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Infraspecific taxa of *Thymus serpyllum* (Lamiaceae) growing in Lithuania

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ABSTRACT: Two subspecies of *T. serpyllum* L. (subsp. *tanaensis* and subsp. *serpyllum*) and four varieties of subsp. *serpyllum* (var. s*erpyllum*, var. *lineatus*, var. *rigidus*, var. *ericoides*) are recorded in Lithuania. In the paper the map of distribution of infraspecific taxa of *T. serpyllum* growing in Lithuania is presented. All varieties are distributed all over the territory of Lithuania, but var. *serpyllum* is mostly found. Subsp. *tanaensis* is a very rare in Lithuania. It was established, that *T. serpyllum* can grow in variable environments and phytocenologically different habitats.

KEYWORDS: *Thymus serpyllum*, habitat characteristics, infraspecific taxa, Lithuania, distribution.

Introduction

Thyme (*Thymus serpyllum* L.) belongs to a *Lamiaceae* family, it is widespread in Western and Central Europe, Scandinavia, Western and Eastern Siberia. The various forms of thyme species are founding in the natural environment (especially, *T. serpyllum, T. pulegioides* has plenty of them), having different morphological features, different chemical composition of the cumulated essential oil (MÁRTONFI 1992, LOŽIENĖ 1997, LOŽIENĖ & al. 1998). This results in difficulties for taxonomists that are trying to develop a system of this genus.

While presenting proposed system of *Thymus* genus, each taxonomist used new systemic features of thyme. BENTHAM (1832), based on the structure of calyx teeth, size and form of a bract, was the first who divided the genus into 3 sections, out of which the major section is *Serpyllum* BENTH. KERNER (1874)

used the feature of leaf nervation for the development of the genus system. VELENOVSKY (1906), by distinguishing a new diagnostic feature of the thyme species – growing direction of sterile and raceme sprouts, divided *Serpyllum* BENTH. section into 3 smaller systemic groups. LYKA (1927) suggested a distinctive system of *Thymus* genus for which they used one more diagnostic feature – heterophylium of generative sprouts. However, systems of *Thymus* genus developed by these authors differ from each other to a great extent: in one system the same generic thyme group is defined as an independent species, in another – as a subspecies or variety. This happened due to the fact that each author used new diagnostic features or more focused on one of them. In addition, they had different views towards a concept of species. Some authors, based on the typological concept of species, considered various forms, varieties, and subspecies as independent species (OPIZ 1824, KLOKOV 1954, 1973). This resulted in great increase in the number of genus species and decrease or elimination of a rank that is lower than species taxons. Other authors referred to the polytypical concept of species, based on which the species most often consists of a lot of subspecies and other taxa of lower rank. This concept is supported by LYKA (1927).

Due to the fact that the diagnostic features are not steady settled in the thyme taxonomy (or due to the difficulties to distinguish them as some features sustainable and reliable for some species are not suitable for another) and due to the different approaches of the taxonomists to the conception of species, there are a lot of thyme taxa of different rank having many nomenclatural and taxonomic synonyms, invalid names (MÁRTONFI 1997), but which describe the same natural forms.

Recently, the polytypical conception of species is widespread, therefore, the systems of *Thymus* genus developed by JALAS (1947) are more frequently used. Based on these systems a description key of infraspecific taxa of thyme growing in Lithuania was drawn up (LEKAVIČIUS & JASKONIS 1969). This key shows that there are two subspecies of *T. serpyllum* found in Lithuania – subsp. *tanaensis* (HYL.) JALAS and subsp. *serpyllum*, as well as four varieties of the latter subspecies (var. *serpyllum*, var. *lineatus* ENDL., var. *rigidus* (WIMM. & GRAB.) RONNIGER and var. *ericoides* (WIMM. & GRAB.) BECK).

Material and methods

A maps of distribution of *T. serpyllum* varieties found in Lithuania were drawn up after the review and description up to varieties samples of this species kept in Herbariums of the Institute of Botany (Vilnius, BILAS) and Vilnius University (Vilnius, WI) (in the BILAS – 101 samples, collected 1893–1980; in WI – 68, collected 1922–1977).

Distribution of *T. serpyllum* infraspecific taxa in Lithuania is mapped using grid system. Squares are arranged according to geographical coordinates with sides 6'latitude and 10' longitude (i. c. 11.2 x 10.4 km in the Northern part and

Tab. 1. Characteristic of habitats with *Thymus serpyllum.*

Habitat number	Characteristic of habitat	
	Locality	Ecological characteristic
1	Jurbarkas reg., Karšuva forest	Wood ground, arid, plane relief, lightning 70 %
2	Šilutė reg., Rambynas regional park	Border of wood, arid, wavy relief, lightning 100 %
3	Jurbarkas reg., Kalnėnai forest	Wayside, arid, plane relief, lightning 100 %
4	Jurbarkas reg., Šilinė forest	Wood ground, arid, plane relief, lightning 100 %
5	Jurbarkas reg., Šilinė forest	Wood ground, arid, wavy relief, lightning 100 %
6	Jurbarkas reg., Raudonė	Wood ground, arid, slope, incline 30°, south side, lightning 70 %
7	Jurbarkas reg., Veliuona	Slope, incline 45°, south side, meadow, lightning 100 %
8	Jurbarkas reg., Veliuona	Gentle slope, incline 15°, south side, meadow, lightning 100 %
9	Varėna reg., Margionys	Wood, wavy relief, lightning 100 %
10	Varėna reg., Darželiai	Wood, plane relief, lightning 100 %
11	Švenčionys reg., Pabradė	Meadow, arid, plane relief, lightning 100 %
12	Ignalina reg., Ignalina national park	Wayside, arid, plane relief, lightning 100 %
13	Jurbarkas reg.,confluence of rivers Armena and Nemunas	Meadow, arid, plane relief, lightning 100 %
14	Vilnius reg., Bezdonys	Wood, wavy relief, lightning 60 %
15	Vilnius reg., Bezdonys	Border of wood with destroying grass cover, arid, lightning 80%
16	Vilnius reg., Rokantiškės,	Pasturing and haying meadow, arid, plane relief, lightning 100%
17	Vilnius reg., Rokantiškės	Slope, south side, incline 30°, meadow, lightning 100%
18	Vilnius reg., Liepynė forestry	Border of wood, arid, lightning 70%
19	Vilnius reg., Balsiai	Wood-cutting area, arid, plane relief, lightning 80%
20	Varėna reg., Kibišiai	Gentle slope, incline 5°, south side, pasturing and haying meadow, arid, lightning 100%
21	Varėna reg., Kibišiai	Wood, plane relief, lightning 70%
22	Šilutė reg., Ventės Ragas	Wayside, gentle slope, incline 5°, east side, meadow, lightning 100%
23	Curonian Spit (Kuršių Nerija) peninsula (Baltic Sea coast), Juodkrantė	Sandy plain, lightning 100 %

11.2 x 11.0 km in the Southern part of Lithuania). The area of squares vary from 116.5 to 123.2 km^2. The Lithuanian territory is divided into 597 squares. Each square has a numeric code. It is compounded from latitudinal and longitudinal twodigit codes. All localities found in the same square are marked by one point (GUDŽINSKAS 1993).

23 different habitats of thyme were described in June and July of 1996–2000. Study sites are presented in Table 1. The study was made in the 16 m^2 fields of meadows, 4 m^2 of sandy soils, and 100 m^2 of forests according to the methodology of BRAUN-BLANQUET (1964). All together 23 habitats were studied. Plant associations were distinguished according to the vegetation classification systems of FUKAREK (1961), BALEVIČIENĖ (1991), POTT (1992), DIERSSEN (1996), BALEVIČIENĖ & al. (1998). Relative lightning of the habitat was defined visually. pH was measured in 1 M KCl electrometrically. Quantities of organic nitrogen (N), mobile phosphorus (P_2O_5) and humus in the soil were defined photoelectrocolorimetrically, mobile potassium (K_2O) – flame photometrically in the Chemical Analysis Sector of the Institute of Botany. Samples of soil were to taken from habitats in the depth of 10–15 cm.

Results and discussion

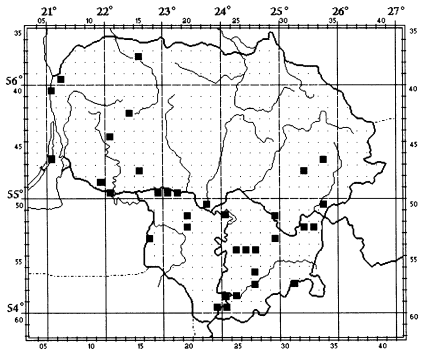
The distribution of infraspecific taxa of *T. serpyllum*

Herbarium specimens of *T. serpyllum* collected at various sites in Lithuania that are kept in herbariums of the Institute of Botany and Vilnius University were reviewed. After the description of these samples up to varieties, it was found that out of subsp. *serpyllum* var. *serpyllum* is most frequently found (56 samples). Other varieties are of the similar frequency: var. *ericoides* were 37, var. *lineatus* – 34, and var. *rigidus* – 32 samples. Only 8 herbarium samples of subsp. *tanaensis* were found. Based on this herbarium material, a distribution map of *T. serpyllum* subsp. *serpyllum* varieties and *T. serpyllum* subsp. *tanaensis* was drawn up (Fig. 1).

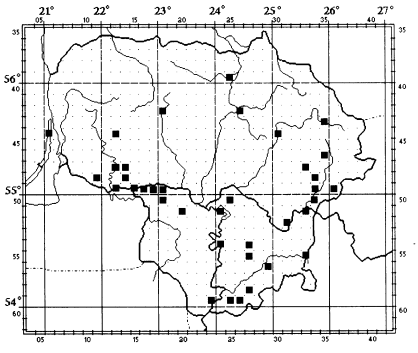
It may be seen from the map that *T. serpyllum* is mostly distributed in Southern, Southeast and Southwest Lithuania. In Northern and Middle Lithuania it is much rarer. This can be explained by the fact that in Southwest, Southeast and particularly in South Lithuania the growing conditions are favourable to this species, as there are more sands, dry meadows and forests.

Var. *serpyllum* is the most frequently found and widespread throughout the territory of Lithuania (LEKAVIČIUS & JASKONIS 1967, LEKAVIČIUS 1976). Fig. 1 shows that this variety is widespread in the entire Lithuania.

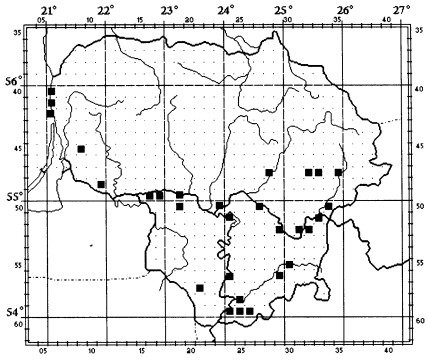
Both aforementioned information sources state that var. *lineatus* is rare and was found only in two regions. Fig. 1 shows that this variety is distributed not only in Southwest, but also in South and Southeast Lithuania, also it was found in some northern regions of Lithuania.



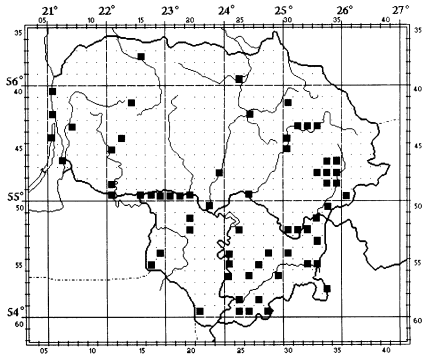
T. serpyllum ssp. serpyllum var. ericoides



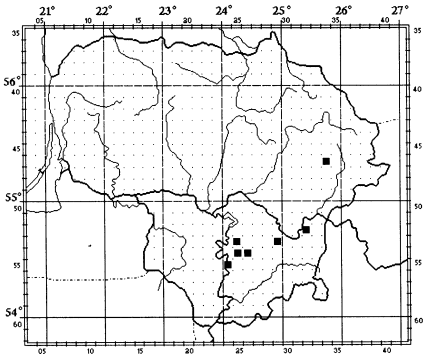
T. serpyllum ssp. serpyllum var. lineatus



T. serpyllum ssp. serpyllum var. rigidus



T. serpyllum ssp. serpyllum var. serpyllum



T. serpyllum ssp. tanaensis

Fig. 1. Maps of spreading of *T. serpyllum* L. subsp. *tanaensis* and varieties of *Thymus serpyllum* L. subsp. *serpyllum* in Lithuania (the map had drawn up according to specimens, which deposited in Vilnius University and Institute of Botany).

LEKAVIČIUS (1976) states that var. *ericoides* and var. *rigidus* are quite rare varieties of *T. serpyllum.* LEKAVIČIUS & JASKONIS (1967) point out that var. *ericoides* and var. *rigidus* is found in Southeast Lithuania. Fig. 1 shows that var. *ericoides* and var. *rigidus* is distributed throughout the entire territory of Lithuania. Var. *rigidus* was not found only in northern regions of Lithuania.

Subsp. *serpyllum* is widespread from South-East of France and West of Austria throughout the entire Central Europe to the Eastern Ukraine and south of Scandinavian Peninsula; while spreading area of subsp. *tanaensis* is much narrower – it is spread in Scandinavian Peninsula (in Sweden, south and middle Norway) (JALAS 1947). Based on the information sources JALAS (1947) indicates that starting from Scandinavian Peninsula towards North East Europe this subspecies is also found, however, much rarer, though it was found even in Siberia (Yenisei basin area). Eight subsp. *tanaensis* herbarium specimens were found. Its localities are in southern and south-eastern parts of Lithuania, and was not found in northern, western and south-western regions of Lithuania).

In order to summarise, it may be stated that var. *serpyllum* is the most frequent and widespread throughout Lithuania varieties. Var. *lineatus,* var. *rigidus* and var. *ericoidus* are spread with the same frequency. Var. *lineatus* and var. *ericoides* are spread throughout the entire territory of Lithuania (earlier sources indicate a distributed that is significantly narrower), samples of var. *rigidus* were not found only in northern part of Lithuania. Subsp. *tanaensis* is a very rare Lithuanian subspecies, found only in south and south-east Lithuania.

As it may be seen, it is not possible to distinguish some areas in Lithuania in which only one of these varieties would be found and other varieties would not grow there at all. Therefore, attempts were made to investigate whether different *T. serpyllum* varieties grow in ecologically and phytocenologicaly different habitats.

The characteristic of *T. serpyllum* habitats

All 23 studied habitats of *T. serpyllum* differ by their environmental conditions (Tab. 1). 17 habitats are in meadows and forests of plane and wavy landscape, 6 habitats are in slope meadows with incline from 5^{o} to 45^{o}. Five slopes are of southern exposure, one – of eastern exposure. Most habitats have good lightning (90–100%), only seven have a lower one (60–80%). Quantitative chemical indicators of nourishment elements of the habitat soil differ. The information sources indicate that this plant likes soil of medium acidity (ELLENBERG 1991) or neutral soil (SIMON 1992). MÁRTONFI (1996) investigated soil of habitat of *T. serpyllum* in Slovakia (territory of the Carpathians) and found out that this species likes the soil reaction from 3.8 to 5.63. Meanwhile, the soil reaction of the *T. serpyllum* habitats studied in Lithuania varies from very acid to alkaline (pH 4.1–7.5) (Tab. 2). Tab. 2 also shows quantities of some soil chemical elements (N, P, K) and humus in the studied habitats. Their quantities in different habitats differ significantly. This may be seen from high variation coefficients (Tab. 2).

Tab. 2. Soil characteristic of *Thymus serpyllum* habitats (n=23).

	N %	P_2O_5 [mg.kg^{-1}]	K_2O [mg.kg^{-1}]	Humus %	pH_{KCl}
Minimum	0,05	47	18	1,7	4,1
Maximum	0,34	284	152	7,2	7,5
Average	0,15	161,23	58,55	3,85	5,85
Coeff. of variation (%)	55,16	49,12	64,57	43,49	17,86

11 described habitats of *T. serpyllum* were assigned to 6 plan associations (belonging to 5 vegetation classes) (Tab. 3 and 4).

The information sources also indicate that *T. serpyllum* is very frequent and abundant in *Vaccinio-Piceetea* and *Koelerio-Corynephoretea* classes of vegetation (SCHMIDT 1969). In the rest 12 habitats the plant associations were not found.

T. serpyllum grows in very different ecotopes: forests, meadows, sands, as well as in a very specific ecotope – in sandy plain of seaside (habitat 23). Habitats of this species differ by both environmental conditions and composition of associations.

Tab. 3. Phytocenological description of plant communities of *Koelerio-Corynephoretea*, *Molinio-Arrhenatheretea, Trifolio-Geranietea sanguinei, Festuco-Brometea erecti* class and no formed associations with *Thymus serpyllum (*associations: *Helichryso-Jasionetum* (23), *Pulsatillo-Phleetum phleoidis* (8), *Festucetum pratensis* (16, 17)*, Geranio-Trifolietum alpestris* (5), no formed associations (3, 7, 11, 13, 20, 22).

Habitat number	23	8	16	17	11	5	7	20	22	3	13
Date	97 08 03	00 07 05	96 06 21	96 08 02	00 07 27	00 07 05	00 07 05	96 07 10	97 07 24	00 07 04	00 07 05
Coverage (%):											
herb layer	60	80	90	90	50	60	90	90	70	50	80
bryophyte layer	20	40	10	10	50	30	50	30	20	50	30
lichen layer	10	-	-	-	10	-	-	-	-	-	-
Number of species in record	10	16	19	11	20	30	24	15	8	11	8
Ch.,D. ass.											
Cladonia mitis Ch	+	.	.	.	.	.	.	.	.	.	.
Helichrysun arenarium Ch	+	.	.	.	.	.	.	.	.	.	.
Phleum phleoides Ch	.	+	.	.	.	+	+	.	.	+	.
Potentilla argentea Ch	.	2	.	.	+	.	1	.	.	2	.
Prunella grandiflora Ch	.	.	.	.	.	+	.	.	.	.	.
Rumex acetosa D	.	+	1	+	+	+	.	+	+	.	.
Ch. All. *Arrhenatherion*											
Geranium pratense	.	.	+	.	.	.	.	.	.	.	.

Habitat number	23	8	16	17	11	5	7	20	22	3	13
Tragopogon pratensis	.	.	+	+	.	.	+	.	.	.	.
Ch. O. *Arrhenatheretalia*											
Dactylis glomerata	.	.	1	.	.	+	+	.	.	.	2
Gallium mollugo	.	.	+	.	.	.	.	.	.	.	.
Ch. Cl. *Molinio-Arrhenatheretea*											
Centaurea jacea	.	.	+	.	.	.	.	.	.	.	.
Festuca pratensis	.	.	2	1	.	.	.	.	.	.	.
Phleum pratensis	.	.	2	+	.	.	+	.	.	.	.
Plantago lanceolata	.	.	+	+	.	.	.	.	.	+	.
Vicia craca	.	.	2	2	.	.	.	.	.	.	.
Ch. All. *Geranion sanguinei*											
Fragaria viridis	.	+	.	.	.	.	+	.	.	.	.
Ch. O. *Origanetalia*											
Ch. Cl. *Trifolio-Geranietea*											
Hypericum perforatum	.	.	.	.	.	+	.	.	.	.	+
Origanum vulgare	.	.	.	.	.	2	1	.	.	.	.
Silene nutans	.	.	.	.	.	+	+	.	.	.	.
Ch. All. *Koelerion glaucae*											
Festuca polesica	1	.	.	.	.	.	.	.	.	.	.
Koeleria glauca	+	.	.	.	.	.	.	.	.	.	.
Ch. O. *Corynephoretalia*											
Carex arenaria	1	.	.	.	.	.	.	.	.	.	.
Corynephorus canescens	1	.	.	.	1	+	.	.	.	.	.
Thymus serpyllum	1	+	2	1	+	+	+	3	1	3	2
Trifolium arvense	+	+	.	.	+	.	.	.	.	+	.
Ch. Cl. *Koelerio-Corynephoretea*											
Jasione montana	+	.	.	.	+	.	.	.	.	.	.
Sedum acre	+	.	.	.	.	1	.	+	.	1	+
Ch. O. *Brometalia*											
Ch. Cl. *Festuco-Brometea*											
Anthyllis vulneraria	.	+	.	.	.	.	+	.	.	.	.
Centaurea scabiosa	.	+	.	.	+	+	.	.	.	.	.
Medicago falcata	.	+	.	.	.	+	.	+	.	.	.
Ranunculus bulbosus	.	+	.	.	.	.	.	1	.	.	.
Veronica spicata	.	+	.	.	.	1	.	.	.	.	.
Ch. Cl. *Nardetea strictae*											
Thymus pulegioides	.	.	+	.	.	.	.	.	.	.	.
Accompanying											
Achillea millefolium	.	+	+	+	.	+	.	1	2	.	.
Agrimonia eupatoria	.	.	.	.	.	.	+	.	.	.	.
Agrimonia eupatoria	.	.	.	.	.	.	+	.	.	.	.
Agrostis tenuis	.	.	.	.	.	1	.	.	.	.	.
Allium oleraceum	.	+	.	.	.	.	.	.	.	.	.
Artemisia campestris	+	.	.	.	1	+	.	.	.	+	2
Artemisia vulgaris	.	.	.	+	.	.	.	.	.	.	.
Berteroa incana	.	.	.	.	+	+	.	.	+	.	.
Briza media	.	.	.	.	.	.	+	.	.	.	.
Calamagrostis epigejos	.	.	.	.	.	1	.	.	.	.	.

Habitat number *	23	8	16	17	11	5	7	20	22	3	13
Carex hirta	.	1	.	.	.	.	.	.	.	.	.
Chamomilla suaveolens	.	.	.	.	.	.	+	.	.	.	.
Cladonia sylvatica	.	.	.	.	+	.	.	.	.	.	.
Convolvulus arvensis	.	.	.	.	.	.	+	.	.	.	.
Daucus carota	.	.	.	.	.	.	+	.	.	.	.
Dianthus deltoides	.	.	+	.	+	.	.	.	.	.	.
Echium vulgare	.	.	.	.	.	.	+	.	.	.	.
Elytrigia repens	.	.	.	2	+	.	.	.	.	.	.
Equisetum arvense	.	.	.	.	.	.	.	.	.	.	+
Erigeron acris	.	+	.	.	+	.	.	.	.	.	.
Euphrasia stricta	.	.	.	+	.	.	.	.	.	.	.
Festuca ovina	.	.	.	.	+	.	.	.	.	.	.
Festuca pratensis	.	.	.	.	.	.	+	.	.	.	.
Festuca rubra	.	.	.	.	.	+	.	.	.	.	1
Fragaria vesca	.	.	2	.	.	.	.	.	.	.	.
Galium album	.	+	.	.	.	.	.	.	1	+	.
Galium verum	.	2	.	.	.	+	+	+	.	2	.
Hieracium pilosella	.	.	2	3	+	.	.	2	.	+	.
Hieracium umbelatum	1	1	.	.	.	1	1	.	.	.	.
Knautia arvensis	.	.	+	1	.	.	+	.	+	+	.
Leontodon hispidus	.	.	.	.	.	.	+	.	.	.	.
Leucanthemum vulgare	.	.	.	.	.	+	.	.	.	.	.
Linaria vulgaris	.	.	.	.	.	+	.	.	.	.	.
Melampyrum nemorosum	+	.	.	.	.	.	.	.	.	.	.
Myosotis stricta	.	.	.	.	.	.	.	.	.	.	+
Oenothera biennis	.	.	.	.	.	+	.	.	.	.	.
Pimpinella saxifraga	.	.	.	.	.	+	.	.	.	.	.
Pinus sylvestris	+	.	.	.	.	.	.	.	.	.	.
Plantago indica	.	.	.	.	+	.	.	2	.	.	.
Poa angustifolia	.	.	.	.	.	+	.	1	.	.	.
Poa pratensis	.	.	.	.	.	.	2	.	.	.	.
Potentilla arenaria	.	.	.	.	.	.	.	.	+	.	.
Potentilla repens	.	.	.	.	.	+	.	.	.	.	.
Prunella vulgaris	.	.	.	.	.	.	.	1	.	.	.
Ranunculus acris	.	.	.	.	.	+	.	.	.	.	.
Rumex acetosella	.	.	.	.	+	.	.	1	.	.	.
Silene cucubalis	.	.	.	.	.	+	.	.	.	.	.
Silene viscosa	.	.	.	.	.	+	.	.	.	.	.
Stellaria graminea	.	.	+	.	+	.	.	+	.	.	.
Tanacetum vulgare	.	.	.	.	.	+	.	.	.	.	.
Taraxacum officinale	.	.	.	+	+	.	.	.	.	.	.
Trifolium hybridum	.	.	+	.	.	.	.	.	.	.	.
Trifolium repens	.	.	1	2	.	.	.	+	.	.	.
Veronica chamaedrys	.	.	2	.	.	.	.	+	.	.	.
Veronica officinalis	.	.	.	.	.	.	.	.	+	.	.
Viola litoralis	+	.	.	.	.	.	.	.	.	.	.

* numbers of habitats as in Tab. 1

Tab. 4. Phytocenological description of plant communities of *Vaccinio-Piceetea* class and no formed associations with *Thymus serpyllum* (associations: *Cladonio-Pinetum* (14, 10, 15, 2), *Leucobryo-Pinetum* (21, 9), no formed associations (1, 6, 12, 18, 4, 19).

Habitat number	14	21	9	10	1	6	15	12	18	4	19	2
Date	96 05 20	96 07 10	00 07 24	00 07 24	00 07 04	00 07 05	96 05 20	00 07 27	96 08 07	00 07 05	00 07 16	00 07 04
Coverage (%):												
herb layer	20	40	50	50	95	20	40	60	80	40	60	50
bryophyte layer	80	90	90	40	60	90	50	50	20	10	80	50
lichen layer	-	-	-	50	-	-	30	-	-	-	-	50
tree layer	20	30	20	-	20	-	5	-	60	-	40	10
Number of species in record	23	19	24	26	28	19	29	14	9	18	23	14
Ch.,D. ass.												
Carex ericetorum Ch	.	.	.	.	.	.	+	.	.	.	.	.
Cladonia gracilis D	1	.	.	.	.	.	.	.	.	.	.	1
Cladonia mitis D	1	.	.	1	.	.	+	.	.	.	.	+
Cladonia rangiferina D	1	.	.	+	.	.	1	.	.	.	.	.
Hypnum cupressiforme D	.	2	2	.	.	.	.	.	.	.	.	.
Leucobryum glaucum D	.	1	+	.	.	.	.	.	.	.	.	.
Peucedanum oreoselinum Ch	.	+	.	.	.	.	.	.	.	.	.	.
Ch. All. *Dicrano-Pinion*												
Ch. O. *Vaccinio-Pinetalia*												
Pinus sylvestris	1	+	+	.	+	.	.	.	.	.	.	+
Juniperus communis	+	2	+	.	.	.	+	.	.	.	.	.
Ch. Cl. *Vaccinio-Piceetae*												
Calluna vulgaris	2	.	.	.	+	.	+	.	.	.	1	.
Dicranum polysetum	2	.	2	.	.	.	+	.	.	.	.	.
Hylocomium splendens	.	+	.	+	.	.	1	.	.	.	1	+
Melampyrum pratense	+	+	+	.	.	.	+	.	.	+	.	.
Pleurozium schreberi	3	.	.	.	.	.	1	.	.	.	+	+
Pyrola rotundifolia	+	+	.	.	.	.	.	.	.	.	.	.
Ch. O. *Arrhenatheretalia*												
Dactylis glomerata	.	.	.	.	+	.	.	.	.	.	2	.
Ch. Cl. *Molinio-Arrhenatheretea*												
Centaurea jacea	.	.	.	.	+	+	.	.	.	+	+	.
Plantago lanceolata	.	.	.	.	+	.	.	+	.	.	.	.
Ranunculus acris	.	.	.	+	.	.	.	.	.	.	.	.
Vicia craca	.	.	.	.	.	.	.	.	.	.	+	.
Ch. O. *Corynephoretalia*												
Corynephorus canescens	.	.	+	+	.	+	+	.	.	+	.	3
Thymus serpyllum	2	+	2	+	+	+	3	+	2	+	1	2
Trifolium arvense	.	.	.	+	.	.	.	1	.	.	.	.
Ch. Cl. *Koelerio-Corynephoretea*												
Jasione montana	.	.	.	.	.	+	.	.	.	+	.	.

Habitat number	14	21	9	10	1	6	15	12	18	4	19	2
Sedum acre	.	.	.	.	.	.	+	.	.	+	.	+
Ch. Cl. *Festuco-Brometea*												
Potentilla argentea	.	.	+	.	.	2	.	+	.	+	.	.
Ranunculus bulbosus	.	.	.	.	+	.	.	.	.	.	.	.
Veronica spicata	.	.	.	.	.	.	.	+	.	.	.	.
Ch. Cl. *Nardetea strictae*												
Potentilla erecta	.	.	.	.	.	.	+	.	.	.	.	.
Thymus pulegioides	.	.	.	.	.	.	.	.	.	.	+	.
Ch. Cl. *Trifolio-Geranietea*												
Hypericum perforatum	+	.	+	.	2	+	+	.	.	.	+	.
Accompanying												
Achillea millefolium	+	2	+	+	1	+	+	.	2	.	1	+
Agrostis tenuis	.	.	+	+	.	.	.	.	.	.	+	.
Alchemilla sp.	.	.	.	.	.	.	.	.	.	1	.	+
Alyssum montanum	.	.	.	+	.	.	.	.	.	.	.	.
Anchusa officinalis	.	.	.	+	.	.	.	.	.	.	.	.
Anthennaria dioica	+	.	.	.	.	.	.	.	.	.	.	.
Artemisia campestris	.	.	+	+	+	+	1	+	.	.	.	+
Artemisia vulgaris	.	.	.	.	.	.	.	.	+	.	+	.
Astragalus arenarius	.	.	.	+	.	.	.	.	.	.	.	.
Berteroa incana	.	.	+	.	.	+	.	.	.	+	.	.
Betula pendula	.	+	.	.	+	.	.	.	.	.	+	.
Briza media	.	.	.	.	+	.	.	.	.	.	.	.
Calamagrostis epigejos	.	.	.	.	.	.	.	.	.	+	.	.
Campanula patula	.	.	.	.	+	.	.	.	.	.	.	.
Cetraria islandica	+	.	.	.	.	.	+	.	.	.	.	.
Chamomilla suaveolens	.	.	.	.	.	.	.	.	.	.	+	.
Convallaria majalis	+	.	.	.	.	.	.	.	.	.	.	.
Convolvulus arvensis	.	.	.	.	.	.	.	.	1	.	.	.
Daucus carota	.	.	.	.	.	.	.	+	.	.	.	.
Dianthus deltoides	.	.	.	.	+	.	.	.	.	.	.	.
Elytrigia repens	.	.	.	.	+	.	.	+	3	.	.	.
Equisetum arvense	.	.	.	+	.	.	.	.	.	.	.	.
Equisetum hyemale	.	.	.	.	.	.	.	.	2	.	.	.
Erigeron acris	.	.	.	.	+	.	.	.	.	.	.	.
Erigeron annuus	.	.	.	.	.	.	.	.	.	+	.	.
Erophila verna	.	.	.	.	.	.	+	.	.	.	.	.
Festuca ovina	2	+	+	+	.	.	3	.	.	1	.	.
Festuca polesica	.	.	+	.	.	.	.	.	.	.	.	.
Festuca rubra	.	.	.	.	+	.	.	.	.	.	.	.
Fragaria vesca	+	3	.	.	3	.	.	.	.	.	2	.
Galium album	.	.	.	.	+	.	.	+	.	.	+	.
Galium verum	.	.	.	.	.	.	.	+	.	+	.	+
Helianthemum nummularium	.	.	.	.	.	.	+	.	.	.	.	.
Helichrysum arenarium	.	.	+	1	.	.	+	.	.	.	.	.
Heracleum sibiricum	.	.	.	.	+	.	.	.	.	.	.	.
Hieracium pilosella	4	1	1	2	.	1	2	.	.	+	.	.
Knautia arvensis	.	.	+	+	.	.	.	+	.	.	.	.

Habitat number*	14	21	9	10	1	6	15	12	18	4	19	2
Koeleria glauca	.	.	+	.	.	.	.	.	.	.	.	.
Linaria vulgaris	.	+	.	.	.	.	.	.	.	.	.	.
Lotus corniculatus	.	.	.	.	.	.	.	.	.	+	.	.
Lupinus polyphyllus	.	.	+	.	.	.	2	.	.	.	+	.
Medicago lupulina	.	.	.	.	+	.	.	.	.	.	.	.
Melampyrum nemorosum	+	.	.	.	.	.	.	.	.	.	.	.
Oenothera biennis	.	.	+	.	+	.	+	.	.	+	.	.
Phleum phleoides	.	.	.	.	.	1	.	.	.	.	.	.
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	+	.
Plantago media	.	.	.	.	+	.	.	.	.	.	.	.
Poa angustifolia	.	.	.	.	.	.	.	+	.	.	.	.
Polygala vulgaris	.	.	.	.	+	.	.	.	.	.	.	.
Polygonatum odoratum	+	.	.	.	.	.	+	.	.	.	.	.
Polytrichum splandus	.	.	.	+	.	.	+	.	.	.	1	.
Populus tremula	.	.	.	.	.	.	.	.	.	.	+	.
Potentilla arenaria	.	.	.	+	.	.	.	.	.	.	.	.
Pulsatilla pratensis	.	.	.	+	.	.	.	.	.	.	.	.
Quercus robur	.	.	.	.	.	.	+	.	.	.	.	+
Rabidopsis taliana	.	.	.	.	.	.	+	.	.	.	.	.
Rubus ideaus	.	.	.	.	.	.	.	.	.	.	+	.
Rumex acetosella	.	+	+	+	.	.	+	.	.	.	.	.
Scabiosa ochroleuca	.	.	.	.	.	+	.	.	.	.	.	.
Scleranthus annua	.	.	.	+	.	.	.	.	.	.	.	.
Silene alba	.	.	+	.	+	+	.	+	.	.	.	.
Silene pratense	.	+	.	.	.	.	.	.	.	.	.	.
Silene viscosa	.	.	.	.	.	+	.	.	.	+	.	.
Solidago virgaurea	.	.	.	.	.	+	.	.	.	.	.	.
Sorbus aucuparia	.	.	.	.	.	.	.	.	.	.	+	.
Stellaria graminea	.	.	.	+	.	.	.	.	.	.	+	.
Taraxacum officinale	+	.	.	.	+	+	.	.	1	+	+	.
Trifolium hybridum	.	.	.	.	.	.	.	.	+	.	.	.
Trifolium repens	.	.	.	.	+	.	.	.	+	.	.	.
Verbascum nigrum	.	.	.	.	.	+	.	.	.	.	.	.
Veronica officinalis	.	+	.	.	.	.	.	.	.	.	+	.
Vicia tetrasperma	.	.	.	.	.	+	.	.	.	.	.	.
Vincetoxicum hirundinaria	.	.	.	+	.	.	.	.	.	.	.	.
Viola arvensis	.	.	.	.	+	+	.	.	.	.	+	.
Viola canina	.	+	.	.	.	.	.	.	.	.	.	.
Viola rupestris	+	.	.	.	.	.	.	.	.	.	.	.

* numbers of habitats as in Table 1

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