeopsis pubescens* +, *Knautia drymeia* +, *Populus alba* juv. +, *Quercus robur* juv. +, *Solanum dulca-mara* +; 11. *Alopecurus* sp. +, *Epilobium montanum* +, *Mentha longifolia* +, *Senecio jacobea* +.

* species in moss layer, all others in herb layer.

CONCLUSION

This work describes four communities that can be found on trampled habitats in the Prekmurje region. Since this type of vegetation has been poorly studied so far, further intensive studies will be necessary in the Prekmurje region and all over Slovenia.

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POVZETEK

Vegetacija pohojenih habitatov v Prekmurju (SV Slovenija)

V Prekmurju smo raziskovali vegetacijo, ki se razvije ob cestah, na poteh in kolovozih, kjer je podvržena večjemu ali manjšemu vplivu teptanja tal. Glavni selektivni pritisk, ki omogoči razvoj združb na pohojenih tleh, je hoja človeka ali živali ter vožnja vozil, ki delujejo s svojim pritiskom vertikalno na tla in hkrati na vegetacijo. S tem delovanjem je povezanih več dejavnikov, med katerimi so najpomembnejše mehanične poškodbe rastlinskih delov in stiskanje zemlje, kar povzroči zamažanje areacije ter omejevanje vode v tleh. Takšno delovanje ima na rastline, ki so na takšno delovanje prilagojene, sicer določen učinek, hkrati pa negativen selektiven pritisk na konkurenčne rastlinske vrste. Zaradi hoje oz. vožnje imajo rastline tipične oblike razrasti npr. rozete (*Plantago*), plazeča stebela (*Trifolium*) ali šopasto razrast (*Gramineae*). (Čarni & al. 2002)

V Evropi uvrščamo pionirske rastlinske združbe, ki se pojavljajo na pohojenih tleh, v glavnem v razred *Polygono-Poëtea annuae* (Rivas-Martínez 1972). Združbe grade večinoma terofiti (npr. *Chamomilla suaveolens*, *Poa annua*), ki dosežejo optimalno fazo svojega razvoja v pozni pomladi in zgodnjem poletju. Kasneje se pojavijo vrste, ki so prilagojene na visoke temperature in imajo C4 fotosintetsko pot in dosežejo optimum svojega razvoja v drugi polovici poletja (Čarni & Mucina 1998). Teh združb v tem delu ne obravnavamo.

Poleg tega pa lahko med pohojene združbe prištejemo tudi nekatere druge združbe, ki jih sicer uvrščamo v druge sintaksone, na primer med plevelne in ruderalne združbe razreda *Stellarietea mediae* ali v razred antropogenih travišč na globljih in bogatih rastiščih *Molinio-Arrhenatheretea*.

Združbo *Martiacarietum discoideae-recutitae* smo uvrstili v zvezo *Malvion*, ki združuje enoletne, ruderalne, terofistke združbe, ki imajo fenološki optimum poleti. Združbe najdemo v nižinskih predelih s toplo klimo. Uspevajo na različnih odpadkih in na rahlih tleh, ki so bogata z organskimi snovmi, pogosto z nitrati iz organskih odpadkov ali snovmi iz gnojevke. Združbe iz zveze *Malvion* najdemo v planarnem in kolinskem pasu. Areal zveze je v subkontinentalni srednji Evropi in v vzhodnem delu Balkanskega polotoka (Mucina 1993).

V zvezo *Sisymbriion*, kamor uvrščamo združbo *Polygono-Lepidietum*, uvrščamo enoletne ruderalne združbe, ki se razvijejo na sončnih, nitrofilnih rastiščih v naseljih in tudi drugje v kulturni krajini. Večinoma so to vrstno revne združbe. Tla so rahla in se hitro posušijo, saj so skeletna in zato prepustna. (Pott 1995, Mucina 1993)

Združbo, ki jo najdemo na gozdnih poteh uvrščamo v red *Plantagini-Prunellitalia* razreda *Molinio-Arrhenatheretea*. Red *Plantagini-Prunellitalia* obsega hemikriptofitske pohojene združbe, ki jih najdemo na senčnih rastiščih. V združbah se pojavljajo številne širokolistne in nizke zeliščne vrste, medtem ko so mezofilne travne vrste manj pogoste. Tipična ra-

stišča za to vegetacijo so gozdne poti, kjer ponavadi najdemo združbo *Prunello-Ranunculetum repentis*. V teh združbah se pojavlja razmeroma malo rastlinskih vrst. (Ellmauer & Mucina 1993)

REFERENCES

- Braun-Blanquet, J. 1964: Pflanzensoziologie. Grundzüge der Vegetationskunde. 3. Aufl. Springer Wien, 865 pp.
- Čarni, A. 1996: Thermophilous vegetation of trampled habitats in Istria (Croatia, Slovenia). *Biologia* 51(4): 405–409.
- Čarni, A., Kostadinovski, M. & Matevski, V. 2002: Vegetacija na pohojenih rastiščih v Republiki Makedoniji. *Hacquetia* 1(2): 209–221.
- Čarni, A. & Mucina, L. 1998: Vegetation of trampled soils dominated by C4 plants in Europe. *Journal of Vegetation Science* 9(1): 45–56.
- Ehrendorfer, E. 1973: Liste der Gefäßpflanzen Mitteleuropas. Gustav Fisher Verlag, 318 pp.
- Ellmauer, T. & Mucina, L. 1993: *Molinio-Arrhenetetea*. In: Mucina, L., Grabherr, G. & Ellmauer, T.: Die Pflanzengesellschaften Österreichs. Teil I. Anthropogene Vegetation, pp. 297–401.
- Faliński, J. B. 1963: Zbiorowiska dywanowe zachodniej części Niziny Wielkopolsko-Kujawskiej. *Acta Soc. Bot. Pol.* 32: 81–99.
- Jarolímek, I. 1980: *Prunello-Plantaginetum majoris* Faliński 1963 v jugozápanej časti Malých Karpát. *Biológia* 35(1): 11–16.
- Jarolímek, I. & Zaliberová, M. 1995: Ruderal plant communities of north-eastern Slovakia II. *Chenopodieta, Plantagineteta*. *Thaiszia* 5: 61–75.
- Jarolímek, I., Zaliberová, M., Mucina, L. & Moch-nacký, S. 1997: Rastlinné spoločenstvá Slovenska, 2. Synanthropná vegetácia. Veda, Bratislava, 416 pp.
- Kopecký, K. & Hejný, S. 1974: A new approach to the classification of anthropogenic plant communities. *Vegetatio* 29: 17–20.
- Marković, L. 1984: Die Ruderalvegetation im dinarischen und vordinarischen Gebiet Sloweniens. *Razprave IV. razreda SAZU* 25(2): 65–120.
- Marković, L. 2000: Die Ruderalvegetation im subpannonischen Gebiet Sloweniens. *Razprave IV. razreda SAZU* 41(2): 95–178.
- Marinček, L. & Čarni, A. 2002: Komentar k vegetacijski karti gozdnih združb Slovenije v merilu 1: 400.000. Založba ZRC, Ljubljana, 160 pp.
- Martinčič, A. 2003: Seznam listnatih mahov (*Bryopsida*) Slovenije. *Hacquetia* 2(1): 91–166.
- Mucina, L. 1993: *Stellarietea mediae*. In: Mucina, L., Grabherr, G. & Ellmauer, T. (eds.): Die Pflanzengesellschaften Österreichs. Teil I. Anthropogene Vegetation, pp. 110–168.
- Rivas-Martínez, S. 1972: Sobre la nueva clase *Polygono-Poëtea annuae*. *Phytocoenologia* 2: 123–140.
- Ogrin, M. 1996: Podnebni tipi v Sloveniji. *Geografski vestnik* 68: 39–56
- Pott, R. 1995: Die Pflanzengesellschaften Deutschlands, 2. Auflage, Ulmer Verlag, Stuttgart, 622 pp.
- Schall, B. 1988: Die Vegetation der Waldwege und ihre Korrelation zu den Waldgesellschaften in verschiedenen Landschaften Südwestdeutschlands mit einigen Vorschlägen zur Anlage und Pflege von Waldwegen. *Ber. ANL* 12: 105–140.
- Stepančič, D. 1984: Komentar k listu Murska Sobota – Osnovna pedološka karta SFRJ, Pedološka karta Slovenije 1 : 50.000. Katedra za pedologijo, prehrano rastlin in ekologijo, VTOZD za agronomijo, Biotehniška fakulteta, Ljubljana, 64 pp.
- Šilc, U. 2001: Ruderal communities on sandy soil in south-eastern-Slovenia. *Acta Biologica Slovenica* 44(1/2): 53–70.
- Šilc, U. 2002: *Odontito-Ambrosietum* Jarolímek 1997 – a ruderal association new to Slovenia. *Acta Botanica Croatica* 61(2): 179–198.
- Westhoff, V. & van der Maarel, E. 1973: The Braun-Blanquet approach. In: Whittaker, R.H. (eds.): *Ordination and Classification of Communities*. Dr. W. Junk Publishers, The Hague, pp. 617–727.

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