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Phytosociological study of the forest vegetation of Kyiv urban area (Ukraine)

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Key words: forest vegetation, syntaxonomy, DRSA algorithm, classification of vegetation, Kyiv, Central Ukraine.

Ključne besede: gozdna vegetacija, sintaksonomija, DRSA algoritem, klasifikacija vegetacije, Kijev, osrednja Ukrajina.

Abstract

The study presents a floristic-sociological classification of the forest vegetation of Kyiv urban area. We identified 18 syntaxa within 7 classes, 7 orders, 8 alliances, and 3 new associations were allocated (*Aristolochio clematitis-Populetum nigrae*, *Galio aparines-Aceretum negundi*, *Dryopterido carthusianae-Pinetum sylvestris*). We analyzed vegetation data using quantitative approaches of ordination and phytoindication. Considering many relevés of transitional nature in the collected data on urban forests, the clustering algorithm of DRSA (Distance-Ranked Sorting Algorithm) was applied to classify vegetation matrix. Large-scale comparative floristic analysis of syntaxa from different regions and countries have been conducted and summarized in differentiating tables.

Izvleček

Raziskava predstavlja floristično-sociološko klasifikacijo gozdne vegetacije na urbanem območju Kijeva. Ugotovili smo 18 sintaksonov, ki jih uvrščamo v 7 razredov, 7 redov, 8 zvez in tri nove asociacije (*Aristolochio clematitis-Populetum nigrae*, *Galio aparines-Aceretum negundi*, *Dryopterido carthusianae-Pinetum sylvestris*). Vegetacijske podatke smo analizirali s kvantitativnim pristopom z ordinacijo in fitoindikacijo. Zaradi številnih popisov prehodnih tipov, narejenih v urbanih gozdovih, smo za klasifikacijo vegetacijske matrike uporabili klastrski algoritem DRSA (Distance-Ranked Sorting Algorithm). V primerjalnih tabelah smo predstavili primerjalno floristično analizo sintaksonov iz različnih območij in držav.

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Introduction

The forest vegetation of Kyiv urban area consists of three types: semi-natural forests that are remnants of the Dnieper prehistoric forested area, artificial plantations and spontaneous forest vegetation alternating each other on many sites. Kyiv region is located near the border of two natural zones – Forest and Forest-Steppe. Specific location determines the diversity of habitats. Climate of this region is warm-summer humid continental. The northern and eastern parts are covered with pine and mixed (oak-pine) forests. Broadleaved (oak-hornbeam) forests are mainly concentrated in the southern and western parts of the region. Riparian (poplar and alder) forests mainly develop in the floodplain of the Dnieper River.

Until the 80s, vegetation was studied in Ukraine using the dominant classification approach, which led to the impossibility of comparing classification schemes with the western ones, where the Braun-Blanquet approach was used. Currently, the knowledge on forest vegetation according to this approach remains incomplete. Early publications (Povarnitsyn & Shendrikov 1957, Lyubchenko 1983, Lyubchenko & Padun 1985, Padun 1985a, Padun 1985b) are of historical importance because of the dominant classification approach used in them and since the vegetation in Kyiv urban area had greatly changed from that time especially in recent decades due to the growth of the capital's population. There are recent publications (Didukh & Chumak 1992, Lyubchenko & Vyrchenko 2007, Yakubenko & Grigora 2007, Onyshchenko 2011, Onyshchenko 2013a, Onyshchenko 2013b, Kozyr 2013), but the synthesis of this data is still necessary.

In this study, we aim to provide a vegetation classification and phytosociological characterization of the main types of forest vegetation of Kyiv urban area, including semi-natural and anthropogenous forests. We will also search for environmental drivers that influence the differentiation of studied vegetation using the phytoindication method. It will be shown that the syntaxa differ significantly in the shares of species of different classes of vegetation and their phytosociological structure will be evaluated and involved to establish the specificity of the floristic composition of syntaxa and assess the degree of their anthropogenic transformation in urban conditions.

Material and methods

The present study is based on the relevé data (832 relevés) collected by the authors from 2013 to 2016 in Kyiv and suburbs. Vegetation was sampled using 100 m^2 plots. Turboveg software (Hennekens & Schaminée 2001) was used to store and manage relevé data. Species taxonomy was unified in accordance with the Ukrainian checklist (Mosyakin & Fedoronchuk 1999) and with some corrections regarding the latest data from online taxonomic resources (http://www.catalogueoflife.org, http://www.theplantlist.org).

Vegetation classification was conducted in two steps. Firstly, the relevé dataset was classified using the DRSA algorithm (Goncharenko 2015). It is non-parametric and robust due to ranked distances and belongs to a family of the k-nearest neighbor's approaches (Cover & Hart 1967). Secondly, species were classified and sorted by their fidelities (Bruelheide 2000, Chytrý & Tichý 2003). Fidelities were calculated using the Ochiai index (De Cáceres et al. 2008) and 50% threshold was chosen for differential species. Syntaxa were considered and identified regarding different sources of reliable syntaxonomical information (Schubert et al. 2001, Matuszkiewicz 2007, Jarolimek & Sibik 2008, Onyshchenko 2009, Chytrý et al. 2013, Mucina et al. 2016). Syntaxonomic nomenclature follows the Code of Phytosociological Nomenclature (ICPN), 3rd edition (Weber et al. 2000).

Synoptic table with species constancies is provided in Table 1 and the reordered relevé matrix (Table S1) is placed in the electronic supplement of the article.

We applied DCA ordination (Hill & Gauch 1980), as this method is advisable in the case of high heterogeneity of the data (Leps & Smilauer 2003). Ordination were performed using R software (https://cran.r-project.org) with the *decorana* function from the *vegan* package (Oksanen et al. 2018). To understand the nature of the axes of unconstrained ordination in terms of environmental factors, we added 10 supplementary (passive) phytoindicational variables. For eight of them, we chose the Didukh's ecological scales (Didukh 2011). To assess anthropogenic impact, we also applied the hemeroby (Frank & Klotz 1990) and the naturalness (Borhidi 1995) scales. Phytoindicational scores were calculated for each relevé as weighted averages regarding species abundances. These data were involved in the assessment of the correlation with the axes of the unconstrained ordination, and were also aggregated to obtain the ecological characteristics of syntaxa taking into account the relevé-to-cluster membership.

Results and discussion

Given the analyzed relevé dataset on forest vegetation of Kyiv urban area, we identified 18 syntaxa within 7 classes, 7 orders, 8 alliances, and 18 syntaxa including associations and subordinate units. The numbers in the syntaxonomic scheme correspond to the numbers also used in the tables and figures further in the text.

Syntaxonomic scheme of vegetation

SALICETEA PURPUREAE **Moor 1958** (syn. *Salici purpureae-Populetea nigrae* Rivas-Mart. et Cantó ex Rivas-Mart. et al. 1991)
Salicetalia purpureae Moor 1958
Salicion albae Soó 1951 (syn. *Populion albae* Tx. 1931, *Populion nigrae* Schnitzler 1988)
1. *Aristolochio clematitis-Populetum nigrae* ass. nov. hoc loco (*Salici albae-Populetum nigrae* sensu auct. Ukr. non (Tx. 1931) Meyer-Drees 1936)

ROBINIETEA **Jurko ex Hadač et Sofron 1980**
Chelidonio-Robinietalia Jurko ex Hadač et Sofron 1980
Aegopodio podagrariae-Sambucion nigrae Chytrý 2013 (*Chelidonio-Acerion negundi* L. et A. Ishbirdin 1989 nom. inval., ICPN, art. 1)
Galio aparines-Aceretum negundi ass. nov. hoc loco (*Chelidonio-Aceretum negundi* Ishbirdina et Ishbirdin 1989 nom. inval., ICPN, art. 1)
2. *Galio aparines-Aceretum negundi* var. *Aristolochia clematitis*
3. *Galio aparines-Aceretum negundi typicum*

Chelidonio majoris-Robinion pseudoacaciae Hadač et Sofron ex Vítková in Chytrý 2013
Balloto nigrae-Robinietum pseudoacaciae Jurko 1963
4. *Balloto nigrae-Robinietum* var. *Acer tataricum*
5. *Balloto nigrae-Robinietum typicum*

ALNO GLUTINOSAE-POPULETEA ALBAE **P. Fukarek et Fabijanić 1968**
Alno-Fraxinetalia excelsioris Passarge 1968
Alnion incanae Pawłowski et al. 1928 (syn. *Alno-Ulmion minoris* Br.-Bl. et Tx. 1943, *Alno-Padion* Knapp 1942)
6. *Carici remotae-Fraxinetum excelsioris* Koch ex Faber 1936

CARPINO-FAGETEA SYLVATICAE **Jakucs ex Passarge 1968** (syn. *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937)
Carpinetalia betuli P. Fukarek 1968 (*Fagetalia sylvaticae* sensu auct. Ukr.)
Carpinion betuli Issler 1931
Galeobdoloni luteae-Carpinetum betuli Shevchyk, Bakalyna et V. Solomakha 1996
7. *Galeobdoloni-Carpinetum* var. *Acer campestre*
8. *Galeobdoloni-Carpinetum* var. *Prunus avium*
9. *Galeobdoloni-Carpinetum* var. *Mercurialis perennis*
10. *Galeobdoloni-Carpinetum* var. *Carex pilosa*
11. *Galeobdoloni-Carpinetum* typicum

Galeobdoloni luteae-Carpinetum betuli subass. *impatientosum parviflorae* Goncharenko, Ignatjuk et Shelyag-Sosonko 2013
12. com. *Acer platanoides+Lapsana communis*

QUERCETEA ROBORI-PETRAEAE **Br.-Bl. et Tx. ex Oberd. 1957**
Quercetalia roboris R. Tx. 1931
Vaccinio myrtilli-Quercion roboris Bulokhov et Solomeshch 2003
Dryopterido carthusianae-Pinetum sylvestris ass. nov. hoc loco (*Pteridio-Pinetum sylvestris* Andrienko 1986 nom. invalid., ICPN, art. 2b, 5)
13. *Dryopterido-Pinetum sylvestris* var. *Cardamine impatiens*
14. *Dryopterido-Pinetum sylvestris* var. *Fragaria vesca*
15. *Dryopterido-Pinetum sylvestris* var. *Carex ericetorum*
16. *Dryopterido-Pinetum sylvestris typicum*

VACCINIO-PICEETEA **Br.-Bl. in Br.-Bl. et al. 1939**
Pinetalia sylvestris Oberd. 1957
Dicrano-Pinion (Libbert 1932) Matuszkiewicz 1962 nom. cons. propos. (syn. *Pino-Quercion* Medwecka-Kornaś et al. in Szafer 1959)
17. *Chamaecytiso zingeri-Pinetum sylvestris* Vorobyov, Balaschov et V. Solomakha 1997

QUERCETEA PUBESCENTIS **Doing-Kraft ex Scamoni et Passarge 1959**
Quercetalia pubescenti-petraeae Klika 1933
Convallario majalis-Quercion roboris Shevchyk et V. Solomakha 1996
18. *Polygonato odorati-Quercetum roboris* (Shevchyk et V. Solomakha 1996) Goncharenko et Yatsenko nom. nov. hoc loco (*Convallario majalis-Quercetum roboris* sensu Shevchyk et V. Solomakha 1996, ICPN, art. 31)

Numerical analysis of phytocoenotic clusters

Figure 1 shows the tree diagram of cluster analysis of the studied forest syntaxa taking into account species constancies in the columns of the synoptic table. Numerical study of the syntaxa was fulfilled using the flexible-beta algorithm with beta = −0.25 (Lance & Williams 1966).

There are apparently 6 groups (Figure 1, gray-painted groups). The first group consists of the only cluster #1 of the riparian type which is distinctly separated from the rest. The second group is formed by the syntaxa (2–5) of anthropogenic vegetation. There is some discrepancy between the dendrogram and the syntaxonomic scheme in the third group (clusters 12–17), which combines syntaxa from *Vaccinio-Piceetea* (17), *Quercetea robori-petraeae* (13–16) and one "community" (12). Study region is located outside the main distribution range of mentioned classes, and communities of these classes are not typical

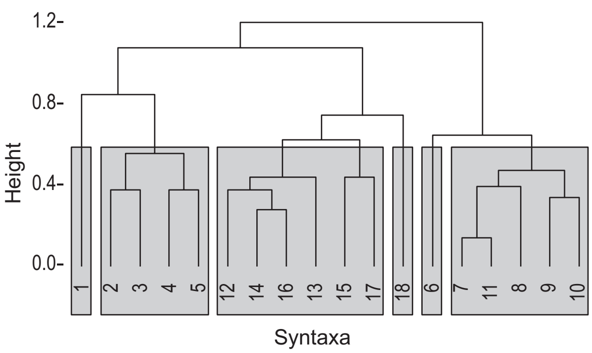

Figure 1: Hierarchical cluster analysis of the syntaxa of forest vegetation of Kyiv urban area. Numbers in the dendrogram correspond to the numbers in the syntaxonomic scheme.
Slika 1: Hierarhična klastrska analiza sintaksonov gozdne vegetacije urbanega območja Kijeva. Številke v dendrogramu so enake kot številke v sintaksonomskem seznamu.

here. Cluster 18 (from *Quercetea pubescenti-petraeae*) is very close to third group as well.

Table 2 summarized the averaged values of the Ochiai coefficient in pairwise comparison of relevés within and between phytocoenotic clusters.

Inter-cluster similarity analysis focuses on two goals: validation of partitioning and interpretation of syntaxa of higher ranks. The higher the diagonal values of the matrix above, the greater the density of clusters, and the share of species of higher constancies. As can be seen from Table 2, all phytocoenotic clusters have the maximal value in the diagonal, and for most clusters the difference between diagonal and any of non-diagonal values is high. This evidences in favor of the distinguishability of clusters using distance-based criterion.

The «cluster validation» term is commonly used for a procedure of evaluating the goodness of partitioning. In our case, we applied similar approach to assess the reliability of different clusters. This technique is not a reason for removing some clusters, but it allows recognizing some clusters as «good» or «weak». We used different metrics – inner validation criteria and floristic ones. The R repository (http://cran.r-project.org/web/packages) provides many specialized packages for the distance-based (inner) assessment, for example *clValid* (Brock et al. 2008), *Nbclust* (Charrad et al. 2014). The mathematical basis is well described (Halkidi et al. 2001, Rendón et al. 2011). In addition to the Silhouette statistics, we added the *partitioning quality index, PQI* (Goncharenko 2016).

Quality assessment would be incomplete without floristic criteria (Botta-Dukát & Borhidi 1999, Chytrý et al. 2002, De Cáceres et al. 2008, De Cáceres & Legendre 2009). Therefore, we added five floristic measures:

- the averages of constancies (*avg_k*), specifities (*avg_x*), and fidelities (*avg_kx*) of species;
- the homotoneity coefficient, *Ht* (Moravec 1973), which expresses the share of species with more than 40% constancy in the cluster;
- the sharpness index (Chytrý & Tichý 2003).

Table 2: Averaged similarities of relevés within and between phytocoenotic clusters.
Tabela 2: Povprečna podobnost popisov znotraj in med vegetacijskimi klastri.

cluster	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0.38	0.31	0.23	0.16	0.15	0.09	0.12	0.14	0.1	0.09	0.11	0.17	0.18	0.17	0.17	0.17	0.13	0.13
2	*	0.45	0.4	0.32	0.29	0.17	0.22	0.25	0.2	0.17	0.2	0.25	0.25	0.24	0.23	0.24	0.13	0.12
3	*	*	0.48	0.41	0.39	0.18	0.25	0.26	0.24	0.2	0.23	0.28	0.26	0.23	0.23	0.25	0.12	0.11
4		*	**	0.7	0.53	0.17	0.29	0.31	0.28	0.23	0.29	0.34	0.26	0.25	0.2	0.3	0.12	0.12
5		*	*	**	0.54	0.25	0.32	0.37	0.38	0.33	0.33	0.35	0.29	0.27	0.23	0.32	0.13	0.13
6					*	0.42	0.25	0.27	0.34	0.31	0.28	0.23	0.2	0.2	0.24	0.23	0.12	0.09
7		*	*	*	*	*	0.47	0.35	0.35	0.37	0.42	0.27	0.24	0.21	0.22	0.24	0.11	0.11
8		*	*	*	*	*	*	0.47	0.38	0.35	0.38	0.32	0.3	0.29	0.27	0.32	0.16	0.16
9			*	*	*	*	*	*	0.54	0.41	0.4	0.3	0.26	0.22	0.24	0.27	0.13	0.1
10				*	*	*	*	*	**	0.46	0.4	0.26	0.25	0.22	0.22	0.25	0.12	0.11
11			*	*	*	*	**	*	*	*	0.44	0.28	0.25	0.22	0.23	0.26	0.13	0.12
12		*	*	*	*	*	*	*	*	*	*	0.38	0.34	0.34	0.34	0.37	0.22	0.2
13		*	*	*	*		*	*	*	*	*	*	0.51	0.44	0.39	0.41	0.29	0.3
14		*	*	*	*		*	*	*	*	*	*	**	0.53	0.41	0.46	0.3	0.34
15		*	*		*	*	*	*	*	*	*	*	*	**	0.53	0.44	0.33	0.26
16		*	*	*	*	*	*	*	*	*	*	*	**	**	**	0.49	0.3	0.27
17												*	*	*	*	*	0.37	0.28
18													*	*	*	*	*	0.4

Notes: ID syntaxa correspond to the numbers in the syntaxonomic scheme.
Asterisks in cells – mnemonic codes: «***» – similarity > 0.6; «**» – similarity > 0.4; «*» – similarity > 0.2

Table 3 summarizes the results of the quality assessment of phytocoenotic clusters. Since none of methods can be considered comprehensive, the overall assessment was strengthened using a balanced criterion. Firstly, all indices were ranked in each column (by measure), than averages of ranks were calculated in each row (by cluster) and normalized («avg_rank» column).

Table 3: Quality assessment of phytocoenotic clusters using inner and floristic measures.

Tabela 3: Kvalitativne ocene vegetacijskih klastrov z uporabo notranjih in florističnih ocen.

cluster	*PQI*	*silh*	*Ht*	*Sharpness*	*avg_k*	*avg_x*	*avg_kx*	*avg_rank*
1	0.18	0.07	0.80	57.19	41.90	33.60	33.10	0.66
2	0.11	0.07	0.86	29.27	45.50	8.90	18.50	0.43
3	0.15	0.06	0.82	28.95	48.10	12.00	20.20	0.50
4	0.24	0.37	1.02	16.09	69.60	2.40	12.20	0.56
5	0.02	0.01	0.83	19.28	53.70	5.40	15.50	0.28
6	0.19	0.09	0.90	41.70	42.00	16.20	18.80	0.62
7	0.11	0.05	1.04	37.95	47.40	18.90	27.50	0.66
8	0.19	0.03	0.82	30.73	47.50	17.10	26.40	0.58
9	0.24	0.19	0.87	18.45	57.50	4.10	14.00	0.52
10	0.11	0.04	0.62	20.08	51.80	6.50	17.10	0.31
11	0.05	-0.04	0.90	32.16	45.40	15.00	24.30	0.45
12	0.03	-0.10	0.66	21.68	42.60	7.50	16.10	0.16
13	0.14	0.11	0.88	20.25	53.10	5.10	15.10	0.47
14	0.13	0.10	0.86	26.97	50.60	9.40	20.60	0.53
15	0.17	0.15	0.88	28.52	51.40	11.00	21.60	0.63
16	0.06	0.00	0.91	35.23	47.10	22.70	31.30	0.59
17	0.11	0.01	0.74	35.69	44.30	20.50	25.80	0.45
18	0.15	0.06	0.80	48.89	42.20	25.20	29.10	0.60

As seen from Table 3, only clusters 11 and 12 show negative Silhouette values, however they have positive values of *PQI* which is also distance-based criterion. Cluster densities can be judged by *Ht* and *avg_k* scores and all clusters are quite homogeneous. Regarding values in *avg_rank* column, a balanced measure, clusters 1, 7, 15 are the strongest, while clusters 5, 10 and 12 have the smallest values.

Ordination of vegetation

Figure 2 shows the plot of DCA ordination in a space of the first two ordination axes with environmental variables projected by the *vegan::envfit* function (Oksanen et al. 2018).

Clusters 1, 17, 18 are the most different from the others and occupy the distant right position along the first axis which is associated with *Lc* and *Kn*. This is consistent with the fact that they are representatives of the vegetation types distributed mainly in subcontinental regions. In contrast, clusters 7–11 of the *Carpino-Fagetea* class are located in the leftmost position along the first axis. The first axis is strongly correlated with *Lc* (this factor is critical in forest vegetation) and these nemoral communities develop in shady sites (in the opposite direction from the *Lc* arrow). Relevés from clusters 2 and 3 which represent anthropogenous urban forests have scores related mainly to the second axis, and variables that are correlated with anthropogenic load, *Hm* and *Nv*, also demonstrate greater contribution to the second axis of ordination.

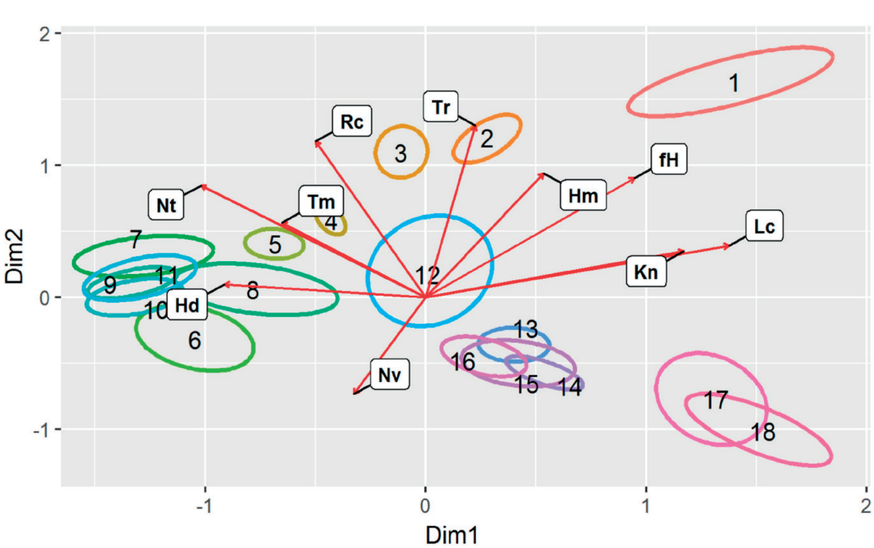

Figure 2: DCA ordination diagram with supplementary (passive) environmental variables. Abbreviations of environmental variables: *Lc* – light value, *Nt* – nitrogen value, *Tr* – total salt regime, *fH* – variability of moisture, *Rc* – soil reaction value, *Kn* – continentality value, *Hm* – hemeroby index, *Hd* – moisture value, *Tm* – temperature value, *Nv* – naturalness value.

Slika 2: DCA ordinacijski diagram s pasivno prikazanimi okoljskimi spremenljivkami. Okrajšave okoljskih spremenljivk: *Lc* – svetloba, *Nt* – dušik, *Tr* – slanost, *fH* – spremenljivost vlažnosti, *Rc* – reakcija tal, *Kn* – kontinentalnost, *Hm* – indeks hemerobije, *Hd* – vlažnost, *Tm* – temperatura, *Nv* – naravnost.

Phytosociological structure of species composition of syntaxa

Synanthropic species are common in the studied syntaxa due to urban conditions and this complicates syntaxonomic decisions. In such a case, the phytosociological spectrum becomes a reliable suggesting tool. The term "phytosociological spectrum" means a method of measuring and comparing the proportions of diagnostic species of different classes of vegetation in the species composition of each syntaxon (Goncharenko et al. 2013b). It is also a method of understanding the ecological specificity of communities, as the proportions of phytosociological spectrum indicate environmental conditions under which the certain types of communities develop.

Table 4 shows the proportions of species of different classes of vegetation in each syntaxon. For species-to-class classification, we have chosen the EuroVegChecklist as a basis (Mucina et al. 2016). To measure the degree of transitiveness of syntaxa (the uncertainty of placement in only one class of vegetation) we calculated the differences in shares between the first and the second classes of phytosociological spectrum («*diff*" column). Syntaxon should be considered ecotonic in the case of low values in this column.

Table 4: Phytosociological spectra of the syntaxa of forest vegetation. Only classes with a share of species greater than 0.05 (5%) in at least one syntaxon are presented in the table.

Tabela 4: Fitocenološki spekter sintaksonov gozdne vegetacije. V tabeli so prikazani samo razredi z deležem vrst v vsaj enem sintaksonu, večjim od 0,05 (5%).

ID syntaxon	*diff*	*BRA*	*EPI*	*FAG*	*GER*	*MOL*	*POP*	*QUE*	*ROB*
1	0.02	–	0.24	–	–	0.23	0.26	–	0.09
2	0.01	–	0.32	0.13	–	–	0.33	–	0.15
3	0.01	–	0.32	0.10	–	–	0.33	–	0.25
4	0.05	–	0.33	0.17	–	–	0.22	–	0.28
5	0.03	–	0.28	0.18	–	–	0.24	–	0.31
6	0.04	–	0.19	0.32	–	–	0.36	–	0.10
7	0.29	–	0.13	0.52	–	–	0.23	–	0.07
8	0.10	–	0.15	0.38	–	–	0.28	–	0.10
9	0.15	–	0.17	0.43	–	–	0.28	–	0.13
10	0.43	–	0.13	0.65	–	–	0.22	–	–
11	0.31	–	0.14	0.54	–	–	0.23	–	0.09
12	0.05	–	0.32	0.25	–	–	0.27	–	0.17
13	0.02	0.14	0.19	0.24	–	–	0.22	–	–
14	0.01	0.10	0.17	0.24	–	–	0.25	–	–
15	0.02	0.09	0.27	0.29	–	–	0.27	–	–
16	0.04	–	0.23	0.24	–	–	0.28	–	0.15
17	0.03	–	0.19	0.18	–	–	0.17	0.22	–
18	0.05	0.17	–	0.14	0.22	–	–	0.15	–

Abbreviations of classes according to Mucina et al. (2016)

As can be seen from Table 4, species of some classes are classified in the majority of compared syntaxa. For example, *Carpino-Fagetea* ("FAG" column) which is a zonal type of forest vegetation in Kyiv region. Also, almost all syntaxa contain a significant participation of *Epilobietea angustifolii* species ranging from 0.13 to 0.33, as a result of recreational and other anthropogenic pressures. Species of other classes ("GER", "MOL" etc.) play differentiating role in the studied forest vegetation. For example, in syntaxon #1 which is the riparian forest type the participation of species of the *Molinio-Arrhenatheretea* class is associated with the formation in the floodplains, where meadows usually develop. Species of the class *Trifolio-Geranietea* constitute up to 0.22 (22%) of the species composition in syntaxon #18, which is caused by xeric conditions and sparse tree layer in these forest communities.

Phytocoenotic characterization and description of new syntaxa

In this section, we present the phytocoenotic characteristic of syntaxa taking into account differentiating species and preferred habitats, as well as the results of phytoindicational and phytosociological assessment from previous sections of the article and aggregated header data obtained for relevés of certain clusters of vegetation. In the following text the syntaxa numbers corresponds to the numbers in the syntaxonomic scheme. Dominant (*dom.*), constant (*const.*) and differential (*diff.*) species are listed for each association. For three associations introduced as new ones, the comparative floristic tables with similar syntaxa (including holotypes) are given in order to confirm their distinguishability and establish differentiating species considering broader geographic scope of such analysis. Also for each syntaxon we will list the related syntaxa. The term "related" does not mean that we regard the syntaxa as synonyms in the nomenclatural sense. This implies similarity in species composition and close position in the syntaxonomic scheme. Such lists of related syntaxa are a part of characteristic and may indicate distant syntaxonomic relations with syntaxa placed by authors in other alliances/orders. They are also aimed at identifying a potential distribution range of associations in wider territories than the region of study.

1. *Aristolochio clematitis-Populetum nigrae* ass. nova hoc loco

Dom.: Populus spp. *(P. nigra, P. alba, P. tremula), Ulmus laevis, Betula pendula, Pinus sylvestris, Quercus robur*

Const.: Rubus caesius, Poa pratensis, Rumex thyrsiflorus, Alopecurus pratensis, Tanacetum vulgare, Carex hirta, Dactylis glomerata, Amorpha fruticosa

Diff.: Aristolochia clematitis, Galium verum, Galium rubioides, Carex praecox, Asparagus officinalis, Filipendula vulgaris, Bromus inermis, Koeleria glauca

EUNIS: G1.1112 Eastern European poplar-willow forests

Related syntaxa. ass. *Galio veri-Aristolochietum clematidis* Shevchyk et V. Solomakha in Shevchyk et al. 1996, *Artemisio dniproicae-Salicetum acutifoliae* Shevchyk et V. Solomakha 1996, *Euphorbio virgultosae-Amorphetum fruticosae* Shevchyk et V. Solomakha 1996

Holotypus: relevé 453 (Table S1); author: H. Yatsenko; date: 26.05.2016; locality: in the central part of the Dolobetsky island of the Dnieper River within the Kyiv city, on sandy soils, in the birch-poplar forest; coordinates: 50.4637° N, 30.5695° E; total coverage of layers: trees – 70%, shrubs – 30%, herbs – 90%. *Alopecurus pratensis* 2, *Aristolochia clematitis* 2, *Artemisia absinthium* 1, *Asparagus officinalis* +, *Berteroa incana* 1, *Betula pendula* 2, *Carex praecox* 2, *Convallaria majalis* 1, *Crataegus monogyna* 1, *Dactylis glomerata* 1, *Erigeron canadensis* +, *Eryngium planum* +, *Festuca pratensis* 1, *Filipendula vulgaris* 2, *Fraxinus excelsior* +, *Galium rubioides* +, *Galium verum* 2, *Hypericum perforatum* +, *Myosotis stricta* +, *Pinus sylvestris* +, *Plantago lanceolata* +, *Poa pratensis* 3, *Populus alba* 1, *Populus nigra* 2, *Potentilla argentea* +, *Quercus robur* +, *Rhinanthus vernalis* 1, *Rumex thyrsiflorus* 2, *Sedum telephium* +, *Tanacetum vulgare* 1, *Trifolium montanum* 1, *Ulmus laevis* +, *Vincetoxicum hirundinaria* 1.

The association combines dry to mesic species-rich poplar riparian forests. Communities occupy elevated areas of floodplains and sandy islands. They mainly occur in the lower courses of larger rivers with powerful alluvial sediments. Most elevated areas of floodplains are not regularly flooded. Under such conditions, trees, especially birch and poplar species (*Populus tremula, P. nigra, P. alba*), are spreading and producing different-age undergrowth. Sparse canopy of trees favors the growth of light-demanding forest-fringe herbs and the increase of floristic richness (Table 5).

To understand the dualistic nature of mixture of species, we should note that soil moisture in such habitats greatly changes during the year. In summer, dry conditions prevail which leads to the co-occurrence of mesophytes and drought-adapted species in the same communities.

The syntaxonomic position of the association is rather complicated as for most riparian forests in Eastern Europe. To demonstrate the complicated syntaxonomy of

Table 5: Aggregated data of relevés for each phytocoenotic cluster (syntaxon).
Tabela 5: Združeni podatki o popisih za vsak vegetacijski klaster (sintakson).

syntaxon	*N*	*R*	*ΔR*	*S*	*S20%*	*S40%*	*cov_tree*	*cov_shrub*	*cov_herb*	*years*
1	39	29	19 – 40	139	37	17	56	11	81	2016
2	22	28	23 – 37	112	44	21	67	15	78	2016
3	26	21	16 – 30	92	37	18	61	10	91	2016
4	7	17	12 – 20	32	69	53	66	25	71	2015
5	21	17	11 – 22	61	41	23	78	34	54	2014 – 2015
6	9	22	17 – 28	73	62	27	73	23	79	2013 – 2016
7	53	24	18 – 33	119	35	21	72	30	70	2013 – 2016
8	64	23	10 – 39	130	28	15	74	32	53	2013 – 2016
9	11	19	16 – 25	62	44	27	68	23	70	2014 – 2015
10	21	19	13 – 26	86	31	14	76	23	50	2013 – 2015
11	55	22	12 – 31	116	34	17	74	27	65	2013 – 2015
12	30	27	18 – 42	162	27	11	56	23	77	2013 – 2016
13	17	25	21 – 34	93	40	24	58	34	66	2015 – 2016
14	36	27	16 – 37	109	39	21	47	27	69	2016
15	33	26	18 – 49	112	37	21	63	29	72	2016
16	115	24	17 – 34	142	30	15	59	29	66	2016
17	35	24	16 – 34	145	25	12	52	22	74	2015 – 2016
18	41	26	20 – 36	137	35	15	38	22	75	2015 – 2016

Notations: *N* – number of relevés, *R* – average number of species per relevé, *ΔR* – min-max range of the number of species in relevés, *S* – total number of species in species list of the cluster (syntaxon), *S20%* – number of species with constancies higher than 20% (I constancy class) divided by *S*, *S40%* – the same but with stronger 40% threshold (I – II constancy classes), the measure of the floristic homogeneity of the cluster, *cov_tree* – average of the total cover of tree layer in relevés, *cov_shrub, cov_herb* – the same for the shrub and herb layers, *years* – the range of years of relevés eastern riparian forests, below we will give a brief descriptions of some alliances that were described from Eastern Europe and placed even in different classes of vegetation.

- *Galio veri-Aristolochion clematidis* Shevchyk et V. Solomakha 1996 (Shevchyk et al. 1996 p. 34) – described from Central Ukraine, the Kaniv Nature Reserve, the holotypus of the association is *Galio veri-Aristolochietum clematidis*; the association was originally included in the *Salicetea purpureae* class; in the EuroVegChecklist was transferred to the *Molinio-Arrhenatheretea* class and placed among the synonyms of the alliance *Agrostion vinealis* Sipailova et al. 1985;

- *Artemisio dniproicae-Salicion acutifoliae* Shevchyk et V. Solomakha 1996 (Shevchyk et al. 1996 p. 29) – also described from the Kaniv Nature Reserve, based on the holotypus of the association *Artemisio dniproicae-Salicetum acutifoliae* (Shevchyk & Solomakha 1996); the association was originally placed by the authors in the class *Festucetea vaginatae* Soó ex Vicherek 1972; the alliance is accepted in the EuroVegChecklist but transferred to the *Salicetea purpureae* class;

- *Rubo caesii-Amorphion fruticosae* Shevchyk et V. Solomakha 1996 (Shevchyk & Solomakha 1996 p. 24) – also from Central Ukraine, with the holotypus of the association *Euphorbio virgultosae-Amorphetum fruticosae*; the association was included in the *Salicetea purpureae* class, the alliance is accepted in the EuroVegChecklist;

- *Calamagrostio epigei-Populion nigrae* (Shevchyk et V. Solomakha 1996) Shevchyk et V. Solomakha in I. Solomakha et. al. 2015 (Solomakha et al. 2015 p. 273) – from southern part of Ukraine; the name was introduced as a *nomen novum* instead of the name *Rubo caesii-Amorphion fruticosae*; the authors of *nomen novum* referred to art. 3k of the ICPN. From this point of view, we cannot accept the legitimacy of the new name *Calamagrostio epigei-Populion nigrae,* because art. 3k of the ICPN cannot be applied – the alliance *Rubo caesii-Amorphion fruticosae* unites the shrub communities with *Amorpha fruticosa* dominated in the main layer, so the name *Calamagrostio epigei-Populion nigrae* seems to be a *nomen superfluum* (ICPN, art. 18b), at least in such an interpretation;

- *Poo angustifoliae-Ulmion laevis* Golub in Golub et E.G. Kuzmina 1997 (Golub & Kuzmina 1997 p. 207) – from the steppe part of Russia, the valley of the Volga River. This alliance is distributed much more to the south than our communities, although it represents a related synmorphologically and ecologically type of open-canopy gallery riparian forests, with a gradual series towards open grassy communities. To the south, in the steppe part of Ukraine, especially in the floodplain of the Dnieper, this alliance is likely to be found. Later, the alliance was transferred by the authors to the order *Alno-Fraxinetalia excelsioris* Passarge 1968 (Golub & Bondareva 2018); the alliance is also accepted in the EuroVegChecklist;

- *Asparago officinalis-Salicion albae* Golub 2001 (Golub 2001 p. 17) – also from the steppe part of Russia, the Volga-Akhtuba district; the holotypus is the association *Achilleo septentrionalis-Populetum nigrae* Golub et E.V. Kuzmina in Golub 2001; in the EuroVegChecklist the alliance is considered as synonym for *Salicion albae* Soó 1951. Nevertheless, in such distant continental regions the floristic and geographical grounds for delimiting a new alliance, a vicariate of the central European *Salicion albae,* are sufficient and it was shown in detail in the later publication by Golub & Bondareva 2017;

- *Agrostio vinealis-Salicion acutifoliae* Bulokhov in Bulokhov et Semenishchenkov 2015 (Bulokhov & Semenishchenkov 2015 p. 31) – from northwest part of Russia, Bryansk region, forest zone; in the EuroVegChecklist the alliance is considered synonymous with *Artemisio dniproicae-Salicion acutifoliae*, described from Ukraine. But perhaps this decision did not take into account that the authors validated this alliance in a separate publication later (Bulokhov & Semenishchenkov 2015), and therefore the alliance deserves an independent status, and not as a synonym.

In Ukrainian publications, different communities were mixed within one too broadly interpreted association *Salici albae-Populetum nigrae*. Only in the case of units of high ranks (orders or classes), this would be acceptable, but such broad misinterpretation is not reasonable for associations. *Salici-Populetum nigrae* is based on a completely different pool of Central European flora and should not be included in the syntaxonomic scheme for more continental regions.

In Table 6, we summarized the results of the comparison of associations of riparian forests. This is part of a differentiating table in which we have omitted rare species and low constancy values below 20%. For comparison, the holotype of the aforementioned Central European association *Salici-Populetum nigrae* is placed in column 9.

Table 6: Comparative study of the syntaxa of riparian forests.
Tabela 6: Primerjalna analiza obrežnih gozdov.

ID syntaxa	1	2	3	4	5	6	7	8	9
Number of relevés	39	5	4	4	6	6	33	20	7
Populus nigra	III	V	.	V	V	V	.	V	III
Aristolochia clematitis	V	.	V	V	.	.	V	.	.
Asparagus officinalis	IV	II	V	IV	.	.	III	V	.
Carex praecox	.	.	IV	III	.	.	IV	III	.
Elymus repens (Elytrigia repens)	.	II	III	.	III	.	V	III	.
Galium verum	III	.	V	.	.	.	IV	.	.
Tanacetum vulgare	III	.	V	IV	.	.	.	.	.
Euphorbia virgata	.	.	IV	V	.	.	III	.	.
Bromus inermis (Bromopsis inermis)	.	.	V	V	.	.	.	IV	.
Rubus caesius	III	.	.	.	.	V	IV	.	.
Salix alba	.	V	.	.	II	V	.	.	IV
Carex hirta	III	.	.	.	II	.	.	.	.
Lysimachia nummularia	III	.	.	.	II	.	.	.	III
Poa pratensis	IV	.	.	.	II	.	.	.	.
Pinus sylvestris	III	.	V	.	.	.	.	.	.
Equisetum pratense	III	.	.	V	.	.	.	.	.
Acer negundo	III	.	.	.	III	III	.	.	.
Cornus sanguinea (Swida sanguinea)	.	.	.	.	II	V	.	.	.
Galium aparine	IV	.	.	.	III	V	.	.	III
Urtica dioica	.	.	.	.	III	V	.	.	V
Arctium lappa	.	.	.	.	.	III	IV	.	.
Calamagrostis epigejos	.	.	III	IV	.	.	V	.	.
Carex melanostachya	.	.	.	.	.	.	V	IV	.
Cirsium arvense	.	.	.	.	.	.	IV	III	.
Fallopia convolvulus	.	.	III	.	.	.	III	.	.
Glechoma hederacea	.	.	.	.	III	.	III	.	II
Lactuca serriola	.	.	.	.	II	.	IV	.	.
Poa angustifolia	.	.	V	IV	.	.	V	.	.
Ulmus laevis	IV	.	.	.	.	.	IV	.	.
Convolvulus arvensis	.	.	.	.	.	.	IV	IV	.
Galium rubioides	III	.	.	.	.	.	.	IV	.
Alopecurus pratensis	III	.	.	.	.	.	.	.	.
Betula pendula	III	.	.	.	.	.	.	.	.
Cornus sanguinea	III	.	.	.	.	.	.	.	.
Erigeron annuus	III	.	.	.	.	.	.	.	.
Geum urbanum	III	.	.	.	.	.	.	.	.
Ligustrum vulgare	III	.	.	.	.	.	.	.	.
Rumex thyrsiflorus	IV	.	.	.	.	.	.	.	.
Sedum telephium	IV	.	.	.	.	.	.	.	.
Amorpha fruticosa	.	V	.	.	.	.	.	.	.
Bromus sterilis (Anisantha sterilis)	.	II	.	.	.	.	.	.	.
Elaeagnus angustifolia	.	III	.	.	.	.	.	.	.
Lithospermum officinale	.	II	.	.	.	.	.	.	.
Secale sylvestre	.	II	.	.	.	.	.	.	.
Silene vulgaris (Oberna behen)	.	II	.	.	.	.	.	.	.
Erysimum marschallianum	.	.	.	III	.	.	.	.	.
Frangula alnus	.	.	.	III	.	.	.	.	.
Galium boreale	.	.	.	IV	.	.	.	.	

ID syntaxa	1	2	3	4	5	6	7	8	9
Number of relevés	39	5	4	4	6	6	33	20	7
Galium verticillatum	.	.	.	V	.	.	.	.	
Salix acutifolia	.	.	.	III	.	.	.	.	
Ulmus glabra	.	.	.	III	.	.	.	.	
Anthriscus sylvestris	.	.	.	.	II	.	.	.	
Arrhenatherum elatius	.	.	.	.	.	IV	.	.	
Equisetum arvense	.	.	.	.	.	IV	.	.	
Humulus lupulus	.	.	.	.	.	III	.	.	III
Impatiens glandulifera	.	.	.	.	.	III	.	.	
Phalaris arundinacea (Phalaroides arundinacea)	.	.	.	.	.	V	.	.	
Poa palustris	.	.	.	.	.	V	.	.	II
Populus alba	.	.	.	.	.	IV	.	.	
Salix fragilis	.	.	.	.	.	III	.	.	III
Solidago canadensis	.	.	.	.	.	V	.	.	.
Symphyotrichum novi-belgii (Aster novi-belgii)	.	.	.	.	.	III	.	.	.
Agrimonia eupatoria	.	.	.	.	.	.	IV	.	.
Artemisia austriaca	.	.	.	.	.	.	III	.	.
Artemisia pontica	.	.	.	.	.	.	IV	.	.
Cannabis sativa	.	.	.	.	.	.	IV	.	.
Carex riparia	.	.	.	.	.	.	III	.	.
Chaiturus marrubiastrum	.	.	.	.	.	.	III	.	.
Eryngium planum	.	.	.	.	.	.	IV	.	.
Euphorbia palustris	.	.	.	.	.	.	IV	.	.
Lactuca tatarica	.	.	.	.	.	.	IV	.	.
Lathyrus incurvus	.	.	.	.	.	.	IV	.	.
Medicago sativa	.	.	.	.	.	.	III	.	.
Prunus spinosa	.	.	.	.	.	.	III	.	.
Quercus robur	.	.	.	.	.	.	V	.	.
Sonchus arvensis	.	.	.	.	.	.	III	.	.
Taraxacum officinale	.	.	.	.	.	.	III	.	.
Achillea salicifolia	.	.	.	.	.	.	.	III	.
Agrostis stolonifera	.	.	.	.	.	.	.	IV	.
Allium angulosum	.	.	.	.	.	.	.	III	.
Althaea officinalis	.	.	.	.	.	.	.	III	.
Artemisia abrotanum	.	.	.	.	.	.	.	III	.
Euphorbia esula	.	.	.	.	.	.	.	IV	.
Fraxinus pennsylvanica	.	.	.	.	.	.	.	III	.
Hierochloe repens	.	.	.	.	.	.	.	III	.
Inula britannica	.	.	.	.	.	.	.	V	.
Lythrum virgatum	.	.	.	.	.	.	.	III	.
Rubia tatarica	.	.	.	.	.	.	.	V	.
Solanum kitagawae	.	.	.	.	.	.	.	III	.
Stachys palustris	.	.	.	.	.	.	.	III	.
Vicia cracca	.	.	.	.	.	.	.	III	.
Xanthium albinum	.	.	.	.	.	.	.	V	.
Calamagrostis lanceolata	.	.	.	.	.	.	.	.	III
Calystegia sepium	.	.	.	.	.	.	.	.	IV
Carex echinata	.	.	.	.	.	.	.	.	IV
Cirsium palustre	.	.	.	.	.	.	.	.	III
Equisetum palustre	.	.	.	.	.	.	.	.	III
Filipendula ulmaria	.	.	.	.	.	.	.	.	V

ID syntaxa	1	2	3	4	5	6	7	8	9
Number of relevés	39	5	4	4	6	6	33	20	7
Galium palustre	.	.	.	.	.	.	.	.	IV
Iris pseudacorus	.	.	.	.	.	.	.	.	V
Juncus effusus	.	.	.	.	.	.	.	.	III
Lycopus europaeus	.	.	.	.	.	.	.	.	III
Lysimachia vulgaris	.	.	.	.	.	.	.	.	IV
Lythrum salicaria	.	.	.	.	.	.	.	.	III
Mentha aquatica	.	.	.	.	.	.	.	.	III
Myosotis scorpioides	.	.	.	.	.	.	.	.	III
Phragmites communis	.	.	.	.	.	.	.	.	III
Ranunculus acris	.	.	.	.	.	.	.	.	IV
Salix viminalis	.	.	.	.	.	.	.	.	III
Scutellaria galericulata	.	.	.	.	.	.	.	.	III
Solanum dulcamara	.	.	.	.	.	.	.	.	V
Symphytum officinale	.	.	.	.	.	.	.	.	V
Valeriana officinalis	.	.	.	.	.	.	.	.	III

Syntaxa: 1 – *Aristolochio clematitis-Populetum nigrae* (Ukraine, Kyiv region), 2 – *Salici-Populetum* (Ukraine, Kherson region) (Dubyna & Dziuba 2014), 3 – *Galio veri-Aristolochietum clematitis typicum*, var. *Pinus sylvestris* (Ukraine, Cherkasy region) (Shevchyk et al. 1996), 4 – *Galio veri-Aristolochietum clematitis typicum*, var. *Populus nigra* (Ukraine, Cherkasy region) (Shevchyk et al. 1996), 5 – *Galio veri-Populetum nigrae* Solomakha, Smoliar et Smagliuk 2016 (Ukraine, Poltava region) (Solomakha et al. 2016), 6 – *Salici-Populetum* (Southwestern Slovakia) (Vojtková et al. 2014), 7 – *Poo angustifoliae-Quercetum roboris* Golub et Kuzmina 1997 (Russia, Volga-Akhtuba region) (Golub & Bondareva 2018), 8 – *Achilleo septentrionalis-Populetum nigrae* Golub et Kuzmina in Golub 2001 (Russia, Volga-Akhtuba region) (Golub & Bondareva 2017), 9 – *Salici albae-Populetum nigrae* (holotypus) Meyer-Drees 1936 (Netherlands, Achterhoek region)

Communities growing in wet conditions are generally considered to be quite homogeneous and have a wide distribution range. But as can be seen from Table 6, it's not really like that. Changes in climatic conditions significantly affect the floristic differences of syntaxa of this type. When comparing columns 8 (continental region) and 9 (suboceanic region), they have very few common species and in relation to column 1 (Kyiv region). Ukrainian communities are somewhere in the intermediate position.

Also, Table 6 confirms that association *Aristolochio clematitis-Populetum nigrae* cannot be seen as identical to other known associations from Ukraine. The expected distribution range of this association most likely covers floodplains in the lower courses of the left-bank tributaries of the Dnieper in the forest-steppe part of Ukraine, especially in habitats with powerful sandy sediments. These communities were often characterized as "short-term flooded lowland forests" and reported for many regions in the Left-Bank Ukraine – in the floodplains of Vorksla, Psel, Sula, Uday, Merla rivers (Tkach 2001). To the south, communities are becoming rarer with a gradual series from mesic riparian forests to xeric sandy steppes.

2, 3. *Galio aparines-Aceretum negundi* ass. nova hoc loco

Dom.: Acer negundo, Robinia pseudoacacia

Const.: Parthenocissus quinquefolia, Rubus caesius, Geum urbanum, Urtica dioica, Chelidonium majus

Diff.: Galium aparine, Geranium robertianum, Chaerophyllum temulum, Impatiens parviflora, Myosotis sparsiflora

EUNIS: G5.2 – Small broadleaved deciduous anthropogenic woodlands

Holotypus: relevé 379 (Table S1); author: H. Yatsenko; date: 11.05.2016; locality: Ukraine, Kyiv city, the Venetian island; in a subspontaneous grove with a mixture of ash-leaved maple, poplar and other riparian tree species, coordinates: 50.4402° N, 30.5842° E; total coverage of layers: trees – 80%, shrubs – 20%, herbs – 90%. *Acer negundo* 3, *Acer platanoides* +, *Alliaria petiolata* 2, *Carex contigua* +, *Carpinus betulus* +, *Chaerophyllum temulum* +, *Cornus sanguinea* +, *Dactylis glomerata* +, *Festuca gigantea* +, *Galium aparine* 2, *Geranium robertianum* +, *Geum urbanum* 1, *Glechoma hederacea* +, *Lysimachia nummularia* +, *Malus sylvestris* +, *Melandrium album* +, *Moehringia trinervia* +, *Myosotis sparsiflora* +, *Parthenocissus quinquefolia* 3, *Poa pratensis* +, *Populus nigra* 2, *Prunus avium* +, *Stellaria media* 1, *Taraxacum officinale* +, *Ulmus laevis* +, *Veronica chamaedrys* 1, *Viola odorata* 2.

Related syntaxa. *Sambuco nigrae-Aceretum negundi* Exner in Exner et Willner 2004, *Ulmo laevis-Acericion negundi* Smetana, Derpoluk et Krasova 1997 (syntax. syn. of *Aegopodio podagrariae-Sambucion nigrae*), *Ulmo carpinifoliae-Acerion negundi* Smetana, Derpoluk et Krasova 1997 (syntax. syn. of *Aegopodio podagrariae-Sambucion nigrae*), *Galio aparine-Robinietum pseudoacaciae* Smetana, Derpoluk et Krasova 1997 nom. inval. (ICPN, art. 1), *Galio aparine-Ulmetum carpinifoliae* Smetana, Derpoluk, Krasova 1997 nom. inval. (ICPN, art. 1), *Chelidonio-Aceretum negundi* L. Ishbirdina et A. Ishbirdin 1989 nom. inval. (ICPN, art. 1).

The association combines boxelder groves with a large portion of the species of *Galio-Urticetea* in the nutrient-rich shady disturbed habitats, mainly in urban areas. Communities occur in city parks, near buildings and fences, on eroded loamy slopes. *Acer negundo* is widely planted in temporary climate regions and migrates primarily through riversides. It quickly reaches the epecophyte stage because of huge seed production, rapid growth, darkness-tolerance. The main limiting factor is low winter temperatures, so this aggressive invader covers only the southern part of Siberia and the Far East (south of Novosibirsk-Omsk-Khabarovsk) (Adamowski 1991).

The association *Galio aparines-Aceretum negundi* is reported by us using a new name. There were several reasons. The closest floristic type of communities in Ukraine is that regarded as the association *Chelidonio-Aceretum negundi* Ishbirdina et Ishbirdin 1989. But, as is the case with the previous association, it is too widely interpreted. This leads to the difficulties in comparative analysis since floristic differences are blurred and the distribution ranges of syntaxa become unclear. Thus, the association *Chelidonio-Aceretum negundi* was described from a region very distant from Ukraine, in Ufa (Russia, Bashkiria). In addition, this association, as well as the *Chelidonio-Acerion negundi* alliance based on it, was not published validly (ICPN, art. 1) (Ishbirdina et al. 1989). In addition, the another *Ulmo laevis-Acericion negundi* alliance was also described in Ukraine and it is not valid too (ICPN, art. 1). The authors of vegetation survey of the Czech Republic considered the *Chelidonio-Acerion negundi* alliance as a synonym for the *Aegopodio podagrariae-Sambucion nigrae* Chytrý 2013 alliance (Chytrý et al. 2013 p. 128). But this is also possible exaggeration, since it further expands the range to the west, and this time to Central Europe. Of course, synanthropic vegetation has many common features in remote regions, but it is originated from different background types of zonal natural vegetation in each region. And this gives rise to regional traits and narrows the range of these vegetation units, which, in our opinion, are misinterpreted too broadly. To demonstrate the floristic differences of known syntaxa of anthropogenous forests, a comparative analysis is necessary. (Table 7). The holotypus of the *Chelidonio-Aceretum negundi* is represented in the last column.

As can be seen from Table 7, *Acer negundo* is the "binding" tree species in the compared associations. This is a well-adaptable generalist, therefore floristic specificity of communities depends more not on the abundance of this species but on the soil and relief conditions in which these forests grow, and on what natural vegetation types they have derived from as a result of extensive anthropogenic pressure. For example, in our case and some other syntaxa (columns 1 and 7) there is a significant participation of nemoral species (*Acer platanoides, Poa nemoralis, Ulmus glabra, Cornus sanguinea, Ulmus laevis*), which act as differentiating species. This suggests that these anthropogenic forests have originated from the floodplain forests of the natural nemoral type. In the herbaceous layer, as being more vulnerable to anthropogenic pressure, indigenous forest species are missing, but in the shrub and tree layers, there are remnant natural species still. In association #2, meadow and marsh species (*Poa trivialis, Dactylis glomerata, Iris pseudacorus,* and *Symphytum officinale*) are differential, which indicates a connection with this type of vegetation in the past.

The difference between the association *Galio aparines-Aceretum negundi* and the next, both from the same *Robinietea* class, is that the first one combines groves with *Acer negundo* dominated in the tree layer (even if *Robinia pseudoacacia* present, its role is auxiliary). Although both species are neophytes, their communities differ ecologically. The *Galio aparines-Aceretum negundi* association combines shady forests mainly in the floodplains, whereas the groves of *Robinia pseudoacacia* are much more open with thermophilous species prevailing.

Legend to the Table 7

Syntaxa: 1 – *Galio aparines-Aceretum negundi* ass. nova hoc loco (Ukraine, Kyiv region), 2 – *Rubo caesii–Aceretum negundi* Batanjski et. S. Jovanović 2015 (Serbia, Zrenjanin region, Carska bara) (Batanjski et al. 2015), 3 – *Chelidonio majoris-Robinietum pseudoacaciae* Jurko 1963 (Czech Republic) (Chytrý et al. 2013), 4 – *Chelidonio majoris-Robinietum pseudoacaciae* (Czech Republic) (Vítková & Kolbek 2010), 5 – *Chelidonio-Aceretum negundi typicum* (Russia, Kursk region) (Arepieva 2013), 6 – *Chelidonio-Aceretum negundi sambucetosum nigrae* (Russia, Kursk region) (Arepieva 2013), 7 – *Chelidonio-Aceretum negundi* (Ukraine, Cherkasy region) (Shevchyk et al. 1996), 8 – *Chelidonio-Aceretum negundi* (Russia, Bashkiria, Salavat city) (Golovanov & Abramova 2013), 9 – *Chelidonio-Aceretum negundi* (Ukraine, Poltava region) (Smahliuk 2016), 10 – *Chelidonio-Aceretum negundi* (holotypus) (Russia, Bashkiria, Ufa city) (Ishbirdina et al. 1989)

Table 7: Comparative study of the syntaxa of the *Robinietea* class. Rare species and I-II constancy values are not shown.
Tabela 7: Primerjalna analiza sintaksonov razreda *Robinietea*. Redke vrste in vrste s stalnostjo I-II niso prikazane.

Species / Syntaxa numbers	1	2	3	4	5	6	7	8	9	10
Number of relevés	26	20	152	174	8	6	3	10	4	12
Acer negundo	V	V	.	.	V	V	V	V	V	V
Galium aparine	V	.	V	V	.	.	IV	.	IV	.
Geum urbanum	V	.	IV	V	IV	IV	.	.	III	.
Sambucus nigra	III	.	V	V	V	V	IV	.	V	.
Urtica dioica	III	III	V	V	IV	V	IV	IV	V	V
Chelidonium majus	III	.	IV	III	IV	IV	.	IV	V	V
Alliaria petiolata	V	.	.	.	IV	III	.	.	III	.
Impatiens parviflora	IV	.	III	III	.	.	IV	.	.	.
Rubus caesius	IV	IV	.	.	.	.	.	.	.	.
Poa trivialis	.	III	.	III	.	.	.	.	.	.
Geranium robertianum	.	.	III	III	.	.	.	.	.	.
Robinia pseudoacacia	.	.	V	V	.	.	IV	.	IV	.
Rubus fruticosus	.	.	III	III	.	.	.	.	.	.
Ballota nigra	.	.	.	III	III	V	.	.	.	
Acer platanoides	III	.	.	.	.	.	IV	III	IV	.
Chaerophyllum temulum	.	.	.	III	.	.	V	.	.	.
Myosotis sparsiflora	.	.	.	.	.	.	V		III	.
Arctium lappa	.	.	.	.	.	.	.	V	III	.
Taraxacum officinale	.	.	.	.	IV	.	.	V	.	V
Anthriscus sylvestris	.	.	III	IV	.	.	.	.	V	.
Cornus sanguinea	III	.	.	.	.	.	.	.	.	.
Parthenocissus quinquefolia	V	.	.	.	.	.	.	.	.	.
Stellaria media	III	.	.	.	.	.	.	.	.	.
Ulmus laevis	IV	.	.	.	.	.	.	.	.	.
Viola odorata	IV	.	.	.	.	.	.	.	.	.
Dactylis glomerata	.	III	.	.	.	.	.	.	.	.
Iris pseudacorus	.	III	.	.	.	.	.	.	.	.
Symphytum officinale	.	III	.	.	.	.	.	.	.	.
Arctium tomentosum	.	.	.	.	.	V	.	.	.	IV
Calystegia sepium	.	.	.	.	.	III	.	.	.	.
Humulus lupulus	.	.	.	.	.	.	IV	.	.	.
Poa nemoralis	.	.	.	.	.	.	IV	.	.	.
Ulmus glabra	.	.	.	.	.	.	IV	.	.	.
Artemisia absinthium	.	.	.	.	.	.	.	III	.	
Artemisia vulgaris	.	.	.	.	.	.	.	V	.	III
Atriplex patula	.	.	.	.	.	.	.	V	.	.
Cynoglossum officinale	.	.	.	.	.	.	.	III	.	.
Glechoma hederacea	.	.	.	.	.	.	.	III	.	.
Lactuca serriola	.	.	.	.	.	.	.	III	.	III
Leonurus quinquelobatus	.	.	.	.	.	.	.	V	.	III
Poa pratensis	.	.	.	.	.	.	.	III	.	.
Sorbus aucuparia	.	.	.	.	.	.	.	IV	.	III
Adoxa moschatellina	.	.	.	.	.	.	.	.	V	.
Festuca gigantea	.	.	.	.	.	.	.	.	III	.
Ficaria verna	.	.	.	.	.	.	.	.	IV	.
Lamium maculatum	.	.	.	.	.	.	.	.	III	.
Myosoton aquaticum	.	.	.	.	.	.	.	.	III	.
Pastinaca sylvestris	.	.	.	.	.	.	.	.	.	III
Lapsana communis	.	.	.	.	.	.	.	.	.	III
Chenopodiastrum hybridum	.	.	.	.	.	.	.	.	.	III
Sambucus racemosa	.	.	.	.	.	.	.	.	.	III

4, 5. *Balloto nigrae-Robinietum pseudoacaciae* Jurko 1963

Dom.: Robinia pseudoacacia
Const.: Sambucus nigra, Geum urbanum, Urtica dioica, Chelidonium majus
Diff.: Impatiens parviflora, Ballota nigra
EUNIS: G1.C – Highly artificial broadleaved deciduous forestry plantations, I2.23 – Small parks and city squares
Related syntaxa. Impatienti parviflorae-Robinietum Sofron 1967, Urtico dioicae-Robinietum Ščepka 1982

Communities develop on nutrient-rich mesic to dry soils and occur in various disturbed territories – in city parks, roadside shelterbelts, wastelands, on ruderal slopes etc, and especially in warm sun-exposed sites. Tree layer is partly or fully artificial, and dominated by the neophyte of *Robinia pseudiacacia*. Most species are aliens of North American origin. Sometimes, the whole *Robinietea* class is interpreted as a synonym of the classes *Rhamno-Prunetea* (Šilc & Čarni 2012, Sádlo et al. 2013), *Galio-Urticetea* (Vítková & Kolbek 2010). It is more traditional for Ukrainian syntaxonomy to accept the *Robinietea* class in its original narrow sense (Hadač & Sofron 1980). In the class, the *Chelidonio majoris-Robinion pseudoacaciae* alliance is a central type widely distributed in Europe (Vítková & Kolbek 2010, Sádlo et al. 2013). This is also reported from many locations in Ukraine (Kramarets et al. 1992, Solomakha 2008, Smahliuk 2016) and Russia (Arepieva 2011). There is less information from Siberian regions. For example, in Bashkiria the *Chelidonio-Acerion negundi* alliance is reported from the *Robinietea* class (Golovanov & Abramova 2013). This can be explained by the limitations for the thermophilous retinue of *Robinia pseudiacacia* groves due to stronger climatic conditions and lower winter temperatures.

6. *Carici remotae-Fraxinetum excelsioris* Koch ex Faber 1936

Dom.: Alnus glutinosa, Fraxinus excelsior
Const.: Prunus padus, Urtica dioica
Diff.: Carex remota, Scirpus sylvaticus, Cardamine amara, Chrysosplenium alternifolium, Athyrium filix-femina, Carex sylvatica, Festuca gigantea
EUNIS: G1.21 – Riverine ash-alder woodland
Related syntaxa. *Ficario-Ulmetum minoris* Knapp 1942, *Fraxino excelsioris-Alnetum glutinosae* (Matuszkiewicz 1952) Julve 1993 ex de Foucault 1994, *Carici remotae-Alnetum glutinosae* Lemée 1937, *Rubo caesii-Alnetum* Stecyuk 1995, *Convallario-Padietum* Bajrak 1996

The association comprises transitional communities between the classes *Carpino-Fagetea* and *Alnetea glutinosae*. This vegetation type is widely distributed in temperate Europe and also occurs in Ukraine (Douda et al. 2016). Tree layer is co-dominated by *Alnus glutinosa, Fraxinus excelsior, Quercus robur,* and *Ulmus glabra*. Herbaceous layer is composed mainly of nutrient-demanding shade-tolerant dicots and neutrophylic low-grown sedges. The association develops under wetter conditions than *Ficario-Ulmetum minoris*, but not so much as communities of the *Alnetea glutinosae* class. Communities do not occupy large areas and occur sporadically in shady nutrient-rich sites: alongside small streams, near springs, in the bottom of forested ravines. They can be found in various depressions with poor drainage, but at a higher hypsometric level than bogs usually develop. Microclimate conditions are damp and shady.

7–11. *Galeobdoloni luteae-Carpinetum betuli* Shevchyk, Bakalyna et V. Solomakha 1996

Dom.: Quercus robur, Carpinus betulus, Tilia cordata, Acer platanoides, Ulmus glabra
Const.: Acer campestre, Corylus avellana, Sambucus nigra, Euonymus verrucosus, Aegopodium podagraria, Galeobdolon luteum, Asarum europaeum, Stellaria holostea, Urtica dioica
Diff.: Dryopteris filix-mas, Mercurialis perennis, Carex pilosa, Galium odoratum, Polygonatum multiflorum, Pulmonaria obscura
EUNIS: G1.A162 – Sub-continental mixed lime-oak-hornbeam forests
Related syntaxa. *Tilio cordatae-Carpinetum Traczyk* 1962, *Polygonato odorati-Carpinetum betuli* Vorobyov et al. 2008, *Stellario holosteae-Aceretum platanoidis* Bajrak 1996, *Lamio maculati-Quercetum roboris* Bulokhov 1989

Within the association, we identified several variants:

- *Galeobdoloni-Carpinetum* var. *Acer campestre* – upper parts of slopes;
- *Galeobdoloni-Carpinetum* var. *Prunus avium* – no specific preferences in relief conditions;
- *Galeobdoloni-Carpinetum* var. *Mercurialis perennis* – lower parts of shady slopes;
- *Galeobdoloni-Carpinetum* var. *Carex pilosa* – tends to occur on steep slopes with good drainage.

The association unites mesic oak-hornbeam forests on nutrient-rich soils. In the Dnieper basin, the *Carpinion betuli* alliance is on the easternmost border of its geographic range. Due to climate continentality, many western suboceanic species disappear, and communities become poorer and less specific. In this regard, Ukrainian and Russian phytosociologists introduced two other alliances as vicariants of the western *Carpinion* alliance. In Ukraine, Onyshchenko (2009) proposed a new name *Scillo sibericae-Quercion roboris*. In Russia, related communities were placed in the *Querco roboris-Tilion* alliance (Bulokhov & Solomeshch 2003). In the study region, within the range of *Carpinus betulus*, we suppose oak-hornbeam forests might be still included in the *Carpinion* alliance and the closest type is the association *Galeobdoloni-Carpinetum*, described from the Kaniv Nature Reserve (Shevchyk et al. 1996).

Communities develop on rugged relief and elevated watersheds. In the depths of forest massifs and on slopes of ravines, they are still preserved and quite natural in species composition (*Actaea spicata, Epipactis helleborine, Lilium martagon, Neottia nidus-avis, Paris quadrifolia*), even in urban conditions. They have a two-layered structure formed with indigenous tree species. There is a notable difference in proportions of species of the first and the second classes (Table 4, *"diff"* column). This is also characteristic of natural communities (most anthropogenic communities demonstrate just the opposite trend in this table). Like previous association, these forests need protection as a type in which endangered species grow in urban area.

12. *Acer platanoides+Lapsana* community

Dom.: Acer platanoides, Quercus robur, Tilia cordata
Const.: Sambucus nigra, Urtica dioica, Impatiens parviflora, Geum urbanum, Viola odorata
Diff.: Lapsana communis, Glechoma hederacea, Scrophularia nodosa, Torilis japonica, Rumex sylvestris, Anthriscus sylvestris
EUNIS: G5.2 – Small broadleaved deciduous anthropogenic woodlands
Related syntaxa. *Chaerophillo temuli-Aceretum platanoidis* Kramarets et al. 1992 nom. invalid. (ICPN, art. 5), *Galeobdoloni luteae-Carpinetum betuli* subass. *impatientosum parviflorae* Goncharenko, Ignatyuk et Shelyag-Sosonko 2013

This is a type of forests of natural origin but transformed under recreational use. On the one hand, the tree layer is still dominated by indigenous species (*Quercus robur, Carpinus betulus* etc.). On the other hand, as a result of the devastating urban recreation, herb layer consists of most synanthropic species, especially from the class *Galio-Urticetea*. In the species composition, 32% species are from *Galio-Urticetea* and 25% species – from *Carpino-Fagetea* (Table 4). Because floristic composition of these stands is not very unique, we see such a vegetation cluster as "community", a provisional unit of vegetation, which can then be assigned a rank in the system when more evidence is available (Westhoff & Van der Maarel 1978).

13–16. *Dryopterido carthusianae-Pinetum sylvestris* ass. nov. hoc loco

Dom.: Quercus robur, Pinus sylvestris
Const.: Rubus caesius, Frangula alnus, Prunus serotina, Sorbus aucuparia, Convallaria majalis
Diff.: Dryopteris carthusiana, Pteridium aquilinum, Brachypodium sylvaticum, Luzula pilosa, Poa nemoralis, Milium effusum, Maianthemum bifolium, Elymus caninus
EUNIS: G4.7 – [*Pinus sylvestris*] woodland south of the taiga (G3.4) intimately mixed with acidophilous [Quercus] woodland (G1.8)
Holotypus: relevé 484 (Table S1); author: H. Yatsenko; date: 06.06.2016; locality: Ukraine, Kiev suburbs, Puscha-Voditsa locality; coordinates: 50.5424° N, 30.3262° E; total coverage of layers: trees – 60%, shrubs – 50%, herbs – 80%. *Carex ericetorum* +, *Convallaria majalis* 1, *Corylus avellana* +, *Dryopteris carthusiana* 2, *Festuca ovina* 1, *Frangula alnus* +, *Galeopsis bifida* 1, *Brachypodium sylvaticum* +, *Hypericum perforatum* +, *Impatiens parviflora* 2, *Luzula pilosa* 2, *Moehringia trinervia* 2, *Pilosella officinarum* +, *Pinus sylvestris* 3, *Poa nemoralis* +, *Prunus padus* 2, *Prunus serotina* 3, *Pteridium aquilinum* 2, *Quercus robur* 1, *Rubus idaeus* +, *Urtica dioica* +, *Veronica chamaedrys* +, *Veronica officinalis* 2, *Viola tricolor* subsp. *matutina* 1.
Related syntaxa. *Calamagrostio arundinaceae-Quercetum petraeae* (Hartmann 1934) Scamoni et Pass. 1959 em. Brzeg, Kasprowicz et Krotoska 1989, *Betulo pendulae-Quercetum roboris* R. Tx. 1930, *Trientalo europaeae-Quercetum roboris* Vorobyov 2014, *Querco roboris-Pinetum* Matuszkiewicz 1981, *Pino-Quercetum* Kozłowska 1925, *Vaccinio myrtilli-Quercetum roboris* Bulokhov et Solomeshch 2003, *Pulmonario obscurae-Quercetum roboris* Bulokhov et Solomeshch 2003, *Violo-Quercetum* sensu Goncharenko 2001 non Oberdorfer 1957, *Pteridio-Pinetum sylvestris* Andrienko 1986 nom. invalid. (ICPN, art. 2b, 5) (Andrienko 1986), *Pteridio-Pinetum* sensu Kuzemko 2001 non Andrienko 1986 (Kuzemko 2001), *Pteridio-Pinetum* sensu Bajrak 1997 non Andrienko 1986 (Bajrak 1997) .

The association includes pine and oak-pine forests on mesic, nutrient-poor and slightly acidic soils on sandy river terraces. It cannot be classified into the *Vaccinio-Piceetea* class with only few boreal species present, as well as nemoral species are also rare. This vegetation type is distributed in north-temperate European regions – especially Poland, *Calamagrostio-Quercetum* (Kasprowicz 2010), *Betulo-Quercetum* (Matuszkiewicz 2007), Ukraine

– *Trientalo-Quercetum* (Vorobyov 2014). The closest alliance might be the *Pino-Quercion* (currently recognized as a synonym of the *Dicrano-Pinion* alliance (Mucina et al. 2016)) and the closest association is *Querco roboris-Pinetum* that is often reported from Ukraine (Onyshchenko 2006, Solomakha 2008, Panchenko 2013). But syntaxonomic entity of *Querco-Pinetum* association is controversial, and some Polish authors suggest that it is close or even based on the type of the former association *Pino-Quercetum* Kozłowska 1925 (Ławrynowicz et al. 2004, Kasprowicz 2010).

Table 8 syntheses the floristic differences of syntaxa of acidophilous pine-oak forests according to published materials. The holotypus of the *Pino-Quercetum* association is presented in the last column.

Table 8: Comparative study of the syntaxa of pine-oak acidophilous forests. Rare species and I-II constancy values are not shown.
Tabela 8: Primerjalna analiza sintaksonov borovo-hrastovih kisloljubnih gozdov. Redke vrste in vrste s stalnostjo I-II niso prikazane.

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Number of relevés	115	26	20	?	14	11	20	36	82	47	23	9	9	8	6	6	26	5	3
Pinus sylvestris	V	.	.	V	IV	IV	IV	V	V	V	V	V	IV	V	V	V	V	.	V
Quercus robur	V	V	V	V	V	V	V	V	III	III	IV	IV	.	.	V	IV	V	V	V
Convallaria majalis	V	V	IV	V	IV	III	.	.	.	IV	.	.	.	IV	.	III	IV	III	IV
Betula pendula	.	V	V	.	IV	III	IV	V	III	III	IV	III	III	.	.	V	V	.	II
Fragaria vesca	.	V	IV	IV	.	IV	.	.	.	IV	.	IV	.	IV	III	.	III	IV	IV
Vaccinium myrtillus	.	V	.	V	V	III	V	V	V	V	V	V	.	.	.	V	V	.	V
Vaccinium vitis-idaea	.	V	.	IV	III	.	IV	IV	V	IV	.	.	.	.	.	V	IV	.	.
Luzula pilosa	.	III	.	III	V	V	IV	V	III	IV	IV	III	.	.	.	V	V	.	.
Frangula alnus	.	IV	.	IV	V	V	V	V	III	III	IV	IV	IV	.	.	V	V	.	.
Sorbus aucuparia	.	IV	III	.	V	IV	V	V	IV	IV	IV	V	.	V	.	V	V	.	.
Trientalis europaea	.	III	IV	IV	IV	IV	V	IV	.	.	III	III	.	.	.	V	V	.	.
Pteridium aquilinum	IV	IV	.	IV	III	III	IV	IV	IV	III	III	.	.	.	V	IV	III	V	IV
Melica nutans	.	IV	IV	IV	III	III	.	.	.	.	.	.	.	IV	.	.	III	III	II
Corylus avellana	III	IV	V	IV	IV	.	.	.	.	.	.	.	.	.	.	.	III	.	V
Euonymus verrucosus	III	.	IV	III	.	.	.	.	.	.	.	.	.	.	.	.	III	.	IV
Maianthemum bifolium	.	.	V	.	IV	V	V	III	.	.	.	.	.	.	.	IV	V	.	V
Calamagrostis arundinacea	.	.	IV	V	III	.	.	.	.	IV	.	.	.	.	.	III	.	.	.
Rubus saxatilis	.	IV	III	V	III	.	.	.	.	III	.	.	III	III	.	.	IV	.	.
Dicranum polysetum	.	.	.	III	.	.	.	III	III	III	.	.	.	.	.	.	.	.	.
Melampyrum pratense agg.	.	.	.	III	.	.	III	.	III	III	.	.	.	.	.	IV	III	.	V
Carpinus betulus	.	.	.	.	V	.	.	.	.	.	III	III	.	.	.	.	.	.	V
Rubus idaeus	.	.	.	.	.	V	.	.	.	III	III	V	.	IV	.	IV	.	.	.
Veronica officinalis	.	.	.	.	.	III	.	.	.	III	.	III	III	III	.	.	III	.	V
Dryopteris carthusiana	IV	.	.	.	IV	IV	V	IV	.	.	IV	V	V	IV	.	V	V	.	.
Molinia caerulea	.	.	.	.	III	.	V	V	.	.	.	.	III	.	.	.	IV	.	.
Pleurozium schreberi	.	III	.	.	.	.	.	.	V	V	IV	V	.	.	.	.	.	.	.
Brachypodium sylvaticum	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euonymus europaeus	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Impatiens parviflora	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus serotina	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus caesius	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sambucus nigra	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ulmus laevis	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Urtica dioica	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	III	.
Galium mollugo	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Orthilia secunda	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.
Pyrola rotundifolia	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Serratula tinctoria	.	III	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola nemoralis	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aegopodium podagraria	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epipactis helleborine	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geranium sylvaticum	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geum urbanum	III	.	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.
Lathyrus vernus	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Milium effusum	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Populus tremula	.	.	V	.	III	.	III	III	.	.	.	.	.	.	.	.	.	.	II
Pulmonaria obscura	.	.	V	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Viola mirabilis	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex digitata	.	.	.	IV	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.
Solidago virgaurea	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ajuga reptans	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia vulgaris	.	.	.	.	III	III	.	.	.	.	.	.	III	.	.	.	.	.	.
Rubus nessensis	.	.	.	.	III	.	III	.	.	.	.	.	.	.	.	.	.	.	.
Amelanchier ovalis	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.
Anemone nemorosa	.	.	.	.	III	IV	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca rubra	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.
Galeopsis tetrahit	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygonatum multiflorum	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.
Alnus glutinosa	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia nummularia	.	.	.	.	.	.	IV	.	.	.	.	.	.	.	.	.	.	IV	.
Polytrichum commune	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.
Rhododendron luteum	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.
Festuca ovina agg.	.	.	.	.	.	.	.	IV	IV	IV	.	.	.	.	.	III	.	.	V
Picea abies	.	.	.	.	.	.	.	III	III	.	III	.	.	.	.	.	.	.	.
Polytrichum formosum	.	.	.	.	.	.	.	IV	III	.	III	III	.	.	.	.	.	.	.
Oxalis acetosella	.	.	.	.	.	.	.	III	.	.	.	IV	.	.	.	.	.	.	II
Carex pilulifera	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.
Dicranum scoparium	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.
Pohlia nutans	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.
Quercus petraea	.	.	.	.	.	.	.	.	III	III	III	III	.	.	.	.	.	.	.
Agrostis capillaris	.	.	.	.	.	III	.	.	.	.	.	IV	.	III	.	.	.	.	V
Campanula rotundifolia	.	.	.	.	.	.	.	.	.	.	.	III	.	III	.	.	.	.	.
Carex hirta	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.
Hypericum perforatum	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.	.
Moehringia trinervia	III	.	.	.	.	.	.	.	.	III	.	IV	.	IV	.	.	.	.	.
Mycelis muralis	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.
Pseudoscleropodium purum	.	.	.	.	.	.	.	III	.	IV	.	V	.	.	.	.	.	.	.
Rumex acetosella	.	.	.	.	.	.	.	.	.	.	.	IV	.	IV	.	.	.	.	.
Viola reichenbachiana	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	V
Anthoxanthum odoratum	.	.	.	.	.	.	.	.	.	III	.	III	IV	.	.	.	.	.	.
Betula pubescens	.	.	.	.	.	.	III	.	.	.	.	.	IV	.	.	.	.	.	.
Carex leporina	.	.	.	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	.
Carex pallescens	.	.	.	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	IV

ID syntaxa	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Deschampsia cespitosa	.	.	.	.	.	III	.	.	.	.	.	.	V	.	.	.	.	.	.
Juncus effusus	.	.	.	.	.	.	.	.	.	.	.	.	V	.	.	.	.	.	.
Potentilla erecta	.	III	.	.	.	.	.	.	.	.	.	.	IV	.	.	.	.	.	II
Calamagrostis epigejos	.	.	.	.	.	.	.	.	.	.	.	III	.	IV	.	.	.	.	.
Chelidonium majus	.	.	.	.	.	.	.	.	.	.	.	.	.	V	IV	.	.	.	.
Elymus caninus	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.
Micarea myriocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.
Poa nemoralis	.	.	.	.	.	.	.	.	.	.	.	.	.	V	IV	.	.	.	.
Silene nutans	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.
Polygonatum odoratum	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.
Betonica officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	III	.
Lactuca serriola	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV	.	.	.	.
Scrophularia nodosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.
Sedum ruprechtii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.
Calluna vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	II
Acer platanoides	III	.	III	.	III	.	.	.	.	.	.	.	.	.	.	.	IV	.	.
Stellaria holostea	.	.	.	III	.	III	.	.	.	.	.	.	.	.	.	.	IV	.	IV
Asarum europaeum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	II
Clematis recta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Clinopodium vulgare	.	IV	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V	.
Torilis japonica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.
Veronica chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	IV	.
Viola hirta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.
Crataegus monogyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Daphne mezereum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Galium intermedium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Galium vernum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Hepatica nobilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Hieracium murorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Hypericum montanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Juniperus communis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Lactuca muralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Lathyrus niger	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Luzula nemorosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Lysimachia borealis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
Melampyrum nemorosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Pyrola secunda	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Sanicula europaea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV

ID Syntaxa: 1 – *Dryopterido carthusianae-Pinetum sylvestris* (Ukraine, Kyiv region), 2 – *Vaccinio myrtilli-Quercetum roboris typicum* (Russia, Bryansk region) (Semenishchenkov 2018), 3 – *Pulmonario obscurae-Quercetum roboris* typicum (Russia, Bryansk region) (Semenishchenkov 2018), 4 – *Querco roboris-Pinetum* coryletosum (Russia, Bryansk region, the "Bryansk forest" Nature Reserve) (Morozova 1999), 5, 6, 7 – *Trientalo europaeae–Quercetum roboris* (5 – subass. *carpinietosum betuli*, 6 – subass. *coryletosum avellanae*, 7 – subass. *molinietosum caeruleae*) (Ukraine, Zhitomyr Polyssya) (Vorobyov 2014), 8-12 – *Querco roboris-Pinetum* (8 – subass. *molinietosum,* 9 – subass. *typicum,* 10 – subass. *coryletosum,* 11 – derivative community of *Querco roboris-Pinetum typicum,* 12 – derivative community of *Querco roboris-Pinetum coryletosum*) (Kasprowicz 2010), 13 – *Querceto roboris-Betuletum* (Ukraine, Sumy region) (Goncharenko 2001), 14 – *Violo-Quercetum* (Ukraine, Sumy region) (Goncharenko 2001), 15 – *Pteridio-Pinetum* (Ukraine, Cherkasy region) (Kuzemko 2001), 16, 17 – *Querco roboris-Pinetum* (16 – *typicum*, 17 – *coryletosum*) (Ukraine, Sumy region) (Panchenko 2013), 18 – *Pteridio aquilini-Quercetum roboris* (Ukraine, Poltava region) (Bajrak 1996), 19 – *Pineto-Quercetum* Kozłowska 1925, holotypus (Poland, Jaksice, Zarogów, Klonów regions) (Kozłowska 1925)

Despite many of common species, almost each association has own differentiating species, as can be seen from a long tail part of the table. In Western Russia, acidophilous mixed forests were classified in a separate alliance *Vaccinio myrtilli-Quercion roboris* (Bulokhov & Solomeshch 2003). Authors emphasized that communities of the Bryansk region significantly differ from those related in Central Europe and discussed this issue in detail (Semenishchenkov 2018). We also support this point of view and consider our association to be the eastern acidophilic type of mixed pine-oak forests, therefore we classified it in this alliance.

17. *Chamaecytiso zingeri-Pinetum sylvestris* Vorobyov, Balaschov et *V. Solomakha* 1997

Dom.: *Pinus sylvestris*
Const: *Festuca ovina, Calamagrostis epigejos, Genista tinctoria, Cytisus ruthenicus*
Diff.: *Rumex acetosella, Pilosella officinarum, Hypericum perforatum, Silene nutans, Hypochaeris radicata*
EUNIS: G4.72 – Continental nemoral pine-oak forests
Related syntaxa. *Peucedano-Pinetum* Matuszkiewicz (1962) 1973, *Veronico incanae-Pinetum* Bulokhov et Solomeshch 2003, *Thymo serpylli-Pinetum sylvestris* Bulokhov et Solomeshch 2003, *Calamagrostio arundinaceae-Pinetum sylvestris* Shevchyk et V. Solomakha 1996.

The association includes subcontinental xeric pine forests with a herbaceous layer dominated by drought-adapted grasses. Communities cover gentle slopes of sandy dunes on river terraces. These forests are usually maintained by recurrent wildfires. Their syntaxonomical affiliation is a matter of debate. Some authors put them in a separate *Pulsatillo-Pinetea sylvestris* class. But it depends on the region. We believe this class is more southern one, covering the steppe and the southernmost part of forest-steppe zones. Our communities should not be attributed to the association *Festuco-Pinetum sylvestris* Kobendza 1930 either because many diagnostic species (*Antennaria dioica, Anthericum, ramosum, Asperula tinctoria,* and *Brachypodium pinnatum*) (Chytrý et al. 2013 p. 386) are absent. The type from the Ukrainian Polissya should be characterized as oligotrophic and acidophilic (Pogrebnyak 1955). There are similar associations of xeric pine forests – *Peucedano-Pinetum* from Poland (Matuszkiewicz 2007), *Chamaecytisi zingeri-Pinetum* from Ukraine (Vorobyov et al. 1997), and *Veronico incanae-Pinetum* from Western Russia (Bulokhov & Solomeshch 2003). Most likely, these associations are vianants, replacing each other in the direction from west to east. We classified our communities in the second type of *Chamaecytisi zingeri-Pinetum* also relying on geographical proximity. The absence of *Cytisus zingeri* (*Cytisus ruthenicus* agg.) in our case does not make much difference, since other characteristic species (*Genista tinctoria, Hypericum perforatum, Silene nutans* etc.) are common.

18. *Polygonato odorati-Quercetum roboris* (Shevchyk et V. Solomakha 1996) Goncharenko et Yatsenko nom. nov. hoc loco

Dom.: *Pinus sylvestris, Quercus robur*
Const.: *Cytisus ruthenicus, Poa nemoralis, Convallaria majalis, Polygonatum odoratum*
Diff.: *Clinopodium vulgare, Betonica officinalis, Geranium sanguineum, Euphorbia cyparissias, Teucrium chamaedrys, Digitalis grandiflora, Turritis glabra, Silene nutans, Hypericum perforatum*
EUNIS: G4.C – Mixed *Pinus sylvestris* – thermophilous *Quercus* woodland

Related syntaxa: *Lathyro nigri-Quercetum roboris* Bulokhov et Solomesch 2003, *Chamaecytiso ruthenici-Quercetum roboris* Semenishchenkov, Poluyanov 2014, *Galio tinctori-Quercetum roboris* Goncharenko 2003, *Pteridio aquilini-Quercetum robori* Bajrak 1996, *Vincetoxico hirundinariae-Quercetum roboris* Sokolova 2011, *Violo hirtae-Quercetum roboris* Vorobyov 2017, *Potentillo albae-Quercetum petraeae* Libbert 1933, *Potentillo albae-Quercetum roboris* Bulokhov 1991

The association includes dry-mesic oak and oak-pine forests. Communities are easily identifiable due to a rich herbaceous layer consisting of light-demanding species, which are mainly characteristic for the *Trifolio-Geranietea* class. The percentage of species of the latter class equals 22% (Table 4). The tree layer is mainly composed by a late phenologic form of oak species (*Quercus robur* var. *tardiflora*) with a frequent admixture of *Pinus sylvestris*. This association is included in the class *Quercetea pubescenti-petraeae* mainly following the tradition in Ukrainian syntaxonomy (Solomakha 2008). In EuroVegChecklist, the *Convallario majalis-Quercion roboris* alliance is considered a synonym of *Aceri tatarici-Quercion* Zólyomi 1957, which also belongs to the *Quercetea pubescenti-petraeae* class. In fact, the placement of clusters 13–18 into different classes of vegetation is a more nomenclatural solution. In the study region, all three classes of vegetation – *Vaccinio-Piceetea, Quercetea pubescenti-petraeae,* and *Quercetea robori-petraeae* are outside their main distribution optima. Therefore, their communities greatly converge towards each other. This becomes especially manifested in xeric conditions.

Unfortunately, the former name *Convallario majalis-Quercetum roboris* (as suggested by Shevchyk et al. 1996) is not legitimate. It is a later homonym of the earlier Hungarian association *Convallario majalis-Quercetum* *roboris* Soó (1939) 1957 (Soó 1957). We suggest replacing this name.

New name: *Polygonato odorati-Quercetum roboris* (Shevchyk et V. Solomakha 1996) Goncharenko et Yatsenko nom. nov. hoc loco

Synonym: *Convallario majalis-Quercetum roboris* sensu Shevchyk et V. Solomakha 1996 non Soó (1939) 1957 (ICPN, art. 31) (Shevchyk et al. 1996, p. 47)

Lectotypus: Table 9, relevé 7 (Shevchyk et al. 1996 p. 48)

Note: The choice of lectotype was motivated by an error (possibly a typo) made by Shevchyk et al. (1996) who used the same relevé (rel. 10 in table 9) as a holotype of – *Asaro europei-Betuletum* Shevchyk et V. Solomakha 1996 (Shevchyk et al. 1996 p. 46) and *Convallario majalis-Quercetum roboris* (Shevchyk et al. 1996 p. 47).

Conclusions

We provided the results of floristic-sociological classification of the most common types of forest vegetation of the Kyiv urban area. The syntaxonomic scheme includes 7 classes of vegetation, but most of them are represented by only one association. We stated a rather small floristic differences of communities within the *Vaccinio-Piceetea, Quercetea robori-petraeae,* and *Quercetea pubescenti-petraeae* classes. All of them are outside of their distribution optima and communities are not typical in the region. A comparative floristic analysis was conducted to confirm significant differences between the described syntaxa and western associations and some of them were proposed new ones. Anthropogenic pressure has led to a significant reduction in the total coenotic diversity of the forest vegetation of the capital. Nevertheless, in some protected areas, on the outskirts of Kyiv and on the Dnieper islands, communities with natural features are still occasionally preserved. First of all, this concerns broad-leaved forests on a rugged elevated relief. They require protection, since it is here that most of the vulnerable species are concentrated.

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Appendix

Table 1: Synoptic table of studied forest vegetation. Constancies higher than 40% threshold marked in bold.
Tabela 1: Sinoptična tabela obravnavane gozdne vegetacije. Stalnost vrst večja od 40%, je prikazana krepko.

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Number of relevés	39	22	26	7	21	9	53	64	11	21	55	30	17	36	33	115	35	41
Aristolochio clematitis-Populetum nigrae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex thyrsiflorus	**74***	.	4	.	.	.	.	.	.	.	.	.	.	.	6	.	11	10
Galium rubioides	**54**	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus officinalis	**69**	.	.	.	.	.	.	.	.	.	.	.	12	.	.	.	6	15
Sedum telephium	**64**	5	.	.	.	.	.	.	.	.	.	.	.	3	.	3	6	15
Tanacetum vulgare	**46**	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
Galium verum	**49**	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	10
Carex praecox	28	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galio aparines-Aceretum negundi var. Aristolochia clematitis																		
Aristolochia clematitis	**97**	**100**	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galio aparines-Aceretum negundi																		
Galium aparine	**62**	**100**	**100**	.	5	11	**49**	8	.	.	25	27	**53**	6	**52**	20	9	5
Myosotis sparsiflora	.	23	35	.	.	.	.	.	.	.	.	7	.	.	3	.	.	.
Stellaria media	28	36	**50**	.	.	11	2	2	.	.	2	7	.	.	15	2	6	.
Balloto nigrae-Robinietum pseudoacaciae var. Acer tataricum																		
Acer tataricum	10	36	8	**100**	10	.	23	8	.	19	18	17	12	25	24	20	3	5
Balloto nigrae-Robinietum pseudoacaciae																		
Robinia pseudoacacia	5	9	31	**100**	**76**	.	17	20	18	14	15	37	6	25	9	35	17	32
Ballota nigra	8	27	31	**71**	**48**	.	6	6	9	10	5	20	.	.	.	.	9	.
Carici remotae-Alnetum glutinosae																		
Alnus glutinosa	.	.	.	.	.	**89**	.	.	.	.	.	.	.	.	.	.	.	.
Carex remota	.	.	.	.	.	**89**	2	.	.	5	.	3	.	.	3	.	.	.
Athyrium filix-femina	.	.	.	.	.	**44**	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus sylvaticus	.	.	.	.	.	**44**	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia vulgaris	.	9	.	.	.	**44**	.	.	.	.	.	.	.	.	.	1	.	.
Cardamine amara	.	.	.	.	.	33	.	.	.	.	.	.	.	.	.	.	.	.
Chrysosplenium alternifolium	.	.	.	.	.	22	2	.	.	.	.	.	.	.	.	.	.	.

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Galeobdoloni luteae-Carpinetum betuli var. Acer campestre																		
Acer campestre	.	18	.	.	.	.	**100**	8	.	.	.	3	6	3	.	1	.	2
Galeobdoloni luteae-Carpinetum betuli var. Prunus avium																		
Prunus avium	5	18	8	.	.	.	4	**100**	.	5	7	7	.	22	3	9	3	10
Galeobdoloni luteae-Carpinetum betuli var. Mercurialis perennis																		
Mercurialis perennis	.	.	.	.	.	11	21	.	**100**	38	24	.	.	.	.	.	.	.
Galeobdoloni luteae-Carpinetum betuli var. Carex pilosa																		
Carex pilosa	.	.	.	.	.	.	25	.	.	**100**	24	3	6	.	.	.	.	.
Galeobdoloni luteae-Carpinetum betuli & d.s. ord. Fagetalia																		
Tilia cordata	5	18	23	.	38	**44**	**58**	**55**	**91**	**86**	**69**	30	6	8	12	10	.	.
Carpinus betulus	5	5	4	.	24	**44**	**85**	**67**	18	**90**	**84**	33	24	8	27	24	3	2
Asarum europaeum	.	.	.	.	10	**56**	**66**	34	**82**	**52**	**67**	10	.	.	9	2	.	.
Galeobdolon luteum	.	.	.	.	10	**89**	**42**	11	**55**	**71**	**56**	17	.	.	24	3	.	.
Aegopodium podagraria	.	.	15	.	14	**89**	36	14	**91**	**57**	**40**	7	.	.	9	.	.	.
Dryopteris filix-mas	10	36	.	14	33	22	25	30	**73**	33	35	3	35	.	.	6	3	.
Galium odoratum	.	.	.	.	.	.	**51**	**56**		19	**44**	7	.	.	.	.	.	.
Paris quadrifolia	3	5	.	.	5	33	9	33	9	10	13	7	.	.	.	3	.	.
Actaea spicata	.	.	.	.	.	11	2	20	**45**	10	11	3	.	.	.	3	.	.
Pulmonaria obscura	.	.	.	.	.	11	**66**	**47**	27	14	**76**	10	.	.	.	.	.	.
Stellaria holostea	.	.	.	.	.	**44**	**75**	11	9	24	**78**	10	.	.	33	6	3	.
Polygonatum multiflorum	.	5	4	14	10	33	**70**	**42**	**45**	**67**	**75**	7	.	.	.	6	.	.
Acer platanoides+Lapsana communis community																		
Lapsana communis	5	5	.	.	.	.	2	8	.	5	4	**100**	.	.	6	5	6	.
Dryopterido carthusianae-Pinetum sylvestris var. Cardamine impatiens																		
Cardamine impatiens	.	5	.	.	.	.	6	2	.	.	5	10	**100**	11	.	3	6	5
Dryopterido carthusianae-Pinetum sylvestris var. Fragaria vesca																		
Berberis vulgaris	3	.	.	.	.	.	8	2	.	.	2	.	12	**100**	6	3	3	**49**
Fragaria vesca	28	23	.	.	.	.	.	6	.	.	.	17	35	**56**	15	15	6	**46**
Dryopterido carthusianae-Pinetum sylvestris var. Carex ericetorum																		
Amelanchier spicata	.	.	.	.	.	.	.	.	.	.	.	3	.	.	**79**	5	6	.
Carex ericetorum	3	.	.	.	.	.	.	.	.	.	.	7	.	.	**76**	10	14	.
Luzula pilosa	.	.	.	.	.	.	.	.	.	.	.	.	.	6	**58**	22	9	2
Dryopterido carthusianae-Pinetum sylvestris & d.s. ord. Quercetalia roboris																		
Convallaria majalis	5	18	8	.	5	22	**42**	38	.	29	**51**	**43**	**94**	**92**	**97**	**88**	**63**	**83**
Prunus serotina	3	5	4	.	.	33	2	14	.	.	.	37	**88**	**97**	**88**	**80**	**83**	**80**
Dryopteris carthusiana	10	32	4	.	19	**78**	9	12	36	38	22	33	18	**72**	**70**	**67**	**40**	12
Poa nemoralis	13	32	4	**43**	5	11	21	9	.	29	24	37	**71**	**61**	21	32	20	32
Pteridium aquilinum	.	.	.	.	.	.	2	12	.	.	.	33	**76**	**56**	**73**	**64**	**43**	**46**
Melica nutans	.	.	.	.	.	.	6	11	.	.	5	17	**71**	**69**	18	31	17	**54**
Galeopsis bifida	.	.	4	.	.	.	2	5	.	.	.	17	12	19	**91**	31	**69**	15
Brachypodium sylvaticum	.	.	.	.	.	.	6	11	.	5	.	23	18	**89**	3	**83**	11	22
Frangula alnus	.	5	.	.	.	11	.	3	.	.	.	3		33	15	17	**40**	27
Sambucus racemosa	.	.	4	.	.	.	.	6	.	.	.	17	6	31	18	24	31	5
Rubus idaeus	15	23	19	.	.	.	.	2	9	5	.	17	12	19	21	24	17	2

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Chamaecytiso zingeri-Pinetum sylvestris																		
Rumex acetosella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	4	**63**	5
Festuca ovina	5	.	.	.	.	.	.	.	.	.	.	.	.	.	6	5	**69**	20
Calamagrostis epigejos	.	.	.	.	.	.	.	.	.	.	.	7	.	14	3	1	**74**	**44**
Pilosella officinarum	3	.	.	.	.	.	.	.	.	.	.	.	6	8	.	1	**66**	32
Avenella flexuosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	26	.
Genista tinctoria	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	26	.
Hypericum perforatum	3	.	.	.	.	.	.	.	.	.	2	17	35	25	21	10	**63**	37
Veronica officinalis	.	.	.	.	.	.	.	.	9	.	.	13	12	11	15	10	**49**	39
Polygonato odorati-Quercetum roboris																		
Peucedanum oreoselinum	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	17	**80**
Campanula rotundifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	**59**
Melampyrum pratense	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	23	**68**
Geranium sanguineum	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	6	**59**
Hieracium umbellatum	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	1	6	**51**
Cytisus ruthenicus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**41**
Euphorbia cyparissias	.	.	.	.	.	.	.	.	.	.	.	.	12	3	.	.	.	**49**
Polygonatum odoratum	.	.	4	.	.	.	.	5	.	10	.	.	35	31	6	3	17	**78**
Rubus saxatilis	.	.	.	.	.	.	.	8	.	.	.	10	6	17	.	19	.	**49**
Betonica officinalis	.	.	.	.	.	.	.	3	.	.	.	3	6	25	.	3	9	**44**
Salicetea purpureae																		
Rubus caesius	**51**	**77**	**65**	29	24	22	6	**45**	9	5	13	27	35	**69**	**52**	**60**	**43**	27
Festuca gigantea	10	27	23	.	.	22	2	9	.	.	2	**43**	12	39	**42**	35	.	12
Humulus lupulus	21	14	4	**43**	14	.	.	8	.	.	2	13	.	22	12	32	17	5
Stachys sylvatica	5	18	23	14	5	22	23	9	27	19	22	3	.	.	.	1	.	.
Populus nigra	**54**	**82**	38	.	.	11	2	.	.	.	2	.	.	.	.	.	.	.
Silene baccifera	18	27	.	.	.	.	.	11	.	.	.	13	18	28	3	33	11	5
Populus alba	26	32	23	.	.	.	6	6	.	14	5	3	.	.	.	1	.	.
Amorpha fruticosa	28	18	.	.	.	.	.	.	.	.	.	.	.	3	.	3	9	5
Populus tremula	5	14	8	.	.	.	6	3	.	5	4	10	.	.	.	2	3	.
Salix alba	18	18	.	.	.	.	4	3	9	.	5	.	.	.	.	.	.	.
Robinietea																		
Impatiens parviflora	28	**59**	**69**	14	**100**	**100**	**64**	**94**	**91**	**90**	**64**	**87**	**88**	**100**	**97**	**95**	**54**	34
Chelidonium majus	23	18	**54**	**100**	**86**	22	28	30	.	14	35	**80**	**41**	**44**	**55**	**65**	37	32
Geranium robertianum	38	**55**	23	14	14	11	38	**53**	**64**	29	36	**70**	**53**	**67**	**73**	**69**	31	**41**
Acer negundo	**44**	**77**	**88**	**86**	**81**	.	9	**41**	18	14	20	**40**	**41**	**78**	21	**57**	9	34
Parthenocissus quinquefolia	33	**77**	**96**	29	**48**	.	13	11	27	24	11	37	**47**	28	27	23	9	5
Erigeron annuus	**56**	**41**	27	**71**	10	11	8	11	9	10	16	**40**	29	11	18	9	37	29
Oxalis dillenii	8	.	.	.	14	11	6	6	9	.	4	27	24	.	.	5	9	2
Quercus rubra	31	32	15	.	10	11	4	2	.	.	4	3	.	.	6	1	11	.
Acer saccharinum	8	5	19	29	14	.	2	.	9	.	.	.	.	3	.	1	.	2
Acer pseudoplatanus	.	.	4	.	24	.	2	3	9	14	4	3	.	.	.	.	.	.
Carpino-Fagetea																		
Quercus robur	38	9	12	.	29	**44**	**74**	**91**	**73**	**76**	**75**	**83**	**94**	**89**	**100**	**86**	**89**	**80**
Acer platanoides	18	**45**	**58**	**86**	**86**	33	**94**	**78**	**64**	**76**	**64**	**70**	35	33	27	**44**	17	20
Ulmus laevis	**62**	**86**	**85**	**86**	**48**	.	36	11	18	10	24	37	**47**	**42**	**45**	**50**	14	17
Euonymus europaeus	3	18	12	**86**	**86**	11	**68**	**73**	36	33	**67**	**43**	24	33	12	**45**	9	22
Euonymus verrucosus	.	.	.	.	19	.	**53**	36	**45**	**67**	**55**	23	**65**	**78**	39	**47**	31	29
Corylus avellana	.	.	4	29	24	33	17	**59**	**73**	14	**42**	**40**	12	17	**45**	**48**	34	7
Prunus padus	8	27	12	14	10	**67**	6	22	27	10	5	30	6	17	**61**	37	29	2
Crataegus monogyna	28	**41**	15	29	5	.	32	**45**	.	19	22	13	**53**	31	18	21	6	12
Fraxinus excelsior	33	**50**	23	14	29	11	**57**	19	9	38	38	7	.	3	.	2	3	.

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Cornus sanguinea	**49**	77	**69**	.	29	11	8	39	18	10	11	10	.	3	.	.	.	.
Ulmus glabra	.	.	.	.	14	11	**42**	**61**	36	19	29	30	.	6	3	12	.	2
Viola mirabilis	.	5	.	.	.	11	21	28	9	10	31	10	6	8	6	10	9	.
Milium effusum	.	.	4	.	.	**44**	4	3	.	5	2	17	6	14	33	24	11	2
Pyrus communis	.	14	15	.	.	.	17	2	9	5	5	3	18	17	6	10	6	20
Circaea lutetiana	.	.	.	.	.	22	4	30	27	14	11	3	.	6	.	14	.	.
Malus sylvestris	5	5	8	.	5	.	.	11	9	.	7	3	12	3	24	4	3	5
Anemone ranunculoides	.	.	.	.	.	.	**49**	.	.	.	33	.	.	.	.	.	.	.
Corydalis cava	.	.	.	.	.	.	**53**	.	.	.	27	.	.	.	.	.	.	.
Vaccinio-Piceetea																		
Pinus sylvestris	**51**	9	4	.	5	.	4	20	.	.	2	**57**	**100**	**100**	**100**	**99**	**100**	**100**
Sorbus aucuparia	18	**41**	8	.	10	22	6	19	.	19	9	10	29	25	3	10	9	**46**
Maianthemum bifolium	.	.	.	.	10	**56**	2	23	.	29	7	13	6	11	27	34	6	.
Vaccinium myrtillus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	3	.
Epilobietea angustifolii																		
Geum urbanum	**56**	**73**	**92**	**100**	**86**	**89**	**62**	**89**	**82**	38	**58**	**73**	**76**	**56**	39	**43**	3	15
Urtica dioica	8	**50**	**46**	**86**	**81**	**44**	**45**	**72**	**91**	33	**58**	**97**	**88**	**56**	**67**	**78**	26	17
Sambucus nigra	5	14	**46**	**86**	**100**	**44**	**51**	77	**91**	**76**	**73**	**57**	**59**	31	6	**50**	11	10
Alliaria petiolata	13	**59**	**85**	**100**	**48**	11	**57**	20	18	14	24	**47**	18	28	33	39	6	5
Viola odorata	15	**50**	**69**	**71**	**62**	22	**53**	33	18	38	**55**	17	6	3	3	1	3	2
Moehringia trinervia	26	36	8	14	.	11	6	11	.	14	11	23	29	**50**	**88**	**57**	**43**	12
Glechoma hederacea	28	**45**	31	.	10	11	21	19	27	5	13	**53**	24	25	**61**	20	11	2
Fallopia dumetorum	26	32	4	.	29	22	11	19	.	5	11	27	12	**50**	9	**42**	9	27
Lactuca muralis	3	5	.	.	10	33	2	16	27	38	11	30	**59**	22	18	19	11	20
Chaerophyllum temulum	5	**41**	**46**	**71**	19	.	38	16	9	5	18	23	.	.	.	2	.	.
Torilis japonica	36	23	.	.	.	.	.	19	.	.	5	27	12	17	15	4	.	7
Scrophularia nodosa	8	9	.	.	.	11	15	6	.	10	7	33	.	.	3	2	.	.
Koelerio-Corynephoretea																		
Potentilla argentea	13	.	.	.	.	.	.	.	.	.	.	3	.	.	3	.	3	5
Bromus inermis	15	.	.	.	.	.	.	.	.	.	.	3	.	.	3	.	.	.
Koeleria glauca	18	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myosotis stricta	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia marschalliana	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Molinio-Arrhenathretea																		
Lysimachia nummularia	**59**	**91**	35	.	.	11	4	33	9	.	4	7	6	.	.	3	.	.
Poa pratensis	**74**	27	12	.	.	.	.	2	.	.	.	.	6	8	33	12	**40**	37
Dactylis glomerata	38	36	15	.	5	22	.	5	.	5	5	23	18	8	6	1	9	24
Carex hirta	**41**	23	.	.	.	.	.	.	.	.	.	13	6	8	3	8	20	17
Equisetum pratense	**49**	**45**	8	.	.	22	2	.	.	.	2	3	.	.	.	.	.	.
Achillea submillefolium	21	5	.	.	.	.	.	.	.	.	.	17	.	3	3	.	6	22
Alopecurus pratensis	**54**	5	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis capillaris	3	.	.	.	.	.	.	.	.	.	.	3	.	3	6	.	6	37
Elymus repens	8	.	8	.	.	.	.	.	.	.	.	13	.	.	.	.	11	5
Stellaria graminea	31	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	9	.
Ranunculus polyanthemos	31	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostis gigantea	.	.	.	.	.	.	.	.	.	.	.	3	6	.	.	1	20	2
Rhinanthus vernalis	23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca pratensis	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago lanceolata	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trifolio-Geranietea																		
Veronica chamaedrys	36	27	31	.	.	.	15	5	.	5	2	17	**53**	17	**42**	15	31	34
Clinopodium vulgare	.	.	.	.	.	.	.	2	.	.	.	10	12	**44**	12	10	9	39
Vincetoxicum hirundinaria	13	.	.	.	.	.	6	2	.	.	.	.	24	.	.	.	17	29

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Silene nutans	.	.	.	.	.	.	.	.	.	.	.	.	18	.	.	1	26	12
Eryngium planum	38	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthericum ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	9	22
Trifolium montanum	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Filipendula vulgaris	28	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species																		
Betula pendula	**44**	9	8	.	.	.	4	17	.	5	4	17	.	6	6	17	14	17
Ligustrum vulgare	**44**	**50**	8	.	.	.	21	2	.	.	2	.	.	3	.	.	.	.
Carex contigua	8	23	4	.	.	11	.	3	9	.	2	10	18	14	6	10	.	5
Erigeron canadensis	38	9	8	14	.	.	6	.	.	.	2	13	.	6	.	3	9	7
Ficaria verna	3	9	27	.	.	.	32	.	.	5	24	.	.	.	.	.	.	..
Taraxacum officinale	31	23	4	.	.	.	8	2	.	.	2	10	6	.	.	.	.	2
Ptelea trifoliata	5	5	.	.	.	.	.	.	.	.	.	.	29	14	6	9	11	7
Melandrium album	5	27	15	.	.	.	.	.	.	.	.	10	.	3	6	1	6	5
Glechoma hirsuta	3	5	.	.	24	.	9	2	9	14	7	.	6	.	.	1	.	.
Viburnum opulus	5	14	.	.	.	11	8	23	.	5	2	.	.	3	.	.	3	.
Plantago major	3	9	4	.	.	11	2	5	9	.	.	23	.	.	.	.	.	.
Oxalis acetosella	.	.	.	.	.	33	.	.	.	.	.	7	.	.	21	5	.	.
Viola matutina	.	.	.	.	.	.	.	.	9	.	.	3	.	.	6	3	34	2
Artemisia vulgaris	18	9	.	.	.	.	.	3	.	.	2	20	.	.	.	.	.	.
Carex sylvatica	.	.	.	.	.	22	4	5		10	9	.	.	.	.	.	.	.
Solanum dulcamara	.	.	.	.	.	33	.	.	.	.	.	.	6	3	.	2	3	.
Hemerocallis fulva	.	5	**42**	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berteroa incana	10	9	.	.	.	.	.	.	.	.	.	.	.	.	.	1	9	12
Bromus mollis	8	5	.	14	10	.	2	2	.	.	.	.	.	.	.	1	3	.
Cystopteris fragilis	.	.	.	.	.	.	23	.	.	.	18	.	.	.	.	.	.	.
Lysimachia europaea	.	.	.	.	.	22	.	.	.	.	.	.	.	.	9	3	3	.
Hypochaeris radicata	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	23	5
Juncus inflexus	.	.	.	.	.	22	.	.	.	.	.	.	.	.	3	3	.	2
Ranunculus auricomus	13	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clematis recta	.	.	.	.	.	.	.	2	.	.	.	.	.	6	6	1	.	.
Artemisia absinthium	18	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.	.	.
Anthriscus cerefolium	15	14	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chenopodium album	13	5	.	.	.	.	.	.	.	.	2	13	.	6	.	.	9	5
Rosa canina	10	9	.	.	.	.	2	.	.	.	4	.	.	.	.	.	.	2
Lactuca serriola	10	5	.	.	.	.	2	.	.	.	.	3	.	3	6	1	9	.
Anthriscus sylvestris	.	18	.	.	.	.	4	2	.	.	.	10	6	3	.	2	.	2
Bromus sterilis	10	18	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aesculus hippocastanum	.	.	4	.	14	.	.	2	.	10	.	.	.	.	.	.	.	.
Impatiens noli-tangere	.	.	.	.	.	11	.	.	.	.	.	.	.	.	3	1	.	.
Caltha palustris	.	.	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus repens	.	.	.	.	.	11	.	.	9	5	.	.	.	.	.	.	.	.
Lamium purpureum	.	9	8	.	.	.	13	2	9	.	9	3	.	.	.	.	.	.
Juglans regia	.	5	8	.	10	.	8	9	18	10	5	3	.	.	.	.	.	.
Cardamine bulbifera	.	.	.	.	.	.	8	2	.	10	4	.	.	.	.	.	.	.
Equisetum hyemale	.	.	.	.	.	.	.	2	9	10	2	.	.	.	.	.	.	.
Lathyrus vernus	.	.	.	.	.	.	4	6	9	10	13	.	.	.	.	.	.	.
Scilla siberica	.	.	.	.	.	.	11	.	.	.	13	.	.	.	.	.	.	.
Vinca minor	.	.	.	.	10	.	.	5	.	5	11	.	.	.	.	.	.	.
Rumex sylvestris	.	.	.	.	.	.	.	2	.	.	.	10	.	.	.	.	.	.
Tussilago farfara	.	.	.	.	.	.	.	.	.	.	.	13	.	.	.	.	.	.
Bidens frondosa	.	.	.	.	.	.	.	.	.	.	.	10	.	.	3	.	3	.
Lamium maculatum	.	5	4	.	.	.	6	2	.	.	.	13	.	.	.	.	.	.

ID syntaxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Lilium martagon	.	.	.	.	.	.	.	5	.	.	.	7	12	11	.	8	.	.
Ajuga genevensis	.	.	.	.	.	.	8	.	.	5	2	.	12	.	.	1	9	10
Carex leporina	.	.	.	.	.	.	.	.	.	.	.	3	12	3	3	8	6	2
Vitis sylvestris	.	18	.	.	.	.	.	.	.	.	.	.	18	.	.	1	.	.
Elymus caninus	.	.	.	.	.	.	.	3	.	.	.	7	6	17	.	5	6	.
Cruciata glabra	.	.	.	.	.	.	4	2	.	.	.	3	6	11	6	1	3	2
Turritis glabra	.	.	.	.	.	.	.	.	.	.	.	3	.	.	3	1	17	10
Sedum purpureum	.	5	.	.	.	.	.	.	.	.	.	.	.	.	3	.	17	.
Cerastium holosteoides	5	.	.	.	.	.	.	.	.	.	.	.	.	.	9	.	14	.
Luzula multiflora	.	.	.	.	.	.	.	.	.	.	.	.	6	11	.	3	17	.
Capsella bursa-pastoris	8	.	.	.	.	.	.	.	.	.	.	.	6	.	3	.	14	.
Digitalis grandiflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	.
Festuca rubra	10	.	.	.	.	.	.	.	.	.	.	.	.	.	6	3	11	2
Polygonum aviculare	5	.	.	.	.	.	.	.	.	.	2	3	.	.	6	1	11	.
Ambrosia artemisiifolia	.	.	.	.	.	.	.	.	.	.	.	3	6	.	.	.	11	2
Silene vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	6	.	.	1	3	12
Saponaria officinalis	.	5	.	.	.	.	.	.	.	.	.	3	.	6	.	.	3	12
Viola canina	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	12
Veronica spicata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
Teucrium chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
Rubus nessensis	.	.	.	.	.	.	.	2	.	.	.	.	.	14	.	4	3	15
Allium oleraceum	.	.	.	.	.	.	.	3	.	.	.	.	.	3	.	1	.	10
Melampyrum nemorosum	.	.	.	.	.	.	.	2	.	.	.	3	.	3	.	.	.	10
Physocarpus opulifolius	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	10
Potentilla alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10

Rare species: *Agrimonia eupatoria (01, 03, 12, 14, 18); Allium angulosum (01); Anthoxanthum odoratum (17, 18); Arctium lappa (01, 07, 12); Arctium tomentosum (12); Arenaria uralensis (01, 03); Asclepias syriaca (18); Asperugo procumbens (01); Astragalus glycyphyllos (12, 14, 16); Berberis aquifolium (07); Betula pubescens (08); Bromus tectorum (01, 03); Calamagrostis arundinacea (18); Calluna vulgaris (17, 18); Campanula patula (12); Campanula trachelium (08, 11); Caragana arborescens (10, 17); Cardamine quinquefolia (10); Carex colchica (07); Carex digitata (10, 11); Carex michelii (07, 11); Carex pallescens (08, 17); Celtis occidentalis (13, 17, 18); Chamerion angustifolium (12); Cichorium intybus (12); Cirsium oleraceum (07); Cirsium setosum (12); Daucus carota (12); Duchesnea indica (08, 10); Echinochloa crus-galli (12); Echium vulgare (17, 18); Epilobium tetragonum (12); Equisetum arvense (01, 02); Gagea lutea (11); Galinsoga parviflora (12, 15); Geranium pratense (12); Geranium pusillum (01, 03, 12); Gleditsia triacanthos (01); Grossularia reclinata (03, 05); Hedera helix (05); Helichrysum arenarium (18); Heracleum sibiricum (16); Heracleum sphondylium (05); Hieracium piloselloides (17); Hierochloe odorata (17); Iris pseudacorus (02); Juglans mandshurica (09); Juncus effusus (12); Knautia arvensis (13); Lathraea squamaria (07); Lathyrus niger (07, 08, 11, 12, 16); Leonurus quinquelobatus (02, 03, 07, 11, 12, 15); Lolium perenne (12, 17); Lonicera caprifolium (07, 10, 11); Lycopus europaeus (18); Medicago falcata (12); Morus nigra (03, 08, 13, 17); Neottia nidus-avis (08, 11, 14); Origanum vulgare (12); Pastinaca sylvestris (12); Phleum phleoides (18); Poa annua (17); Poa bulbosa (01, 02); Poa palustris (01, 02, 16); Polygonum persicaria (12, 15, 16, 17); Primula veris (07); Prunella vulgaris (12, 15, 18); Prunus spinosa (18); Ranunculus acris (08, 12); Reynoutria japonica (03, 09, 15); Rhodococcum vitis-idaea (16); Ribes aureum (08); Rumex confertus (12); Sanicula europaea (08); Scutellaria altissima (11); Sedum sexangulare (01); Sempervivum ruthenicum (18); Solidago canadensis (08, 10, 11, 12, 13); Spergula arvensis (17); Stachys palustris (08, 12); Thlaspi arvense (12); Thymus serpyllum (18); Tragopogon orientalis (17); Trifolium alpestre (18); Trifolium arvense (18); Trifolium medium (12); Trifolium pratense (01, 07, 12); Ulmus minor (11); Verbascum lychnitis (17); Veronica arvensis (01, 02, 03, 15); Veronica verna (01); Vicia sepium (11, 12); Viola hirta (16); Viscaria vulgaris (16, 17); Xanthium strumarium (12).*