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Contributions to the thermophilous fringe communities (*Trifolio-Geranietea sanguinei*) in Belarus

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Abstract. The paper presents the results of phytosociological studies on thermophilous forb fringes conducted in August, 2012, in Belarus. A dataset of 31 relevés is analyzed, 3 associations and 1 community of 3 alliances and 3 orders of the class *Trifolio-Geranietea sanguinei* T. Müller 1962 are distinguished. For the first time for this area, the association *Galio borealis-Geranietum sanguinei* Tüxen 1967 is reported and characterized. The results of syntaxonomical interpretation are discussed based on chorological data.

Key words: forest fringes; edges, *Trifolio-Geranietea sanguinei*; syntaxonomy; vegetation; Belarus

1. Introduction

Thermophilous fringe communities on forest edges and margins formed by meso-xerothermic forbs are widespread in forest zone of Europe. These marginal plant communities are considered within distinct *Trifolio-Geranietea sanguinei* T. Müller 1962 class (Müller 1962; Dierschke 1974a; Mucina 1997). The communities of this class have been studied since 1960s in different parts of the continent, also in Central-Eastern Europe (Dierschke 1974b; Passarge 1979; Mucina & Kolbek 1993; Brzeg 2005; Čarni 2005; Chytrý 2007; Brzeg & Wika 2014; Valachovič & Hegedüšová Vantarová 2014).

However, for the territory of Belarus, communities of the *Trifolio-Geranietea sanguinei* class were mentioned only scarcely. Mesophillous fringes dominated by *Trifolium medium* were characterized based on 10 phytosociological relevés from north-western part of the country (Scepanovich & Scepanovich 1991). In the last vegetation survey, 3 associations of this class were listed: *Stachyo-Melampyretum nemorosi* Passarge 1967 (within the *Melampyrion pratensis* Passarge 1967 alliance), *Trifolietum medii* Müller 1961 em. Stepanovič (1987) 1991 and *Equisetetum hyemali* ass. nova (in the *Trifolion medii* Müller 1961 alliance) (Scepanovich 2006). Xero-thermophilous edges were neglected or omitted, only for south-eastern part of the country, one relevé classified as *Geranio-Trifolietum alpestris* T. Müller 1962 *galietosum aparines* Korneck 1974 was published (Lukash & Iakushenko 2008).

So, the thermophilous edge vegetation in Belarus is poorly documented and still studied fragmentarily. The aim of this paper was to present new phytosociological materials and syntaxonomical considerations on some forest fringe communities from Belarus.

2. Material and methods

2.1. Study area

The natural forest vegetation of the country is mainly represented by hemiboreal spruce forests with broad-leaved trees and by hemiboreal Scots-pine forests (Bohn *et al.* 2000). Belarus is divided into three vegetation sub-zones: the oak-spruce forests sub-zone in the northern part, the hornbeam-oak-spruce forests sub-zone in the central part, and the broadleaved-pine forests sub-zone in the southern part of the country (Yurkevich *et al.* 1979). The first sub-zone mainly overlaps with the Boreal biogeographical region and two others – with the Continental region (Evans 2005).

The data were sampled in the geobotanical region Ashmyanska-Minskaya akruga of the oak-spruce forests sub-zone, on three geomorphological units: (1) Narachanskaya plain, (2) Svyantsyanskiya ridges (two units – within the frames of the Narachanski National

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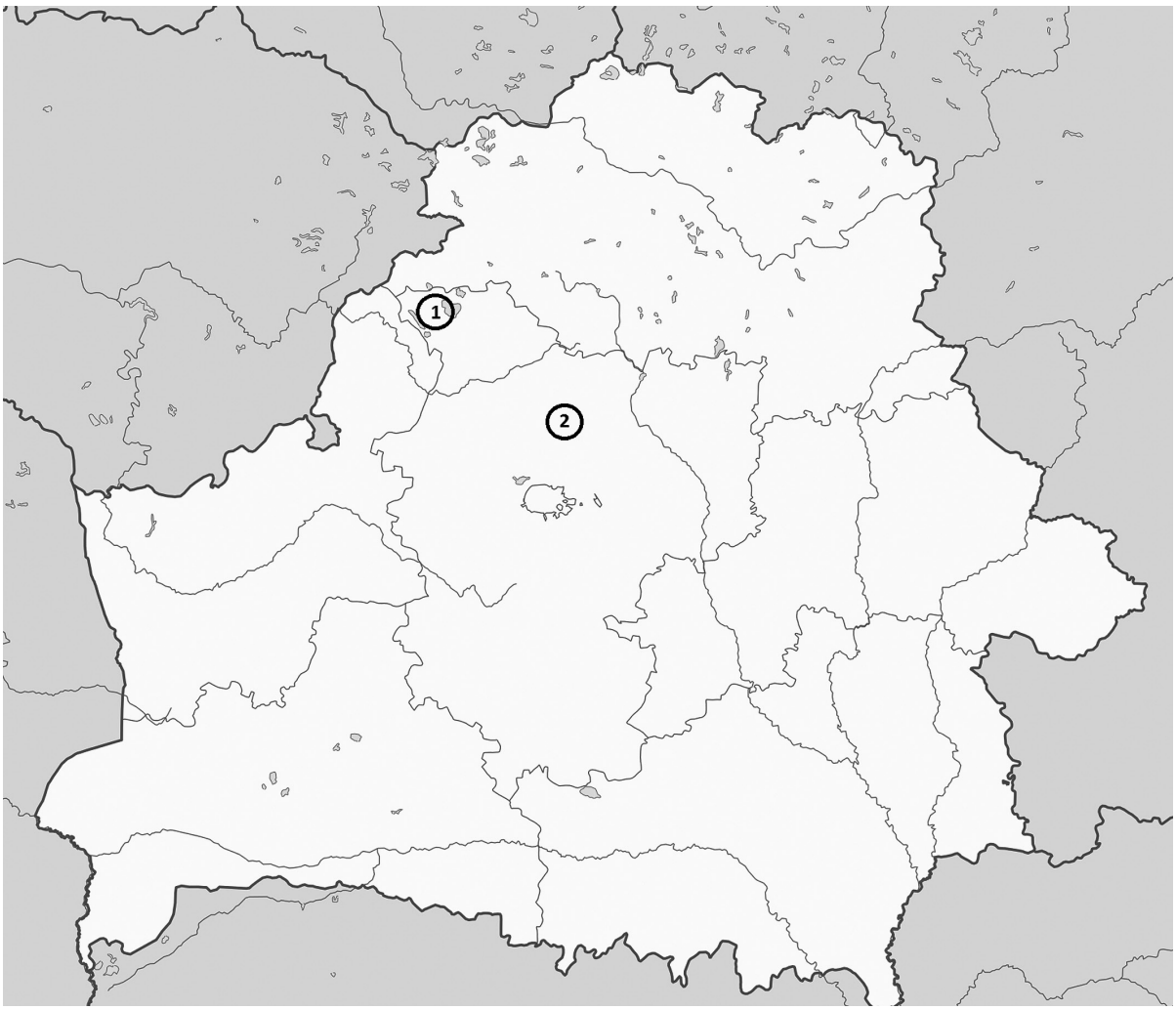

Fig. 1. Map of Belarus with studied localities (https://commons.wikimedia.org/wiki/File:Belarus_location_map.svg)
Explanations: 1 – Narachanski National Park, Miadziel district, Minsk region, 2 – vicinities of Kozyry village, Lahoysk district, Minsk region

Park), and (3) Minskaya highland (Fig. 1) (Myasnikowich 2002).

2.2. Data collection and phytosociological analysis

The research was conducted in the middle of August, 2012. The phytosociological relevé sampling followed the Braun-Blanquet approach (Westhoff & van der Maarel 1973). The relevés were stored in the TurboVeg database (Hennekens & Schaminée 2001). A small dataset of 31 relevés was used for the analysis using Juice 7.0 software package (Tichý 2002). Numerical classification of the dataset was performed by the PC-ORD 5 program (McCune & Mefford 1999) with relative Euclidean distance as a measure of dissimilarity and Ward's linkage method, square-root transformed cover values were used.

Diagnostic species were chosen on the basis of fidelity measure (Chytrý *et al.* 2002). The threshold value for a species considered as diagnostic was set at a Phi-coefficient (multiplied by 100) more than 30. Species that were recorded in at least 61% of the relevés of a community were considered constant for a syntaxon. The classification followed the results of syntaxonomical revisions of the *Trifolio-Geranietea sanguinei* class for adjacent European countries: Latvia (Rūsiņa 2007), Lithuania (Balevičiene *et al.* 1998), Poland (Brzeg 2005), and Ukraine (Solomakha 2008). The names of syntaxa and lists of diagnostic species were based on the current European synthesis (Mucina *et al.* 2016). The nomenclature of vascular plants followed the Euro+Med PlantBase (Euro+Med 2006-), and for mosses – a checklist by Hill *et al.* (2006).

3. Results

3.1. Classification of plant communities

The results of cluster analysis are presented in the dendrogram (Fig. 2). As a result of PC-ORD analysis, six distinct groups of relevés were obtained. In two main clusters, the first one consisted of the communities asso-

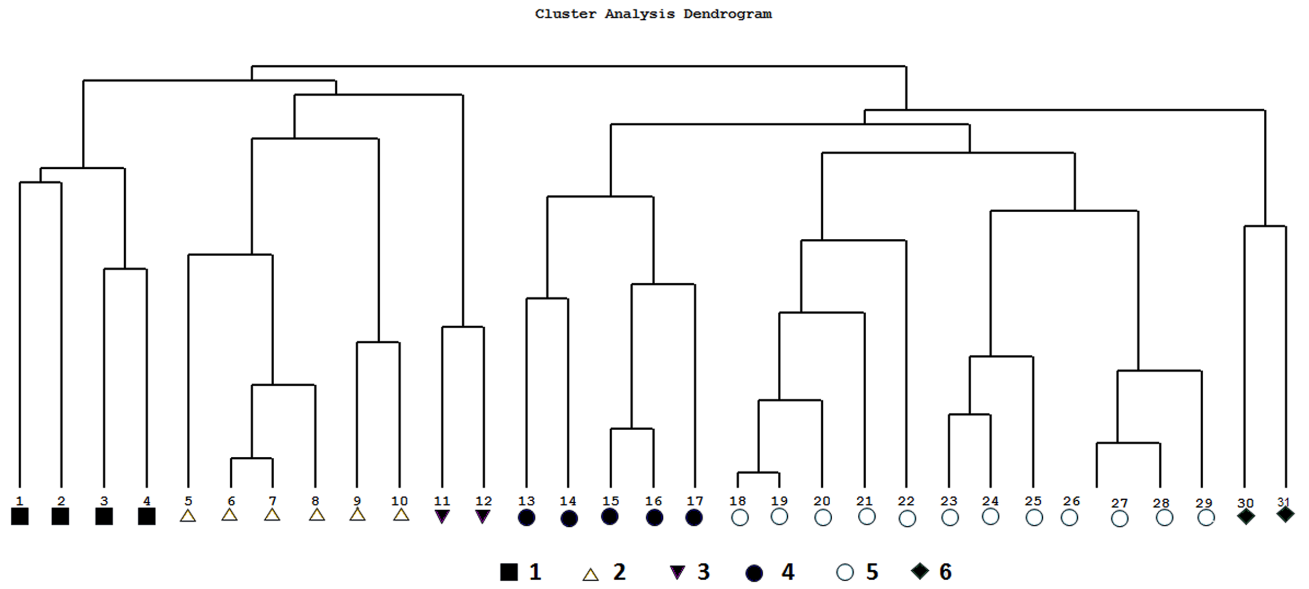

Fig. 2. Dendrogram of numerical classification of the studied relevés

Explanations: 1 – *Galio borealis-Geranietum sanguinei*, 2 – community with *Melampyrum pratense* – typical plots, 3 – community with *M. pratense* – plots dominated by *Vicia cassubica*, 4 – *Trifolio-Melampyretum nemorosi-thermophilous* plots, 5 – *Trifolio-Melampyretum nemorosi*, 6 – *Trifolio medii-Agrimonietum*

ciated with the edges of coniferous (pine or spruce-pine) forests. The further division within this cluster reflected the differentiation into xerothermophilous communities (group 1) and acidophilous communities on sandy soils (groups 2-3). The second main cluster consisted of mesophilous fringe communities (groups 4-6).

For these three clusters, the constancy and threshold value for a diagnostic species are presented in Table 1. The most frequent herbal species with high fidelity for the first group were *Calamagrostis arundinacea*, *Festuca ovina*, *Fragaria vesca*, *Geranium sanguineum*, *Hieracium umbellatum*, *Peucedanum oreoselinum*, *Polygonatum odoratum*, *Pulmonaria angustifolia*, *Rubus saxatilis*, and *Veronica spicata*. This group corresponds to the *Geranion sanguinei* alliance. For the second group, which refers to the *Melampyrion pratensis* alliance, such species as *Achillea millefolium*, *Knautia arvensis*, *Melampyrum pratense*, and *Solidago virgaurea*, were the most frequent with high fidelity index. *Dactylis glomerata* and *Trifolium medium* were the most frequent species with high fidelity in the third cluster, corresponding to the *Trifolion medii* alliance.

As a result of syntaxonomical interpretation of phytosociological materials, the following scheme was established:

Trifolio-Geranietea sanguinei T. Müller 1962
- *Antherico ramosi-Geranietalia sanguinei* Julve ex Dengler in Dengler *et al.* 2003
  - *Geranion sanguinei* Tx. in T. Müller 1962
    - *Galio borealis-Geranietum sanguinei* Tüxen 1967
- *Melampyro-Holcetalia mollis* Passarge in Theurillat *et al.* 1995
  - *Melampyrion pratensis* Passarge 1979
    - Community with *Melampyrum pratense*
  - *Origanetalia vulgaris* T. Müller 1962
    - *Trifolion medii* T. Müller 1962
      - *Trifolio-Melampyretum nemorosi* (Passarge 1967) Dierschke 1973
      - *Trifolio medii-Agrimonietum* T. Müller 1962

3.2. Characteristics of the associations

Galio borealis-Geranietum sanguinei Tüxen 1967 association (Table 2): Species-rich (average number of species per relevé was 45.5), dense (herb layer cover consisted of 80-95%), picturesque communities dominated by forbs: *Laserpitium latifolium* (20-25%), *Geranium sanguineum* (10-30%), *Vincetoxicum hirundinaria* (5-15%), *Clinopodium vulgare* (10-15%), *Dracocephalum ruyschiana* (up to 10%), *Convallaria majalis*, *Rubus saxatilis*, *Galium boreale*, *Polygonatum odoratum*, *Lathyrus niger*, etc. and broad-leaved graminoids: *Calamagrostis arundinacea* (5-15%), *Brachypodium pinnatum* (up to 30%), *Molinia caerulea* (15-17%), *Carex montana* (up to 20%). The species of the *Trifolio-Geranietea* class and the *Geranion sanguinei* alliance were well represented. A significant role of the species from the *Molinion caerulei* alliance (*Molinia caerulea*, *Laserpitium prutenicum*, *Rhinanthus serotinus*, and *Succisa pratensis*) should be admitted. Also, the described plots were rich in species protected on national level (Kachanovskiy *et al.* 2015): *Dracocephalum ruyschiana*, *Laserpitium latifolium*, *Lathyrus pisiformis, Pulsatilla patens*, and *Thesium ebracteatum*. In the shrub layer (cover 5%),

Table 1. Shortened synoptic table with frequency (%) and modified fidelity index for the distinguished alliances*

Successive No.	1	2	3
Number of relevés	4	8	19
Total number of species	84	87	155
D.s. Al. *Geranion sanguinei*			
Geranium sanguineum	100 100.0	. ---	. ---
Polygonatum odoratum	100 100.0	. ---	. ---
Pulmonaria angustifolia	100 100.0	. ---	. ---
*Veronica spicata***	100 100.0	. ---	. ---
*Rubus saxatilis***	100 100.0	. ---	. ---
*Calamagrostis arundinacea***	100 92.6	. ---	11 ---
Vincetoxicum hirundinaria	75 81.6	. ---	. ---
Dracocephalum ruyschiana	75 81.6	. ---	. ---
Lathyrus niger	75 81.6	. ---	. ---
Galium boreale	75 81.6	. ---	. ---
Carex montana	75 81.6	. ---	. ---
*Convallaria majalis***	75 81.6	. ---	. ---
Viola rupestris	75 81.6	. ---	. ---
*Laserpitium prutenicum***	75 81.6	. ---	. ---
*Rhinanthus serotinus***	75 81.6	. ---	. ---
D.s. Al. *Melampyrion pratensis*			
Melampyrum pratense	25 ---	88 73.0	. ---
*Luzula pilosa***	. ---	62 51.0	26 ---
D.s. Al. *Trifolion medii*			
*Dactylis glomerata***	. ---	88 38.7	95 49.2
Trifolium medium	. ---	25 ---	89 74.7
*Galium mollugo***	25 ---	62 12.4	74 28.3
D.s. Cl. *Trifolio-Geranietea*			
Peucedanum oreoselinum	100 80.7	25 ---	5 ---
Hieracium umbellatum	100 63.1	25 ---	42 ---
Fragaria vesca	100 40.6	62 ---	63 ---
Campanula persicifolia	75 77.1	. ---	5 ---
Trifolium alpestre	75 72.8	. ---	11 ---
Clinopodium vulgare	75 63.8	12 ---	11 ---
Solidago virgaurea	75 ---	100 38.0	58 ---
Knautia arvensis	75 ---	100 28.0	84 ---
Veronica chamaedrys	75 ---	88 9.7	84 3.7
Melampyrum nemorosum	75 22.1	25 ---	79 27.8
Hypericum perforatum	50 10.3	62 28.2	16 ---
Poa angustifolia	25 ---	62 38.7	21 ---
Other species			
Festuca ovina	100 74.2	38 ---	5 ---
Ajuga reptans	75 61.6	. ---	26 ---
Vaccinium vitis-idaea	75 55.9	25 ---	11 ---
Agrostis capillaris	75 12.2	62 ---	63 ---
Achillea millefolium	50 ---	100 47.1	58 ---
Lupinus polyphyllus	. ---	62 62.9	11 ---
Artemisia vulgaris	. ---	62 35.1	53 20.7
Pimpinella saxifraga	25 ---	50 3.1	68 29.2
Phleum pratense	. ---	38 3.2	68 49.0
Vicia cracca	. ---	25 ---	74 61.4

Explanations: 1 – *Geranion sanguinei* (Table 2), 2 – *Melampyrion pratensis* (Table 3), 3 – *Trifolion medii* (Table 4); * – Only species with constancy of more than 61% at least in one column, are shown. Species from the layers b and d are excluded; ** – Species which are diagnostic to other syntaxa, but obtained a high frequency and fidelity in this dataset

Picea abies, *Juniperus communis, Pinus sylvestris*, *Sorbus aucuparia* were common. Moss layer (cover up to 20%) was formed by *Pleurozium schreberi*, *Hylocomium splendens*, *Dicranum polysetum*, *Polytrichum juniperinum*. The communities of the association were formed on forest glades within species-rich pine forests on gentle slopes (10-20°) of moraine hills with sandy-clay soils. Diagnostic species: *Geranium sanguineum* (opt.), *Galium boreale*, *Dracocephalum ruyschiana*.

Community with *Melampyrum pratense* (Table 3): These communities were rather sparse (cover from 30 to 60%, up to 85%) and well recognized physiognomically by the aspect of *Melampyrum pratense* (cover 10-40%). In relatively poor species composition (average number of species per relevé was 28.5), grasses obtained a sig-

Table 2. Floristic composition of communities from the alliance *Geranion sanguinei*

Successive No. of relevé	1	2	3	4
No. of relevé in the field	72	73	74	35
Shrub layer cover [%]	5	5	5	5
Herb layer cover [%]	80	95	85	80
Moss layer cover [%]	20	5	20	3
Altitude a.s.l. [m]	256	260	258	197
Slope exposure	NW	.	S	S
Inclination [°]	20	.	10	10
Area of relevé [m2]	100	100	100	30
Number of species	48	50	43	41
D.s. Ass. *Galio borealis-Geranietum sanguinei*				
Geranium sanguineum	3	2	4	3
Galium boreale	1	r	.	1
Dracocephalum ruyschiana	r	2	2	.
D.s. Al. *Geranion sanguinei*				
Polygonatum odoratum	1	1	1	2
Veronica spicata	r	r	2	1
Calamagrostis arundinacea	2	2	2	2
Pulmonaria angustifolia	r	r	r	r
Rubus saxatilis	1	1	1	r
Vincetoxicum hirundinaria	2	1	1	.
Carex montana	1	2	3	.
Lathyrus niger	r	1	r	.
Viola rupestris	r	r	1	.
Laserpitium latifolium	3	3	.	.
Brachypodium pinnatum	4	.	.	.
D.s. Cl. *Trifolio-Geranietea*				
Hieracium umbellatum	r	r	1	r
Peucedanum oreoselinum	1	1	r	2
Fragaria vesca	2	2	2	1
Veronica chamaedrys	1	2	.	1
Trifolium alpestre	2	1	.	1
Campanula persicifolia	r	1	.	r
Solidago virgaurea	r	.	1	r
Knautia arvensis	.	1	r	r
Melampyrum nemorosum	1	1	r	.
Clinopodium vulgare	1	2	2	.
Ranunculus polyanthemos	1	r	.	.
Lathyrus pisiformis	r	1	.	.
Hypericum perforatum	1	.	.	1
Silene nutans	.	.	r	1
D.s. Cl. *Vaccinio-Piceetea*				
Pleurozium schreberi d	1	1	2	1
Vaccinium vitis-idaea	1	1	1	.
Dicranum polysetum d	1	1	1	.
Picea abies b	1	1	1	.
Juniperus communis b	1	1	r	.
Vaccinium myrtillus	2	r	.	.
D.s. Cl. *Nardetea strictae*				
Potentilla erecta	r	1	.	.
Veronica officinalis	.	1	1	.
Calluna vulgaris	.	1	1	.
D.s. Cl. *Koelerio-Corynephoretea*				
Thymus serpyllum	.	1	.	1
Pilosella officinarum	.	.	1	2
D.s. Al. *Molinion caeruleae*				
Laserpitium prutenicum	r	1	2	.
Rhinanthus serotinus	1	1	r	.
Molinia caerulea	.	3	3	.
D.s. Cl. *Carpino-Fagetea*				
Melica nutans	2	2	.	.
Carex digitata	1	.	.	r
Convallaria majalis	.	1	2	2
Other species				
Festuca ovina	1	r	1	1
Pinus sylvestris b	r	.	r	1
Agrostis capillaris	1	1	.	1
Sorbus aucuparia b	1	1	1	.
Ajuga reptans	r	1	1	.
Pteridium aquilinum	1	2	.	.
Populus tremula b	.	1	.	1
Achillea millefolium	.	.	r	r

nificant role (*Agrostis capillaris*, *Festuca ovina*, *Holcus mollis*, *Anthoxanthum odoratum*, *Dactylis glomerata*, *Poa angustifolia*, etc.). Among dicots, mesophilous and slightly psammophytic species prevailed (*Veronica chamaedrys*, *Knautia arvensis*, *Pilosella officinarum*, *Solidago virgaurea*, *Achillea millefolium*, *Fragaria vesca*, etc.). The advanced invasion of *Lupinus polyphyllus* was observed. Two stands (Table 3, rel. 7-8) were strongly dominated by *Vicia cassubica* (cover of this species – up to 50%, total herb cover varied in 2 relevés from 50 to 70%). Moss layer normally was developed (cover up to 70-80%), formed by typical forest mosses: *Hylocomium splendens* and *Pleurozium schreberi*. Communities with *Melampyrum pratense* formed on narrow strip linear margins of pine forests on sandy soils (*Dicrano-Pinion sylvestris* (Libbert 1933) W. Matuszkiewicz 1962). Diagnostic species: *Melampyrum pratense* (opt.), *Agrostis capillaris*, *Holcus mollis*, *Festuca ovina*.

Trifolio-Melampyretum nemorosi (Passarge 1967) Dierschke 1973 association (Table 4, rel. 1-17): These dense (total cover varied from 70 to 100%) communities commonly distinguished physiognomically by the co-domination in different proportions of two mesophilous species: *Melampyrum nemorosum* and *Trifolium medium*. Other species characteristic for the *Trifolion medii* alliance (*Galium mollugo*, *Dactylis glomerata*, *Vicia sepium*, etc.) and for the *Trifolio-Geranietea* class (*Solidago virgaurea*, *Veronica chamaedrys*, *Knautia arvensis*, *Hieracium umbellatum*) were frequent. In species composition, various species of mesophytic meadows (*Phleum pratense*, *Vicia cracca*, *Centaurea jacea*, etc.) and ruderal habitats (*Anthriscus sylvestris*, *Artemisia vulgaris*, *Geum urbanum*, *Cirsium arvense*, etc.) were common. Some sites were enriched in xeromesophilous species from *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947 class: *Centaurea scabiosa*, *Medicago*

Sporadic taxa: rel. 1: *Hylocomium splendens* d (2), *Lathyrus vernus* (r), *Orthilia secunda* (1), *Pimpinella saxifraga* (r), *Polytrichum juniperinum* d (1); rel. 2: *Astragalus glycyphyllos* (1), *Cirsium arvense* (1), *Galium mollugo* (r), *Succisa pratensis* (r), *Urtica dioica* (r); rel. 3: *Betula pendula* b (1), *Gnaphalium sylvaticum* (1), *Koeleria grandis* (1), *Rosa* sp. b (1), *Sieglingia decumbens* (r), *Thesium ebracteatum* (1), *Vicia cassubica* (1); rel. 4: *Anthyllis vulneraria* (1), *Astragalus arenarius* (1), *Carex ericetorum* (1), *Erigeron acris* (r), *Hylotelephium maximum* (1), *Hypochaeris maculata* (1), *Hypochaeris radicata* (1), *Melampytum pratense* (1), *Poa angustifolia* (1), *Pulsatilla patens* (1), *Rubus idaeus* (r), *Scorzonera humilis* (1), *Verbascum thapsus* (r), *Viola canina* (r)

List of localities:

1 – 54°19.362' N 27°55.639' E; Minsk Region, Lahoysk district, 4.5 km E of Kazyry village; 19.08.2012; **2** – 54°19.299' N 27°55.049' E; Minsk Region, Lahoysk district, 4.5 km E of Kazyry village; 19.08.2012; **3** – 54°19.274' N 27°55.037' E; Minsk Region, Lahoysk district, 4.5 km E of Kazyry village; 19.08.2012; **4** – 54°57.932' N 26°23.080' E; Minsk Region, Miadziel district, vicinities of Glublia lake; 15.08.2012

Table 3. Floristic composition of communities from the alliance *Melampyrion pratensis*

Successive No. of relevé	1	2	3	4	5	6	7	8	
No. of relevé in the field	30	33	31	15	62	61	32	68	
Shrub layer cover [%]	3	5	1	1	5	5	10	1	Constancy
Herb layer cover [%]	30	60	30	85	60	60	70	50	
Moss layer cover [%]	50	10	5	.	70	80	5	.	
Altitude a.s.l. [m]	206	206	206	173	172	171	206	144	
Area of relevé [m2]	20	50	50	20	100	40	25	50	
Number of species	33	33	25	15	35	33	29	25	
D.s. Al. *Melampyrion pratense*									
Melampyrum pratense	2	3	2	5	4	3	.	1	V
Holcus mollis	1	1	3	.	.	.	1	.	III
Anthoxantum odoratum	1	1	1	.	.	.	1	.	III
D.s. Al. *Trifolion medii*									
Dactylis glomerata	.	1	2	1	1	2	1	1	V
Galium mollugo	.	1	.	1	r	1	.	1	IV
Trifolium medium	r	1	.	.	.	.	.	.	II
D.s. Cl. *Trifolio-Geranietea*									
Solidago virgaurea	1	1	1	r	1	r	2	1	V
Veronica chamaedrys	1	1	1	2	1	2	.	1	V
Knautia arvensis	2	1	1	1	1	1	1	2	V
Fragaria vesca	1	1	.	.	1	3	3	.	IV
Hypericum perforatum	r	1	1	.	r	.	r	.	IV
Poa angustifolia	.	1	.	1	1	1	.	1	IV
Peucedanum oreoselinum	.	.	.	.	r	2	.	.	II
Melampyrum nemorosum	.	.	.	.	1	1	.	.	II
Ranunculus polyanthemos	.	.	.	.	r	r	.	r	II
Silene nutans	.	.	.	.	1	1	.	.	II
Hieracium umbellatum	.	r	.	.	.	.	r	.	II
Vicia cassubica	.	.	.	.	.	.	5	4	II
D.s. Cl. *Molinio-Arrhenateretea*									
Phleum pratense	r	.	.	.	.	.	1	r	II
Poa pratensis	1	.	.	.	.	.	.	1	II
Equisetum pratense	.	.	1	.	.	.	r	r	II
Taraxacum officinale	.	.	r	.	.	r	.	r	II
Rumex acetosa	.	.	.	1	.	1	.	r	II
Vicia cracca	.	.	.	.	r	r	.	.	II
D.s. Cl. *Vaccinio-Piceetea*									
Pleurozium schreberi d	2	1	1	.	5	5	1	.	IV
Luzula pilosa	1	.	r	.	1	1	r	.	IV
Hylocomium splendens d	4	1	.	.	2	2	.	.	III
Vaccinium vitis-idaea	1	.	.	.	r	.	.	.	II
Vaccinium myrtillus	1	1	.	.	.	.	.	.	II
Trientalis europaea	r	.	r	.	.	.	.	.	II
Polytrichum juniperinum d	1	.	.	.	.	.	1	.	II
D.s. Cl. *Nardetea strictae*									
Veronica officinalis	1	.	.	.	1	.	.	.	II
Calluna vulgaris	1	.	.	.	1	.	.	.	II
D.s. Cl. *Koelerio-Corynephoretea*									
Pilosella officinarum	.	2	1	.	2	.	2	.	III
Jasione montana	r	.	.	.	.	.	r	.	II
Rumex acetosella	.	.	r	.	.	.	r	.	II
D.s. Cl. *Artemisietea vulgaris*									
Artemisia vulgaris	.	r	1	.	r	.	r	1	IV
Elytrigia repens	.	.	1	2	.	1	1	.	III
Tanacetum vulgare	r	1	.	.	.	.	.	.	II
Silene latifolia	.	r	.	r	.	.	.	.	II
D.s. Cl. *Carpino-Fagetea*									
Acer platanoides b	.	.	.	.	1	.	.	1	II

Other species									
Achillea millefolium	1	2	2	r	1	r	1	r	V
Agrostis capillaris	1	2	.	2	3	3	.	.	IV
Lupinus polyphyllus	1	2	1	1	.	.	.	1	IV
Pimpinella saxifraga	.	r	.	r	.	1	.	r	III
Rubus idaeus	.	1	1	.	1	1	.	.	III
Salix caprea b	1	1	.	.	.	.	.	.	II
Festuca ovina	2	1	.	.	3	.	.	.	II
Populus tremula b	r	1	.	.	1	.	.	.	II
Pinus sylvestris b	1	1	.	.	.	.	2	.	II
Pteridium aquilinum	.	2	r	.	.	.	.	.	II
Erigeron acris	.	.	1	.	.	.	1	.	II
Betula pendula b	.	.	.	.	1	.	1	.	II
Sorbus aucuparia b	.	.	.	.	1	1	.	.	II
Quercus robur b	.	.	.	.	1	1	.	.	II
Quercus robur c	r	.	.	.	.	.	.	.	I
Malus domestica b	.	.	.	.	.	1	1	.	II
Medicago sativa	.	.	.	.	.	1	.	1	II

Sporadic taxa: rel. 1: *Galeopsis bifida* (r), *Luzula campestris* (r), *Trifolium repens* (1); rel. 2: *Artemisia campestris* (r), *Equisetum pratense* (1), *Orthilia secunda* (1); rel. 3: *Convolvulus arvensis* (1), *Frangula alnus* b (r), *Hypochaeris radicata* (1); rel. 4: *Amelanchier spicata* b (1); rel. 5: *Chamaenerion angustifolium* (r), *Dicranum polysetum* d (2), *Picea abies* b (r), *Sieglingia decumbens* (1); rel. 6: *Agrimonia eupatoria* (r), *Carex hirta* (1), *Centaurea scabiosa* (r), *Euphorbia cyparissias* (r), *Melica nutans* (r), *Potentilla argentea* (r); rel. 7: *Carlina* sp. (r), *Clinopodium vulgare* (1), *Epilobium* sp. (1), *Gnaphalium sylvaticum* (r), *Potentilla erecta* (1); rel. 8: *Schoenodorus pratensis* (r), *Linaria vulgaris* (1), *Oenothera rubricaulis* (r), *Verbascum nigrum* (r), *Viburnum opulus* b (1)

List of localities:
1 – 54°57.188' N 26°48.682' E; Minsk Region, Miadziel district, vicinities of Grumbinenty village; 15.08.2012; **2** – 54°56.540' N 26°24.550' E; Minsk Region, Miadziel district, vicinities of Grumbinenty village; 15.08.2012; **3** – 54°56.538' N 26°24.539' E; Minsk Region, Miadziel district, vicinities of Grumbinenty village; 15.08.2012; **4** – 54°51.892' N 26°43.199' E; Minsk Region, Miadziel district, vicinities of Nanosy village; 13.08.2012; **5** – 54°54.471' N 26°42.874' E; Minsk Region, Miadziel district, vicinities of Narach town; 17.08.2012; **6** – 54°53.561' N 26°41.367' E; Minsk Region, Miadziel district, vicinities of Narach town; 17.08.2012; **7** – 54°56.547' N 26°24.561' E; Minsk Region, Miadziel district, vicinities of Grumbinenty village; 15.08.2012; **8** – 54°50.99' N 26°51.635' E; Minsk Region, Miadziel district, S of Gatavichy village; 18.08.2012

falcata, *Trifolium montanum*, *Plantago media* (Table 4, rel. 1-4). Other communities, developed in shady and moist conditions, contained nemoral forest species: *Aegopodium podagraria*, *Stellaria holostea*, *Asarum europaeum*. Shrubs cover up to 10 %. Moss layer was rare and sparse. The communities of the association were common in mesic conditions on margins and forest glades of broad-leaved and spruce-broad-leaved

Table 4. Floristic composition of communities from the alliance *Trifolion medii*

Successive No. of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19
No. of relevé in the field	29	17	18	12	37	34	21	20	19	27	23	28	38	11	26	25	24		64	36
Shrub layer cover [%]	7	.	10	.	5	1	5	.	10	4	.	5	10	5	10	5	10		15	2
Herb layer cover [%]	90	95	95	80	70	95	85	100	100	95	95	85	70	65	85	85	95		80	85
Moss layer cover[%]	.	.	.	5	.	.	.	.	.	.	.	.	15	.	.	.	3		10	10
Altitude a.s.l. [m]	178	157	161	170	224	220	200	193	194	184	187	.	228	158	186	185	180		163	172
Inclination [°]	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.		.	.
Area of relevé [m2]	100	100	50	50	50	20	40	10	60	35	20	25	30	50	25	50	100		50	20
Number of species	45	25	30	31	34	32	25	21	29	29	28	33	29	28	30	38	41		30	31
D.s. Ass. *Trifolio medii-Agrimonietum*																				
Agrimonia eupatoria	1	.	r	.	.	.	.	.	.	.	.	1	.	.	.	.	.	I	3	3
D.s. Al. *Trifolion medii*																				
Trifolium medium	3	1	4	1	2	5	4	5	5	2	4	3	.	.	2	2	3	V	1	4
Dactylis glomerata	2	3	.	2	3	2	2	2	1	3	3	2	2	1	2	2	2	V	1	1
Galium mollugo	1	2	1	2	1	3	1	.	.	2	.	.	1	1	.	1	1	IV	1	2
Vicia sepium	1	.	1	.	1	.	.	.	.	r	2	1	.	.	.	r	1	III	.	1
Hypericum maculatum	.	.	.	.	.	.	.	.	r	.	1	.	.	r	.	1	1	II	.	.
Campanula glomerata	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	r	I	.	.

Constancy 1-17

Successive No. of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19
No. of relevé in the field	29	17	18	12	37	34	21	20	19	27	23	28	38	11	26	25	24		64	36
Shrub layer cover [%]	7	.	10	.	5	1	5	.	10	4	.	5	10	5	10	5	10	Constancy 1-17	15	2
Herb layer cover [%]	90	95	95	80	70	95	85	100	100	95	95	85	70	65	85	85	95		80	85
Moss layer cover[%]	.	.	.	5	.	.	.	.	.	.	.	.	15	.	.	.	3		10	10
Altitude a.s.l. [m]	178	157	161	170	224	220	200	193	194	184	187	.	228	158	186	185	180		163	172
Inclination [°]	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.		.	.
Area of relevé [m2]	100	100	50	50	50	20	40	10	60	35	20	25	30	50	25	50	100		50	20
Number of species	45	25	30	31	34	32	25	21	29	29	28	33	29	28	30	38	41		30	31
D.s. Cl. *Trifolio-Geranietea*																				
Knautia arvensis	1	1	.	1	1	2	2	r	.	1	r	r	2	.	1	1	1	V	3	3
Veronica chamaedrys	2	1	1	1	2	1	1	1	.	1	2	.	1	1	.	2	2	V	1	1
Fragaria vesca	2	1	.	1	2	1	.	.	.	.	.	1	.	1	1	1	2	III	4	1
Melampyrum nemorosum	.	.	2	1	2	.	1	2	1	3	3	2	3	4	1	1	2	V	3	.
Solidago virgaurea	1	.	1	1	1	1	.	.	.	r	.	.	r	1	r	r	1	IV	.	.
Hieracium umbellatum	.	.	1	r	.	.	2	r	.	.	.	.	.	r	2	1	2	III	.	.
Clinopodium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	I	.	r
Hypericum perforatum	1	.	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	I	.	.
Ranunculus polyanthemos	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	2	.	I	1	.
Poa angustifolia	3	2	.	.	.	2	.	2	.	.	.	.	.	.	.	.	.	II	.	.
Trifolium alpestre	.	.	.	.	.	.	.	.	.	.	.	r	.	.	2	.	.	I	.	.
D.s. Cl. *Molinio-Arrhenateretea*																				
Phleum pratense	1	1	.	1	1	2	1	2	1	1	1	.	r	.	.	.	1	IV	.	1
Equisetum pratense	r	.	2	.	.	.	1	1	.	.	.	.	.	.	.	.	.	II	.	.
Rumex acetosa	r	r	.	r	.	r	.	.	.	.	r	.	.	r	.	.	r	III	.	.
Taraxacum officinale	r	.	.	r	1	.	.	.	.	r	.	.	.	r	.	.	.	II	.	.
Schenodorus pratensis	2	1	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	II	.	.
Poa pratensis	.	.	.	.	.	.	1	.	1	.	1	.	.	.	.	.	.	I	.	.
Trifolium repens	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	I	1	1
Vicia cracca	r	1	r	.	1	1	1	1	1	2	1	1	.	.	1	.	1	IV	.	1
Centaurea jacea	1	1	.	.	.	.	1	.	1	1	1	1	.	.	.	r	2	III	.	r
Leucanthemum vulgare	.	.	.	.	.	.	1	.	r	.	.	.	.	.	.	r	r	II	.	.
Plantago lanceolata	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	r	r	I	.	1
Alchemilla sp.	.	.	.	r	.	.	.	.	.	.	1	.	.	.	.	r	2	II	.	.
Ranunculus acris	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	I	.	.
Stellaria graminea	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	1	I	.	.
Lathyrus pratensis	.	.	r	1	.	.	.	1	1	.	.	.	.	.	.	.	.	II	.	.
Medicago lupulina	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.	.	I	.	1
Trifolium pratense	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	I	.	r
Leontodon automnalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	1
D.s. Cl. *Vaccinio-Piceetea*																				
Luzula pilosa	.	.	.	1	r	.	.	.	.	.	.	1	1	.	.	.	.	II	1	.
Trientalis europaea	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	I	r	.
Maianthemum bifolium	.	.	.	.	.	.	.	.	.	.	.	.	1	.	r	.	.	I	.	.
Vaccinium vitis-idaea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	I	r	.
Hylocomium splendens d	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3
D.s. Cl. *Carpino-Fagetea*																				
Corylus avellana b	.	.	.	.	1	.	.	.	.	1	.	1	1	.	1	1	1	III	1	1
Hepatica nobilis	.	.	.	r	.	.	.	.	.	r	.	r	r	.	r	.	.	II	1	.
Stellaria holostea	.	.	.	.	.	.	1	1	.	.	1	r	.	.	1	1	.	II	.	.
Asarum europaeum	.	.	.	.	.	.	.	.	.	r	.	1	.	.	1	r	.	II	.	.
Viola riviniana	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	1	r	II	r	.
Acer platanoides b	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	I	2	1
Fraxinus excelsior b	1	.	r	.	.	.	.	.	.	.	.	.	1	.	.	.	.	I	.	.
Primula veris	2	.	.	r	.	.	.	.	.	.	.	.	.	.	.	r	.	I	.	.
Carex pilosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	r	I	.	.
Phyteuma spicatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	I	.	.
D.s. Cl. *Nardetea strictae*																				
Potentilla erecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	I	r	.
Veronica officinalis	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	r	I	r	.

Carex pallescens	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	r	I	.	.
D.s. Cl. *Festuco-Brometea*																				
Centaurea scabiosa	2	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Medicago falcata	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Trifolium montanum	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
D.s. Cl. *Epilobietea*																				
Aegopodium podagraria	1	.	.	.	.	.	r	.	1	1	1	3	.	.	1	r	.	III	2	.
Anthriscus sylvestris	.	.	1	.	.	.	r	1	.	1	1	1	.	1	.	.	r	III	r	.
Geum urbanum	r	.	.	.	r	r	.	.	.	.	.	r	r	1	.	.	.	II	.	r
Heracleum sphondylium s.l.	r	.	r	.	.	.	.	.	.	.	.	.	.	r	.	.	.	I	.	.
Urtica dioica	.	1	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	I	.	.
Galeopsis tetrahit	.	.	.	.	.	.	.	.	.	r	.	.	.	r	.	.	.	I	.	.
D.s. Cl. *Artemisietea*																				
Artemisia vulgaris	1	2	1	1	r	r	.	r	r	1	.	1	.	.	.	.	.	III	.	.
Elytrigia repens	1	2	1	2	1	1	.	.	2	1	1	.	.	.	1	.	.	III	.	1
Tanacetum vulgare	1	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Silene latifolia	r	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Cichorium intybus	r	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	I	.	.
Tussilago farfara	.	.	.	.	r	.	.	.	2	.	r	.	.	.	.	.	.	I	.	.
Melilotus albus	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	I	.	.
D.s. O. *Molinietalia caerulea*																				
Deschampsia caespitosa	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	1	2	II	.	1
Angelica sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	I	.	.
Other species																				
Agrostis capillaris	.	.	1	2	1	2	1	1	.	1	1	.	2	.	3	1	.	IV	.	1
Pimpinella saxifraga	1	r	r	r	r	1	.	r	.	1	.	r	.	.	1	.	r	IV	r	1
Achillea millefolium	1	r	1	1	1	1	.	.	.	r	.	r	.	.	.	r	r	III	.	1
Cirsium arvense	r	.	1	.	r	.	1	1	2	.	r	.	.	.	.	.	.	III	.	.
Quercus robur b	1	.	1	.	1	.	1	.	1	.	.	1	1	.	1	1	1	III	.	.
Quercus robur c	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	1	.	I	.	.
Medicago sativa	2	.	.	.	.	.	.	1	.	1	.	1	.	.	.	.	.	II	.	.
Rubus idaeus	.	1	.	.	r	r	.	.	.	.	.	.	.	1	.	.	.	II	.	.
Carex hirta	.	.	1	.	.	.	.	r	.	.	1	1	.	1	.	.	.	II	.	.
Equisetum sylvaticum	.	.	.	r	.	.	.	.	r	3	1	1	.	.	.	.	.	II	.	.
Ranunculus repens	.	.	.	1	1	.	.	.	.	.	1	.	.	1	.	.	.	II	.	.
Populus tremula b	.	.	.	.	1	1	1	.	.	1	.	.	1	.	1	.	.	II	.	.
Ajuga reptans	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	II	1	.
Malus domestica b	1	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	1	.
Sorbus aucuparia b	1	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	I	.	.
Silene vulgaris	.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Alnus glutinosa b	.	.	1	.	.	.	.	.	2	.	.	1	.	.	.	.	.	I	.	.
Calamagrostis epigeios	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2	.	I	.	.
Lupinus polyphyllus	.	.	.	.	1	r	.	.	.	.	.	.	.	.	.	.	.	I	.	.
Carex contigua	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	I	.	r
Bromopsis inermis	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	I	.	.
Sonchus arvensis	.	.	.	.	.	.	.	r	1	.	.	.	.	.	.	.	.	I	.	.
Rumex sanguineus	.	.	.	.	.	.	.	.	r	.	.	r	.	r	.	.	.	I	.	.
Filipendula ulmaria	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	I	.	.
Geranium palustre	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	I	.	.
Salix caprea b	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	I	.	.
Salix cinerea b	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	r	I	.	.
Dianthus barbatus	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	I	.	.
Pteridium aquilinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	I	2	.
Prunella vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	I	.	1
Platanthera bifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	I	.	.
Calamagrostis arundinacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	I	1	.

Sporadic taxa: rel. 1: *Briza media* (1), *Campanula rapunculoides* (1), *Geranium pratense* (r), *Lactuca serriola* (r), *Lonicera xylosteum* b (1), *Rosa villosa* b (1), *Silene nutans* (r); rel. 2: *Chaerophyllum aromaticum* (1), *Convolvulus arvensis* (r), *Humulus lupulus* (r); rel. 3: *Schoenodorus arundinaceus* (r), *Geranium sylvaticum* (r), *Plantago media* (r); rel. 4: *Cerastium* sp. (r), *Peucedanum oreoselinum* (r); rel. 5: *Astragalus glycyphyllus* (1), *Lamium galeobdolon* (1),

Lathyrus sylvestris (r), *Lysimachia vulgaris* (1); rel. 6: *Festuca ovina* (r); rel. 7: *Epipactis helleborine* (1); rel. 9: *Campanula patula* (r), *Galeopsis bifida* (1), *Impatiens noli-tangere* (1), *Stachys palustris* (r), *Trifolium hybridum* (r); rel. 11: *Athyrium filix-femina* (r); rel. 12: *Pulmonaria obscura* (r); rel. 13: *Anthoxanthum odoratum* (2), *Dicranum polysetum* d (1), *Orthilia secunda* (1), *Pleurozium schreberi* d (2), *Polemonium caeruleum* (r), *Viola canina* (r); rel. 14: *Eupatorium cannabinum* (r), *Moehringia trinervia* (1), *Prunus padus* b (1), *Ribes* sp. b (1), *Vaccinium myrtillus* (1); rel. 16: *Stachys officinalis* (2), *Campanula persicifolia* (1), *Selinum carvifolia* (1), *Succisa pratensis* (r); rel. 17: *Juncus conglomeratus* (r), *Nardus stricta* (1), *Ptilium crista-castrensis* d (1); rel. 18: *Chelidonium majus* (r), *Oxalis acetosella* (2); rel. 19: *Carex digitata* (1), *Melica nutans* (r), *Stellaria media* (r).

List of localities:
1 – 54°54.582' N 26°26.766' E; Minsk Region, Miadziel district, vicinities of Kanstantinava village; 15.08.2012; **2** – 54°54.432' N 26°43.811' E; Minsk Region, Miadziel district, vicinities of Narach town; 13.08.2012; **3** – 54°58.108' N 26°48.275' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **4** – 54°58.100' N 26°48.228' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **5** – 54°57.955' N 26°48.305' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **6** – 54°54.424' N 26°43.838' E; Minsk Region, Miadziel district, vicinities of Narach town; 13.08.2012; **7** – 54°54.549' N 26°26.750' E; Minsk Region, Miadziel district, vicinities of Kanstantinava village; 15.08.2012; **8** – 54°56.942' N 26°49.292' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **9** – 54°57.188' N 26°48.682' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **10** – 54°57.200' N 26°48.733' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **11** – 54°56.343' N 26°24.420' E; Minsk Region, Miadziel district, vicinities of Grumbinenty village; 15.08.2012; **12** – 54°57.914' N 26°48.297' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **13** – 54°57.866' N 26°48.315' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **14** – 54°58.155' N 26°48.349' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **15** – 54°58.167' N 26°48.350' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **16** – 54°58.125' N 26°48.340' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **17** – 54°58.188' N 26°48.438' E; Minsk Region, Miadziel district, vicinities of Chuchelitsy village; 14.08.2012; **18** – 54°54.437' N 26°43.522' E; Minsk Region, Miadziel district, vicinities of Narach town; 17.08.2012; **19** – 54°57.628' N 26°21.869' E; Minsk Region, Miadziel district, vicinities of Glublia lake; 15.08.2012

forests. Average number of species per relevé – 31.2. Diagnostic species: *Melampyrum nemorosum* (dom., opt.), *Trifolium medium* (dom., opt.).

Trifolio medii-Agrimonietum T. Müller 1962 association (Table 4, rel. 18-19): Relatively dense (total cover 80-85%) communities with significant participation of *Agrimonia eupatoria* (15-20%) and other species of the *Trifolion medii* alliance (*Trifolium medium*, *Knautia arvensis*, *Galium mollugo*, etc.). Moss layer (cover – 10%) was formed mainly by *Hylocomium splendens*. These communities were described on mesophilous margins of the nemoral spruce forests. Average number of species per relevé comprised 30.5. Diagnostic species: *Agrimonia eupatoria* (opt., dom.).

4. Discussion

The positions of thermophilous xero-mesophytic forb-fringe communities with *Geranium sanguineum* in the Baltic region are widely discussed (Westhoff *et al.* 1983; Dierssen & Dierssen 1996; Rūsiņa 2007; Dengler & Boch 2008). We described these communities close to the southern limit of hemiboreal zone. According to chorological data, some thermophilous fringe species have specific distribution patterns in the territory of Belarus (Kozlovskaya & Parfenov 1972; Kachanovskiy *et al.* 2015): such species as *Clematis recta*, *Hypericum montanum*, *Peucedanum cervaria*, *Potentilla alba*, *Pyrethrum corymbosum*, *Stachys recta*, considered as characteristic species of the *Geranion sanguinei* alliance and, partly, of the *Geranio-Trifolietum alpestris* T. Müller 1962 association, are limited in their distribution mainly to southern regions of the country. So, we could not expect these species on forest edges of hemiboreal zone, and, consequently, thermophilous fringes communities with *Geranium sanguineum* on the northern part of Belarus could not be classified as *Geranio-Trifolietum alpestris* association (confront with preliminary communication by Iakushenko & Tsvirko 2013).

In contrast, localities of some thermophilous species noticed in the phytosociological relevés on this survey (i.e. *Dracocephalum ruyschiana, Laserpitium latifolium Lathyrus pisiformis*) were concentrated mainly (but not exclusively) on highlands in the central part of the country (Kozlovskaya & Parfenov 1972; Kachanovskiy *et al.* 2015).

For *Dracocephalum ruyschiana,* in accordance with the chorological data, the Baltic fragment of the European part of the species range could be recognized: it includes South Scandinavia, North-Eastern Poland, Baltic States, and Central Belarus (Hultén & Fries 1986; Zając & Zając 2001; Yakovleva 2015). In this area, current localities of the discussed heliophilous species were mostly related to the thermophilous sites occupied by the communities of the *Trifolio-Geranietea* class or to the sparse subcontinental species-rich Scots pine forests (Bambe 2003; Patalauskaitė 2007; Adamowski & Wołkowycki 2014). We wondered, whether communities with *D. ruyschiana* from the northern Belarus belong to the association *Origano-Dracocephaletum ruyschianae* Kielland-Lund 1965, also supposed to be recorded in northern Poland (Brzeg 2005), and found that this name was rejected as invalid. These communities were merged with the association *Galio borealis-Geranietum sanguinei* Tüxen 1967 (Dengler & Boch 2008).

As for *Lathyrus pisiformis* L., only few isolated populations are known currently in Belarus, also in the

central and in the northern parts (Savchuk & Semerenko 2015). The species prefers edges and glades in the sparse species-rich Scots-pine forests on the steep slopes of moraine hills. In the same conditions, *L. pisiformis* was recorded in north-eastern Poland (Pawlikowski 2005; Herbich & Łazarski 2014), Lithuania (Čiuplys 2007), and Latvia (Bambe 2003).

Another fringe species, *Laserpitium latifolium,* was co-dominant in the described phytocoenoses on Minskaya highland. Despite the proposal to put north-European communities with *L. latifolium* into *Trifolio medii-Laserpitietum latifolii* van Gils & Gilissen 1976 association (Passarge 1979; Dengler & Boch 2008), the author supports the opinion of Diekmann (1990) and merged them with the *Galio borealis-Geranietum sanguinei* Tüxen 1967 association. Moreover, it should be admitted, the occurrence of the last association in Belarus is quite possible, taking into consideration literature data of the species distribution and its habitats (Kozlovskaya & Parfenov 1972; Chernik & Dzhus 2011; Skuratovich 2015). Thus, we suggest the described communities with significant role of *Geranium sanguineum* in the hemiboreal part of Belarus belong to the association *Galio borealis-Geranietum sanguinei* Tüxen 1967, on the southern limit of its range.

The edge communities on nutrient-poor acidophilous margins of Scots-pine forests dominated by *Melampyrum pratense* belong to the *Melampyrion pratensis* Passarge 1979 alliance. The position of communities described in this article is still unclear on the association level. In Central Europe, the *Lathyro montani-Melampyretum pratensis* Passarge 1967 association was described (Passarge 1994), later the range of this association was extended to Eastern Poland: few localities are known between the Vistula and Bug rivers (Brzeg 2005). In the study area, *Melampyrum pratense* was a common species on edges of coniferous forests, but it was hard to find another vascular plant species characteristic for these fringe communities (perhaps, because of insufficient amount of relevés in our dataset). Typical species for acidophilous forest edges, *Holcus mollis*, was spread sporadically in southern, western and central regions of the country, and occurred much rarer – in northern and eastern regions (Tretyakov *et al.* 2013). In Belarus, *Lathyrus montanus* reached the eastern limit of the range, its localities were concentrated mainly on moraine highlands in the central part of the country, and this species was absent in Narachanskaya plain (Kozlovskaya & Parfenov 1972; Semerenko & Savchuk 2015), where the analyzed relevés were sampled. On the other hand, we could assume some of the numerous species from the *Pilosella* Vaill. genus occurring in Belarus (Tikhomirov 2000) might be assigned a high fidelity threshold in acidophilous fringe communities associated with pine forests margins. Thus, the described community with *Melampyrum pratense* might be recognized further as specific geographical variant of the *Lathyro montani-Melampyretum pratensis* association.

Two stands with *Vicia cassubica* domination, according to the results of cluster analysis, were closer to *Melampyrion pratense* communities than to *Trifolion medii* communities: these 2 plots (group 3) were located within the group of the communities with *Melampyrum pratense* (group 2), but not within the group of relevés belonging to *Trifolion medii* (groups 4-6) (Fig. 2). Besides, this species is considered to be characteristic for the mesophilous *Agrimonio-Vicietum cassubicae* Passarge 1967 association, it appeared regularly in other more or less acidophilous, xero-mesotermic forest-fringe communities (Brzeg 2005). So, we suggest these stands, which were only patches limited by the coenopopulation of one dominant species, belong to the *Melampyrion pratensis* alliance due to floristic composition and ecological conditions. At the current stage of research, it is hard to determine syntaxonomical positions of these communities more precisely.

The mesophilous fringe communities of the *Trifolion medii* alliance were mentioned previously for the north-western part of Belarus, where the *Trifolietum medii* Stepanovič (1987) 1991 association was described (Scepanovich & Scepanovich 1991; Scepanovich 2000). This name should be rejected according to article 31 of the International Code of Phytosociological Nomenclature (Weber *et al.* 2000). Later, the same author used the form *Trifolietum medii* Müller 1961 em. Stepanovič (1987) 1991 (Scepanovich 2006), which should also be rejected as a homonym.

Communities of the *Trifolio-Melampyretum nemorosi* association are very common in north-western part of Belarus, and seem to be widespread in whole territory of the country. This association was mentioned for Belarus as *Stachyo-Melampyretum nemorosi* Passarge 1967 (Scepanovich 2006). We did not find significant differences within the analyzed dataset between stands dominated by *Melampyrum nemorosum* or *Trifolium medium*, so we did not support the split of such communities into 2 different associations. Taking into consideration the restricted number of relevés involved in this survey, we confined deliberately the attempts to recognize subassociations, because phytosociological materials are scarce and not sufficient for such analyses. Differentiation of this association into subassociations should be the aim of further investigation.

As the field survey was mainly concentrated on forest margins, only two phytosociological relevés of semi-synanthropic communities with significant role of *Agrimonia eupatoria* were conducted. These coenoses were classified as *Trifolio medii-Agrimonietum* T. Müller 1962 association. For better delimitation from

the previous association and precise determination of distribution patterns, wide survey of mesophilous forb-fringe vegetation on larger area is needed.

5. Conclusion

Three associations and one community from the *Trifolio-Geranietea sanguinei* T. Müller 1962 class were distinguished as a result of a short phytosociological survey on forest margins and glades in Belarus. One association, *Galio borealis-Geranietum sanguinei* Tüxen 1967, was mentioned for the first time for this area. The conducted study enriched the syntaxonomical scheme of the vegetation of Belarus, but the number of associations known from this territory is still inadequate to species pool, forest vegetation diversity and potential assemblages. We strongly believe that forest edge communities in Belarus are much more diverse, and the presented article is only a small contribution to their description and evaluation.

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