

# Kenophytes in different forest types of Ukraine

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**Key words:** forest, vegetation, alien plants, kenophytes, invasion, habitats.

**Ključne besede:** gozd, vegetacija, tujerodne rastline, kenofiti, invazija, habitati.

## Abstract

The article aims to 1) describe the distribution of non-native species of vascular plants (only kenophytes, i. e. naturalized species introduced after the 15th century) in different types of forests and different biogeographical regions of Ukraine; 2) compare proportions of kenophytes in forests of different areas; 3) detect statistically significant changes in the occurrence of kenophytes over the last 80 years. The material consists of 2701 relevés sampled in 1990–2018. They were taken from Ukrainian phytocoenological publications and databases. In Ukraine, as in other European countries, the highest proportion of kenophytes (percentage of species number per relevé) is in floodplain forests (up to 9.1% in willow and poplar forests). The lowest proportion is characteristic for bog woods (0%) and most types of mountain forests. Among biogeographical regions, the highest values were found in the flatland areas of the Steppic region and the forest-steppe part of the Continental region. The most frequent species are *Impatiens parviflora* (predominantly in broadleaved woods, absent in relevés from the steppic biogeoregion) and *Erigeron canadensis* (pine woods on sand). Comparison with 1466 older relevés sampled in 1950–1989 allows us to make a conclusion that the proportion of kenophytes increased at least in one habitat type (oak-hornbeam forests).

## Izvleček

V članku smo želeli 1) opisati razširjenost tujerodnih rastlinskih vrst (samo kenofitov, to je naturaliziranih vrst, ki so se pojavile po 15. stoletju) v različnih gozdnih habitatnih tipih in v različnih biogeografskih regijah v Ukrajini; 2) primerjati deleže kenofitov v gozdovih v različnih območjih; 3) prikazati statistično značilne spremembe v pojavljanju kenofitov v zadnjih 80. letih. Podatke predstavlja 2701 popis, ki so bili narejeni v obdobju med 1990 in 2018. Uporabili smo fitocenološko literaturo in podatkovne baze iz Ukrajine. V Ukrajini, kot tudi v ostalih državah v Evropi, je najvišji delež kenofitov (odstotek vrst na popis) v poplavnih gozdovih (do 9,1% v vrbovih in topolovih gozdovih). Najnižji odstotek je značilen za barjanske gozdove (0%) in večino habitatnih tipov gorskih gozdov. Med biogeografskimi regijami je najvišji delež v nižinskih predelih stepske regije in gozdne stepe v kontinentalni regiji. Najbolj pogosti vrsti sta *Impatiens parviflora* (prevladuje v listopadnih gozdovih, odsotna je v popisih iz stepske biogeografske regije) in *Erigeron canadensis* (v borovih gozdovih na pesku). S primerjavo 1466 starejših popisov, narejenih med leti 1950 in 1989 smo prišli do zaključka, da se je delež kenofitov povečal vsaj v enem habitatnem tipu (hrastovo-gabrovi gozdovi).

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## Introduction

Phytosociological relevés are an important source of information about ecological preferences of species, their geographical distribution and dynamics. In recent decades some studies were published that show geographical and ecological patterns of alien species on the basis of phytocoenological data. The study areas were the Czech Republic (Chytrý et al. 2005), Catalonia (Vila et al. 2007), the Basque Country (Campos et al. 2013), Slovakia (Medvecká et al. 2014) and Slovenia (Küzmič & Šilc 2017). Chytrý et al. (2008) performed a comparison of plant invasions for three areas of Europe (the Czech Republic, Catalonia, Great Britain) that represent three biogeographical regions (Continental, Mediterranean, Atlantic). Estimations in the aforementioned articles were made for classes and alliances of vegetation or for EUNIS level 2 habitats (Davies et al 2004, EUNIS habitat ...). According to these studies the lowest proportions of aliens in all regions are in bogs, mires, alpine and subalpine grasslands, heaths on poor soils. The highest proportions are found in synanthropic vegetation, marine coastal habitats, standing inland waters (only kenophytes), sedge and reed beds, riverine shrubs.

Wagner et al. (2017) published the assessment of plant invasions in European forests that is based on the analysis of 83,396 relevés from the European Vegetation Archive (Chytrý et al. 2016) sampled in 1970–2015. The assessment was made for habitat types of the revised version of EUNIS habitat classification (Schaminée et al. 2014). These habitat types approximately correspond to level 3 or 4 habitats of the official EUNIS habitat classification. All analyses were performed only for kenophytes (naturalized species introduced voluntarily or involuntarily after the 15th century). Archaeophytes (introduced before the end of the 15th century) were excluded from consideration because the status of archaeophytes is poorly known in some countries. The highest proportion of kenophytes was found in riparian woods. The lowest proportions were in mountain forests and mire woodlands. The most frequent kenophytes of European woods turned out to be *Impatiens parviflora* (21.1% of total frequency of kenophytes), *Padus serotina* (8.8%), *Robinia pseudoacacia* (7.5%). The highest number of occurrences of kenophytes belongs to phanerophytes and therophytes (for native species hemicryptophytes and phanerophytes). Species originating in Europe constitute 47% of the total number of kenophytes in European woods, and their total frequency is 22% of total frequency of kenophytes.

The distribution of relevés used in the article by Wagner et al. (2017) has a strong geographic bias: Ukraine, Belarus, Moldova, Georgia, Armenia, Azerbaijan and Eu-

ropean Russia occupy 49% of the study area but they are represented only by 1% of the total number of relevés. We made the assessment of occurrences of kenophytes in forests of Ukraine using a higher number of relevés. A more narrow geographical scope allows using the results for comparisons between regions of Europe. The analysis for the territory of Ukraine, even without comparison with other countries, may reveal some geographical patterns because Ukraine comprises parts of four biogeographical regions and measures about 1300 km in length. At present there is no information in literature about the level of invasion in forests of the Steppic biogeographical region of Europe. In other bioregions of Europe, estimations were carried out only at higher levels of habitat classifications.

Presence of 40 alien invasive species within plant communities of Ukraine at the level of alliances of vegetation without quantitative estimations was described in article by Abduloyeva & Karpenko (2009).

The aim of the present study is to describe the frequency of kenophytes in forest types and different biogeographical regions of Ukraine, and to compare the results with published data on the subject from other areas.

## Materials and methods

The study area includes the entire territory of Ukraine. According to the data on the European Environment Agency website (Europe's biodiversity ... 2018) Ukraine comprises parts of four European biogeographical regions: Alpine, Continental, Pannonian and Steppic. Two regions (Continental and Steppic) were subdivided according to the geobotanical subdivision of Ukraine in the National Atlas of Ukraine (2008) (Figure 1).

The relevés for the analysis were taken from the database EU-UA-006 "Vegetation Database of Ukraine and



Figure 1: Biogeographical regions of Ukraine.

Slika 1: Biogeografske regije Ukrajine.

Adjacent Parts of Russia”, unpublished database of relevés from the National Nature Park “Holosiivskiyi”(Kyiv city) and numerous Ukrainian publications (Andrienko et al. 2004, Bairak 1996, Budzhak & Onyshchenko 2004, Chorney et al. 2005, Derzhypilsky et al. 2011, Didukh 1996, 2003, Didukh et al. 2003, Fitsailo 2003, Gomlya 2005, Goncharenko 2001, 2003, Klimuk et al. 2006, Konishchuk 2003, Kuzemko 2001, Kuzemko & Chorna 2002, Lukash & Onyshchenko 2006, Melnyk & Korinko 2005, Onyshchenko 1998, 2002, 2007, 2009, 2013a, 2013b, Onyshchenko & Budzhak 2003, Onyshchenko & Lubinska 2006, Onyshchenko & Lukash 2004, Onyshchenko & Sidenko 2002, Onyshchenko & Yuglichek 2010, Onyshchenko et al. 2007, 2009, 2015, 2016, Orlov & Yakushenko 2005, Panchenko 2013, Panchenko & Onyshchenko 2003, Ralo & Onyshchenko 2008, Shelyag-Sosonko et al. 2003, Shevchyk et al. 1996a, 1996b, 1997, I. Solomakha et al. 2006, 2015, V. Solomakha et al. 2004, 2016, Soroka 2008, Vorobyov et al. 2002, Yakushenko 2003, Yuglichek & Onyshchenko 2003). All relevés selected for estimation of modern occurrence of kenophytes were sampled in 1990–2018. Each relevé was assigned to a habitat of the revised version of the EUNIS habitat classification (European Red List of Habitats, Schaminée et al. 2014) (Table 1). Some relevés were excluded from the analysis: 1) relevés representing highly artificial woods (plantations of species out

of their natural range or in clearly unnatural conditions and natural woods of non-native species), 2) relevés that have no species data obtained in period May 15 – August 31, 3) relevés that could not be unequivocally assigned to either habitat type. The area of the relevés varies from 100 to 2500 m<sup>2</sup>, predominantly 400–900 m<sup>2</sup>. This parameter was not used in relevé filtering. Some analyses showed that the effect of plot size on the proportion of species is negligible (Chytrý et al. 2005, Vilà et al. 2007). The final number of relevés was 2701. In order to compare the current frequency of kenophytes with their frequency in previous decades 1466 relevés sampled in 1950–1989 were used (Bukhalo 1962, Grygora et al. 2005, Vorobyov et al. 1997, Vorobyov et al. 2008). Old relevés were not sampled in the same areas as the relevés from 1990–2018. This reduces the possibility of comparison of two sets of data.

The names of species follow the database Euro+Med (2006–2018). Residence statuses of species (whether a species is a kenophyte or not) were taken from Ukrainian publications (Protopopova 1991, Mosyakin & Yavorska 2003, Bagrikova 2013, Solomakha et al. 2015). Some species are kenophytes only in a part of their distribution area in Ukraine (*Acer pseudoplatanus*, *Arrhenatherum elatuis*, *Berberis vulgaris*, *Corynephorus canescens*, *Fagus sylvatica*, *Ligustrum vulgare*, *Picea abies*, *Spergula morisonii*, *Vinca minor*). They were involved into the analysis

**Table 1:** Codes, names of habitats and number of relevés.

**Tabela 1:** Šifra, ime habitanega tipa in število popisov.

Habitat code	Habitat name	Number of relevés before 1990	Number of relevés since 1990
G1.1	Temperate and boreal softwood riparian woodland	-	84
G1.2a	<i>Alnus</i> woodland on riparian and upland soils	-	93
G1.2b	Temperate and boreal hardwood riparian woodland	-	95
G1.4	Broadleaved swamp woodland on non-acid peat	215	85
G1.5	Broadleaved bog woodland on acid peat	316	-
G1.6a	<i>Fagus</i> woodland on non-acid soils	-	459
G1.6b	<i>Fagus</i> woodland on acid soils	-	37
G1.7a	Temperate and submediterranean thermophilous deciduous woodland	66	151
G1.8	Acidophilous <i>Quercus</i> woodland	-	26
G1.Aa	<i>Carpinus</i> and <i>Quercus</i> mesic deciduous woodland	630	911
G1.Ab	Ravine woodland	-	90
G3.1a	Temperate mountain <i>Picea</i> woodland	-	121
G3.1b	Temperate mountain <i>Abies</i> woodland	-	44
G3.2	Temperate subalpine <i>Larix</i> , <i>Pinus cembra</i> and <i>Pinus uncinata</i> woodland	-	5
G3.4a	Temperate and continental <i>Pinus sylvestris</i> woodland	120	388
G3.4b	Temperate and submediterranean montane <i>Pinus sylvestris</i> - <i>Pinus nigra</i> woodland	80	17
G3.A	<i>Picea</i> taiga woodland	27	17
G3.Da	<i>Pinus</i> mire woodland	44	78
All habitats		1498	2701

only in the cases when they met outside their old distribution area. For each of the species its constancy in every habitat type, constancy in total set of relevés, constancy in Ukrainian forests (mean for habitats types with weighting proportionally to habitat area) and proportion of species occurrences in the sum of occurrences of all kenophytes were calculated.

## Results

Selected relevés were referred to 17 habitat types of the modified EUNIS classification (Table 1). Mean proportion of kenophytes for all relevés is 1.13%, mean weighted proportionally to habitat areas is 1.02%. A total of 62 kenophytes are present in the dataset. Their distribution along habitat types is shown in Table 2. The most frequent kenophytes in Ukrainian woods are *Impatiens parviflora* (20.6% of the sum of kenophytes constancies), *Erigeron canadensis* (14.8%), *Prunus serotina* (9.4%),

*Quercus rubra* (7.9%), *Acer negundo* (7.7%), *Erigeron annuus* (3.8%), *Robinia pseudoacacia* (3.4%). *Impatiens parviflora* is the most frequent kenophyte in the Continental, the Alpine and the Pannonian biogeographical regions. It is not present in forest relevés from the Steppic biogeographical region. *Erigeron annuus* is present only in relevés from the Continental and the Alpine biogeographical regions.

The largest average proportion of kenophytes in relevés (9.1%) is peculiar to G1.1 “Floodplain *Salix*- and *Populus*-dominated woods” (Figure 2). Other habitats with high proportions of kenophytes are G1.2a “*Alnus* woodland on riparian and upland soils” (2.3%) and G1.2b “Temperate and boreal hardwood riparian woodland” (3.1%). Kenophytes are not present in relevés of coniferous bog woodlands (G3.Da), acidophilous beech forests (G1.6b), mountain pine forests (G3.2, G3.4b). A very low proportion is in G3.1a “Temperate mountain *Picea* woodland” (0.03%). Other habitats have intermediate values of this

**Table 2:** Constancy of kenophyte species in habitat types of Ukraine (habitats types without kenophytes were excluded).

**Table 2:** Stalnost kenofitov v habitatnih tipih v Ukrajini (habitatsni tipi brez prisotnih kenofitov niso prikazani).

	G1.1	G1.2a	G1.2b	G1.4	G1.6a	G1.7a	G1.Aa	G1.Ab	G3.1a	G3.1b	G3.4a	Constancy in dataset (%)	% of total kenophytes' occurrences	Constancy with weighting of plots proportionally to habitat areas (%)
Number of relevés	84	93	95	85	459	151	911	90	121	44	388			
Number of kenophytes species														
<i>Acer negundo</i>	39.3	2.2	16.8	11.8	.	4.0	2.4	.	.	.	1.0	3.41	11.7	2.35
<i>Acer pseudoplatanus*</i>	.	1.1	3.2	1.2	.	.	0.4	.	.	.	.	0.33	1.1	0.27
<i>Acer saccharinum</i>	.	.	.	.	.	.	.	.	.	.	0.3	0.04	0.1	0.09
<i>Aesculus hippocastanum</i>	.	1.1	.	.	.	.	0.2	.	.	.	.	0.11	0.4	0.09
<i>Ambrosia artemisifolia</i>	.	.	.	.	.	.	.	.	.	.	2.1	0.30	1.0	0.73
<i>Amelanchier ovalis</i>	.	.	3.2	.	.	.	.	.	.	.	.	0.3	0.15	0.21
<i>Amelanchier spicata</i>	.	.	1.1	.	.	6.0	.	.	.	.	.	1.3	0.56	0.65
<i>Amorpha fruticosa</i>	35.7	.	.	1.2	.	.	.	.	.	.	.	0.5	1.22	0.65
<i>Armeniaca vulgaris</i>	1.2	6.5	.	.	.	.	.	.	.	.	.	0.26	0.9	0.27
<i>Arrhenatherum elatius*</i>	.	.	.	.	.	2.0	.	.	.	.	.	0.11	0.4	0.05
<i>Berberis vulgaris*</i>	.	.	.	.	.	2.0	.	.	.	.	.	1.5	0.33	0.60
<i>Bidens frondosus</i>	16.7	6.5	1.1	7.1	.	.	.	.	.	.	.	1.00	3.4	0.55
<i>Bryonia alba</i>	1.2	.	.	.	.	.	.	.	.	.	.	0.04	0.1	0.02
<i>Cannabis sativa</i>	.	.	1.1	.	.	0.7	.	.	.	.	.	0.07	0.3	0.06
<i>Caragana arborescens</i>	.	1.1	2.1	.	.	1.3	0.7	.	.	.	.	0.3	0.45	0.40
<i>Corynephorus canescens*</i>	.	.	.	.	.	.	.	.	.	.	.	1.5	0.22	0.54
<i>Cuscuta campestris</i>	.	.	.	.	.	.	.	.	.	.	.	0.3	0.04	0.09
<i>Digitaria aegyptiaca</i>	.	.	.	.	.	.	.	.	.	.	.	0.3	0.04	0.09
<i>Echinocystis lobata</i>	3.6	.	.	4.7	.	.	.	.	.	.	.	0.26	0.9	0.07
<i>Eragrostis minor</i>	.	.	.	.	.	.	.	.	.	.	.	1.3	0.19	0.45

	G1.1	G1.2a	G1.2b	G1.4	G1.6a	G1.7a	G1.Aa	G1.Ab	G3.1a	G3.1b	G3.4a	Constancy in dataset (%)	% of total kenophytes' occurrences	Constancy with weighting of plots proportionally to habitat areas (%)
Number of relevés	84	93	95	85	459	151	911	90	121	44	388			
<i>Erigeron annuus</i>	7.1	.	2.1	2.4	0.4	2.6	1.6	2.2	.	.	0.8	1.33	4.6	0.96
<i>Erigeron canadensis</i>	13.1	4.3	2.1	.	.	5.3	.	1.2	.	.	9.0	2.26	7.7	3.74
<i>Fagus sylvatica</i> *	.	.	.	.	.	.	0.2	.	.	.	.	0.07	0.3	0.05
<i>Fraxinus americana</i>	1.2	.	.	.	.	.	.	.	.	.	.	0.04	0.1	0.02
<i>Gleditsia triacanthos</i>	.	.	.	.	.	0.7	0.2	.	.	.	.	0.11	0.4	0.07
<i>Hemerocallis lilioasphodelus</i>	1.2	.	.	.	.	.	.	.	.	.	.	0.04	0.1	0.02
<i>Hordeum murinum</i> s. l.	.	1.1	.	.	.	.	.	.	.	.	.	0.04	0.1	0.04
<i>Hyoscyamus niger</i>	.	.	.	.	1.1	6.0	.	.	.	.	.	0.52	1.8	0.25
<i>Impatiens glandulifera</i>	.	1.1	.	.	.	.	.	.	.	.	.	0.04	0.1	0.04
<i>Impatiens parviflora</i>	3.6	21.5	46.3	15.3	5.9	18.5	8.2	16.7	0.8	4.5	0.8	8.55	29.3	6.11
<i>Iva xanthiifolia</i>	.	1.1	.	.	.	.	.	.	.	.	.	0.04	0.1	0.04
<i>Ligustrum vulgare</i> *	.	.	.	.	.	0.7	.	.	.	.	.	0.04	0.1	0.02
<i>Lonicera tatarica</i>	.	.	.	.	.	2.6	0.1	.	.	.	.	0.19	0.6	0.09
<i>Morus alba</i>	13.1	.	.	.	.	0.7	0.2	.	.	.	.	0.52	1.8	0.24
<i>Morus nigra</i>	2.4	.	.	.	.	.	.	.	.	.	.	0.07	0.3	0.03
<i>Oenothera biennis</i>	8.3	.	.	.	.	.	.	.	.	.	1.3	0.44	1.5	0.57
<i>Oenothera rubricaulis</i>	.	.	.	.	.	0.7	.	.	.	.	0.3	0.07	0.3	0.11
<i>Oxalis dillenii</i>	2.4	.	.	.	.	.	.	.	.	.	.	0.07	0.3	0.03
<i>Oxalis stricta</i>	.	.	.	.	.	.	0.1	.	.	.	.	0.04	0.1	0.03
<i>Partenocissus quinquefolia</i>	1.2	.	.	.	.	.	0.1	.	.	.	.	0.07	0.3	0.04
<i>Parthenocissus inserta</i>	.	.	2.1	.	.	.	.	.	.	.	0.3	0.11	0.4	0.17
<i>Physocarpus opulifolius</i>	.	.	.	.	.	.	.	.	.	.	0.5	0.07	0.3	0.18
<i>Picea abies</i> *	.	.	.	.	.	.	0.7	.	.	.	.	0.22	0.8	0.15
<i>Prunus cerasifera</i>	.	.	.	.	.	2.0	.	.	.	.	.	0.11	0.4	0.05
<i>Prunus serotina</i>	.	1.1	2.1	.	.	4.6	0.2	.	.	.	5.4	1.22	4.2	2.20
<i>Quercus rubra</i>	.	2.2	2.1	.	.	1.3	2.3	1.2	.	.	0.8	1.15	3.9	1.01
<i>Robinia pseudoacacia</i>	1.2	3.2	2.1	.	0.2	2.0	1.4	1.2	.	2.3	2.1	1.22	4.2	1.39
<i>Saponaria officinalis</i>	.	.	.	.	.	2.6	.	.	.	.	.	0.15	0.5	0.07
<i>Secale sylvestre</i>	1.2	.	.	.	.	.	.	.	.	.	.	0.04	0.1	0.02
<i>Senecio viscosus</i>	.	.	.	.	.	.	.	.	.	.	0.5	0.07	0.3	0.18
<i>Sorbus intermedia</i>	.	.	.	.	.	0.7	.	.	.	.	.	0.04	0.1	0.02
<i>Spergula morisonii</i> *	.	.	.	.	.	.	.	.	.	.	0.5	0.07	0.3	0.18
<i>Spiraea chamaedryfolia</i>	.	.	.	.	.	.	.	1.2	.	.	.	0.04	0.1	0.00
<i>Swida alba</i>	1.2	.	.	1.2	0.2	.	.	.	.	.	.	0.11	0.4	0.04
<i>Symphoricarpos albus</i>	.	.	.	.	.	.	.	.	.	.	0.5	0.07	0.3	0.18
<i>Triticum aestivum</i>	.	.	1.1	.	.	.	.	.	.	.	.	0.04	0.1	0.04
<i>Ulmus pumila</i>	1.2	.	.	.	.	.	.	.	.	.	.	0.04	0.1	0.02
<i>Veronica hederifolia</i>	.	.	.	.	.	2.6	0.3	.	.	.	.	0.26	0.9	0.15
<i>Vinca minor</i> *	.	1.1	1.1	.	.	.	0.4	.	.	.	0.3	0.26	0.9	0.28
<i>Vitis vinifera</i>	1.2	.	.	.	.	.	.	.	.	.	.	0.04	0.1	0.02
<i>Xanthium orientale</i> subsp. <i>riparium</i>	1.2	.	.	.	.	.	.	.	.	.	.	0.04	0.1	0.02
<i>Xanthium rupicola</i>	2.4	.	.	.	.	.	.	.	.	.	.	0.07	0.3	0.03
<i>Xanthium strumarium</i>	2.4	.	.	.	.	.	.	.	.	.	.	0.07	0.3	0.03

\* – species is native in a part of the Ukrainian territory.

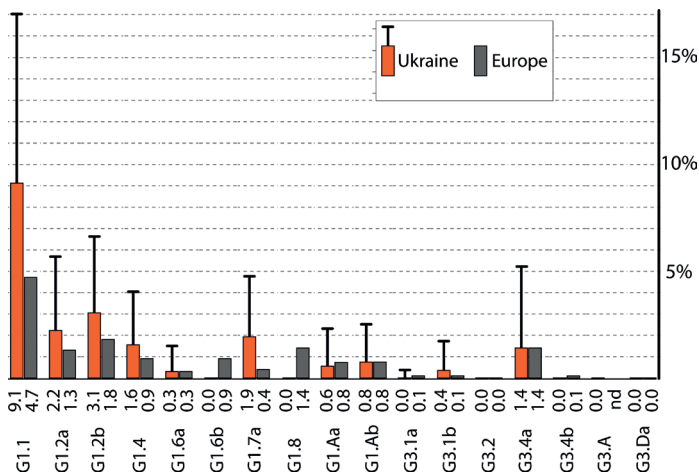


Figure 2: Mean proportions of kenophytes in relevés of different habitats in Ukraine (with standard deviation) and Europe. Data on Europe are from the article by Wagner et al. (2017).

Slika 2: Povprečni deleži kenofitov v popisih v različnih habitatnih tipih v Ukrajini (s standardnim odklonom) in v Evropi. Podatki o pojavljanju v Evropi so iz članka Wagner et al. (2017).

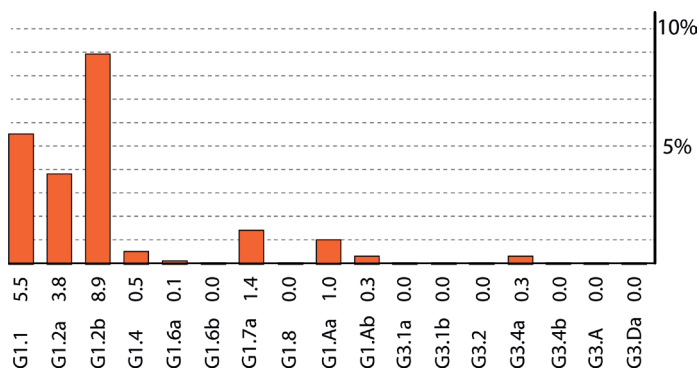


Figure 3: Mean total covers of kenophytes in relevés of different habitats in Ukraine (relevés without kenophytes were included in the calculation with cover of kenophytes = 0).

Slika 3: Povprečna skupna pokrovnost kenofitov v popisih v različnih habitatnih tipih v Ukrajini (popisi brez kenofitov so bili vključeni v izračun s pokrovnostjo kenofitov=0).

index. Proportions of kenophytes in habitats in different areas are presented in Figures 4–6.

Major kenophytes of habitat G1.1 are *Acer negundo* (constancy 39%), *Amorpha fruticosa* (36%), *Bidens frondosus* (17%). These species often have high cover (Figure 3). Mean cover of *Acer negundo* in relevés of G1.1 with the presence of the species is 8%, *Acer negundo* – 7%, *Bidens frondosus* – 3%. These species are frequent also in other types of hygrophilous broadleaved forests (G1.2a, G1.2b), however the most frequent kenophyte in these habitats is *Impatiens parviflora* (constancy 22% and 46%, mean cover 20% and 18% respectively). The typical habitats of G1.4 “Broadleaved swamp woodland on non-acid peat” are probably poor in kenophytes. The available relevés represent mainly forests that are transitional to G1.2a. The most frequent kenophyte of mesic eutrophic broadleaved forests (G1.6a, G1.Aa, G1.Ab) is *Impatiens parviflora* (constancy in these habitats 5%, 8%, 17%, mean cover 0.1%, 7%, 1% respectively). In habitat G1.7a “Temperate and submediterranean thermophilous deciduous woodland”, *Impatiens parviflora* also holds the first position (constancy 19%, mean cover 4%). In addition, this habitat has significant constancies of *Acer negundo*, *Amelanchier spicata*, *Erigeron canadensis*, *Prunus*

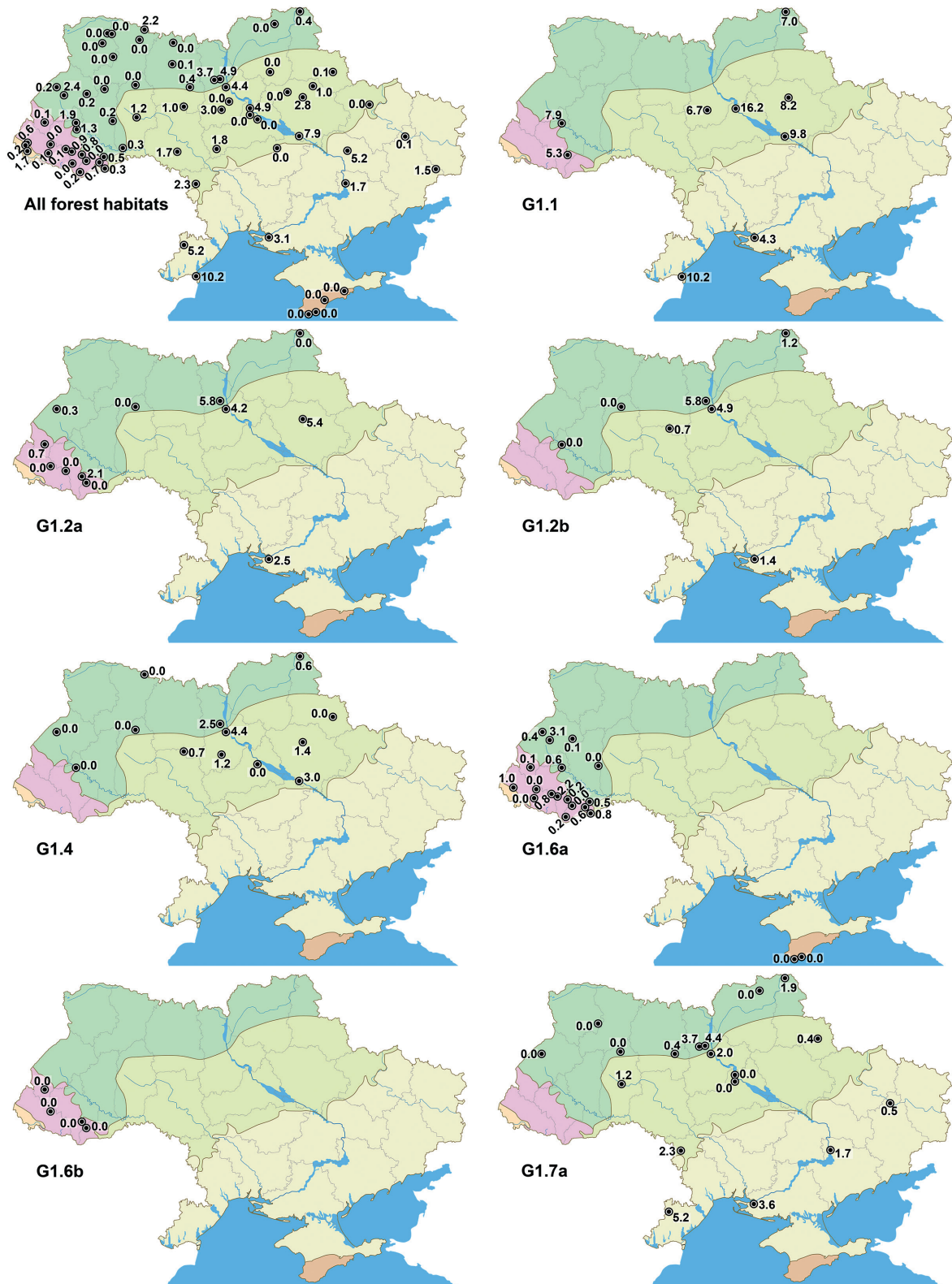
*serotina*. The most frequent kenophytes of habitat G3.4a “Temperate and continental *Pinus sylvestris* woodland” are *Erigeron canadensis* (9%) and *Prunus serotina* (5%, only in relevés from Kyiv).

The relevés from mountain regions have the smallest proportion of kenophytes (Table 3). In the flatland part of Ukraine, higher proportions are characteristic of the Steppic biogeographical region and the forest-steppe part of the Continental biogeographical region.

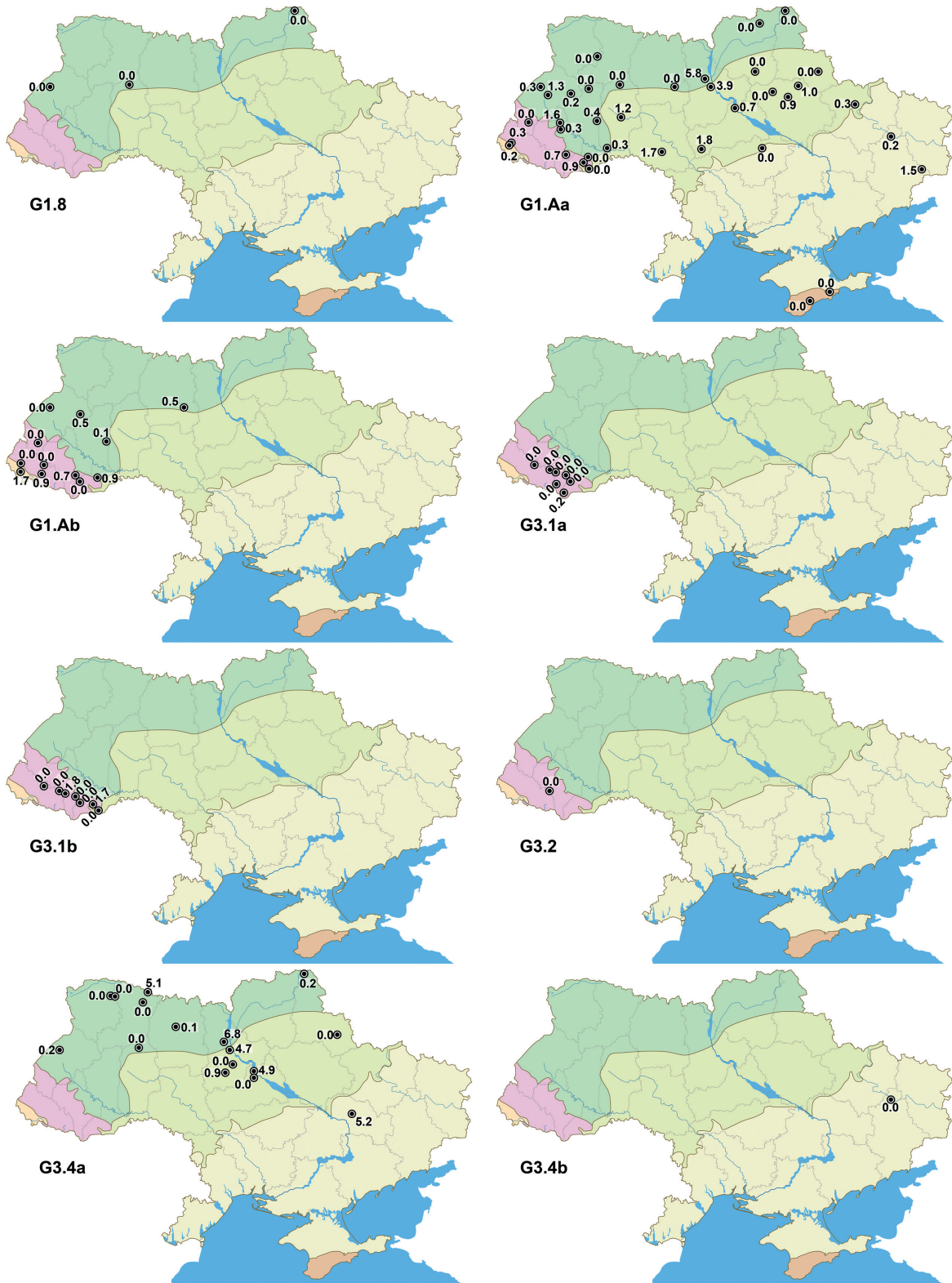
Table 3: Mean proportion of kenophytes in plots from different biogeographical regions of Ukraine.

Tabela 3: Povprečni delež kenofitov na popisnih ploskvah v različnih biogeografskih regijah Ukrajine.

Biogeographical region	Mean % of kenophytes in relevé	Number of relevés
Continental: deciduous forest	0.53	1276
Continental: forest-steppe	2.46	657
Pannonian	1.02	26
Alpine	0.31	530
Steppic: flatland	3.13	180
Steppic: Crimean Mountains	0.00	32
All biogeoregions	1.13	2701

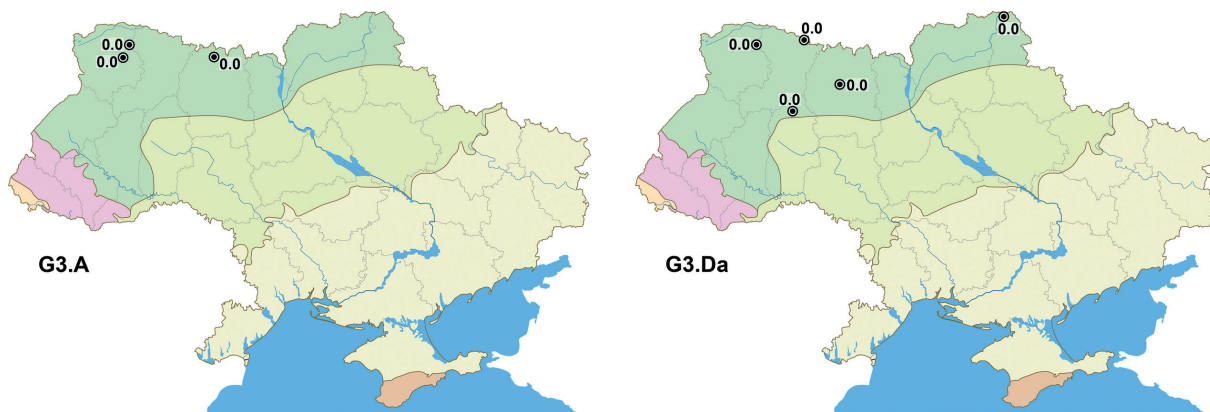


**Figure 4:** Proportions of kenophytes in geographical groups of relevés (total and in habitats G1.1, G1.2a, G1.2b, G1.4, G1.6a, G1.6b, G1.7a).  
**Slika 4:** Delož kenofitov v geografskih skupinah popisov (skupno in v habitatnih tipih G1.1, G1.2a, G1.2b, G1.4, G1.6a, G1.6b, G1.7a).



**Figure 5:** Proportions of kenophytes in geographical groups of relevés (habitats G1.8, G1.Aa, G1.Ab, G3.1a, G3.1b, G3.2, G3.4a, G3.4b).  
**Slika 5:** Delež kenofitov v geografskih skupinah popisov (habitatni tipi G1.8, G1.Aa, G1.Ab, G3.1a, G3.1b, G3.2, G3.4a, G3.4b).





**Figure 6:** Proportions of kenophytes in geographical groups of relevés (habitats G3A, G3.Da)  
**Slika 6:** Delež kenofitov v geografskih skupinah popisov (habitatni tipi G3A, G3.Da)

## Discussion

In general, the distribution of proportions of kenophytes by different forest types of Ukraine is similar to that of the same forest types of entire Europe presented in the article by Wagner et al. (2017). Habitats with the highest number of relevés and largest occupied areas (G1.6a, G1.A1, G3.4a) have close values in Ukraine and Europe. Most kenophyte-rich alluvial, moist and swampy eutrophic forests (G1.1, G1.2a, G1.2b, G1.4) in Ukraine have almost twice as high proportions of kenophytes than forests of the same types from Europe. The main discrepancies are in thermophilous deciduous forests G1.7a, acidophilous beech forests G1.6b and acidophilous oak forests G1.8. A lower frequency of kenophytes in Ukrainian forests of G1.6b can be explained by the fact that this habitat is rare in flatland areas of Ukraine and that all relevés were sampled in the mountains. The proportion of kenophytes in habitat G1.7a from Ukraine is higher than in the same habitat in Europe because in Ukraine this habitat is presented only by relevés from the flatland part of Ukraine with a high proportion of relevés from urbanized areas.

The mean value for all relevés is somewhat higher for Ukraine (1.1%) than for Europe (0.9%). One of the reasons for this difference may be that Ukrainian relevés were sampled more recently.

Some data from literature show that the proportion of non-native species in forests of southern Europe is lower than in forests of more northern areas of the Atlantic and the Continental biogeographical regions. According to the results of Chytrý et al. 2008 the proportion of neophytes in deciduous and mixed deciduous-coniferous forests of Catalonia (the Mediterranean biogeoregion) is much lower (0.2%) than in the same group of forests in the Czech Republic (the Continental biogeoregion, 1.0%) and

Great Britain (the Atlantic biogeoregion, 3.1%). For coniferous forests, these values are 0.0%, 0.4% and 24.8% respectively. Low proportions of neophytes were found also in Slovenian forests (0.5% in deciduous and 0.1% in coniferous forests) (Küzmič & Šilc 2017). In Ukraine, the lowest proportion (0.0%) was found in the Crimean Mountains that are the southernmost part of the country. This area formally belongs to the Steppic biogeoregion, but its vegetation has more in common with that of the northern parts of the Mediterranean biogeoregion. According to the floristic data (Bagrikova 2013, Yena 2012), in Crimea, frequent kenophytes of Ukrainian forests are absent or rare, less naturalized and more recently established. The “true” steppic zone (the flatland part of the Steppic biogeoregion), on the other hand, has the highest proportion of kenophytes (3.1%). In the relevés from the Steppic biogeoregion including the Crimean Mountains, the most frequent forest kenophyte of Ukraine and Europe *Impatiens parviflora* is not present.

In order to detect changes in the proportion of kenophytes over the last few decades, 1498 older relevés sampled in 1950–1989 were analyzed. They correspond to 8 habitat types. For most of them, a comparison of proportions of kenophytes cannot be made for two reasons: 1) absence of relevés of the habitat sampled in one of two time periods (only “new” or only “old” data), 2) “old” and “new” relevés represent different areas. Only habitat G1.Aa “*Carpinus* and *Quercus* mesic deciduous woodland” has large number of “old” and “new” relevés from the same area. This area comprises central and western parts of the forest-steppe subregion and adjacent areas of the deciduous forests region of Western Ukraine. Two variants of selection of “new” relevés from this area were used: with and without relevés from Kyiv that have a high proportion of kenophytes. The results of the comparisons

**Table 4:** Comparison of kenophyte proportions in “old” and “new” relevés of habitat G1.Aa “*Carpinus* and *Quercus* mesic deciduous woodland”.

**Tabela 4:** Primerjava deležev kenofitov v “starih” in “novih” popisih habitatnega tipa G1.Aa “mezofilni listopadni gozdovi vrst rodov *Carpinus* in *Quercus*”.

Datasets	Number of relevés		Mean % of kenophytes		Standard deviation		Mann-Whitney U test
	old	new	old	new	old	new	p-level
“Old” and “new” data without relevés from Kyiv	520	429	0.261	0.430	0.879	1.174	0.0163
“Old” and “new” data with relevés from Kyiv	520	481	0.261	0.812	0.879	1.831	0.0000

are in Table 4. The data does not satisfy the assumption of normality so it was tested with nonparametric Mann-Whitney U test with adjustment for ties. The null hypothesis about equal kenophyte proportions in “old” and “new” relevés was rejected at the 1.63% significance level when “new” data did not include relevés from Kyiv and at the 0.00% level for dataset with relevés from Kyiv. In

other words, the increased proportion of kenophytes is statistically reliable in both variants of comparison. In fact, the result is a little less certain because of possible differences in data sampling by different researchers.

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## References

- Abduloyeva, O. S., Karpenko, N. I. 2009: Occurrence of alien invasive plant species in vegetation syntaxa of Ukraine. *Chornomorskyi botanichnyi zhurnal* 5, №2: 189–198.
- Andrienko, T. L., Klestov, M. L., Khymyn, M. V., Pryadko, O. I., Onyshchenko, V. A., Kot, A. S., Gregorenko, S. O. 2004: Biodiversity of the Tsumanska Pushcha and items of its preservation (ed. by T. L. Andrienko and M. L. Klestov). *Phytosociocentre*, Kyiv, p. 136. [in Ukrainian].
- Bagrikova, N. A. 2013: Structural analysis of the alien fraction of the flora of the Crimean peninsula (Ukraine). *Ukr. Botan. Journ.* 40(4): 489–507. [in Russian] <http://ukrbotj.co.ua/pdf/70/4/ukrbotj-2013-70-4-489.pdf>
- Bairak, O. M. 1996: Syntaxonomy of broadleaved forests of Livoberezhne Prydniprovyia. *Ukr. Phytosoc. Coll. Ser. A*, 3: 51–63. [in Ukrainian].
- Budzhak, V. V., Onyshchenko, V. A. 2004: Diversity of forest vegetation of the upper part of the Chornyi Cheremosh river basin // *Naukovi Visnyk Chernivetskoho Universytetu*. 223, № 1: 282–296. [in Ukrainian].
- Bukhalo, M. O. 1962: Broadleaved forests of formation *Carpineta* in Holohory in West Podillia // *Visnyk Lvivskoho Derzhavnoho Universytetu. Ser. Biologia*, 1: 30–44.
- Campos, J. A., Biurrun, I., García-Mijangos, I., Loidi, J. & Herrera, M. 2013: Assessing the level of plant invasion: A multi-scale approach based on vegetation plots. *Plant Biosystems* 147(4): 1148–1162. <https://www.researchgate.net/publication/258121703>
- Chorney, I. I., Budzhak, V. V., Yakushenko, D. M., Korzhuk, V. P., Solomakha, V. A., Sorokan, Yu. I., Tokariuk, A. I., Solomakha, T. D. 2005: National nature park “Vyzhnytskyi”. *Flora and vegetation*. *Phytosociocentre*, Kyiv – K.: Фітосоціоцентр, Kyiv, p. 248 [in Ukrainian].
- Chytrý, M., Hennekens, S. M., Jiménez-Alfaro, B., Knollová, I., Dengler, J. et al. 2016: European Vegetation Archive (EVA): an integrated database of European vegetation plots. *Applied Vegetation Science* 19(1): 173–180. <https://onlinelibrary.wiley.com/doi/pdf/10.1111/avsc.12191>
- Chytrý, M., Maskell, L. C., Pino, J., Pyšek, P., Vilà, M., Font, M. & Smart, S.M. 2008: Habitat invasions by alien plants: A quantitative comparison among Mediterranean, subcontinental and oceanic regions of Europe. *Journal of Applied Ecology* 45: 448–458. <https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2664.2007.01398.x>
- Chytrý, M., Pyšek, P., Tichý, L., Knollová, I. & Danihelka, J. 2005: Invasions by alien plants in the Czech Republic: A quantitative assessment across habitats. *Preslia* 77: 339–354. [http://www.sci.muni.cz/botany/chytry/Chytry\\_et\\_al2005\\_Preslia.pdf](http://www.sci.muni.cz/botany/chytry/Chytry_et_al2005_Preslia.pdf)
- Davies C. E., Moss D., Hill M.O. EUNIS habitat classification revised 2004. – European Environment Agency, 2004. – 307 p.
- Derzhypilsky, L. M., Tomych, M.V., Yusyp, S.V., Losyuk, V. P., Yakushenko, D. M., Danylyk, I.M., Chorney, I. I., Budzhak, V. V., Kondratyuk, S. Ya., Nyporko, S. O., Virchenko, V. M., Mikhailiuk, T. I., Darienko, T. M., Solomakha, V. A., Prorochuk, V. V., Stefurak, Yu. P., Fokshay, S. I., Solomakha, T. D., Tokaryuk, A.I. 2011: National Natura Park “Hutzulshchyna”. *Plant Kingdom. Phytosociocentre*, Kyiv, p. 360. [in Ukrainian].
- Didukh, Ya. P. 1996: Nemoral forests of the Mountain Crimea of the class *Quercus-Fageteta* Br.-Bl. et Vlieg. 1937. *Ukr. Phytosoc. Coll. Ser. A*, 3: 34–51. [in Ukrainian].
- Didukh, Ya. P. 2003: The mountain pine forests (*Erico-Pineteta* Horvat 1959) of Ukraine. – In: *Vegetation of coniferous forests of Ukraine*. *Phytosociocentre*, Kyiv, 43–79. [in Ukrainian].
- Didukh, Ya. P., Kuzemko, A. A., Haiova, Yu. Yu., Kovtun. 2003: The pine and oak-pine forests of the Cherkaso-Chyhyrinsky geobotanical district. – In: *Vegetation of coniferous forests of Ukraine*. *Phytosociocentre*, Kyiv, 80–95. [in Ukrainian].

EUNIS habitat type hierarchical view. <http://eunis.eea.europa.eu/habitats-code-browser.jsp>.

Euro+Med (2006–2018): Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity. Published on the Internet <http://ww2.bgbm.org/EuroPlusMed/> last accessed 02 October 2018).

European Red List of Habitats: Terrestrial Habitats. Eionet Forum. Published on the Internet <https://forum.eionet.europa.eu/european-red-list-habitats/library/terrestrial-habitats> (last accessed 13 April 2018).

Europe's biodiversity – biogeographical regions and seas. European Environment Agency. <https://www.eea.europa.eu/data-and-maps/data/biogeographical-regions-europe-3> (last accessed 08 April 2018).

Fitsailo, T. V. 2003: The syntaxonomy of vegetation of Kyiv Plateau region. Class *Vaccinio-Piceetea* Br.-Bl. 1939. – In: Vegetation of coniferous forests of Ukraine. Phytosociocentre, Kyiv: 195–203. [in Ukrainian].

Gomlya, L. V. 2005: Vegetation of the Khorol river's valley. Ukr. Phytosoc. Coll. Ser. A, 1 (22): 1–187. [in Ukrainian].

Goncharenko, I. V. 2001: Floristic classification of the woods of Sumy forest-steppe region. Ukr. Phytosoc. Coll. Ser. A, 1 (17): 3–17. [in Ukrainian].

Goncharenko, I. V. 2003: The analysis of vegetation cover of northeast Forest-Steppe of Ukraine. Ukr. Phytosoc. Coll. Ser. A, 1 (19): 1–203. [in Ukrainian].

Grygora, I. M., Vorobyov, Ye. O., Solomakha, V. A. 2005: Forest mires of Ukrainian Polissia (origin, dynamics, classification of vegetation). Phytosociocentre, Kyiv, p. 415. [in Ukrainian].

Klimuk, Yu. V., Miskyvych, U. D., Yakushenko, D. M., Chornei, I. I., Budzhak, V. V., Nyporko, S. O., Shpilchak, M. B., Chernyavsky, M. V., Tokaryuk, A. I., Oleksiv, T. M., Tymchuk, Ya., Ya., Solomakha, V. A., Solomakha, T. D., Mayor, R. V. 2006: Nature reserve “Gor-gany”. Plant Kingdom. Phytosociocentre, Kyiv, p. 400. [in Ukrainian].

Konishchuk, V. V. 2003: Coniferous forests of Cheremsky nature reserve. – In: Vegetation of coniferous forests of Ukraine. Phytosociocentre, Kyiv, 111–122. [in Ukrainian].

Kuzemko, A. A. 2001: Forest vegetation of the Ros' river valley I. Class *Vaccinio-Piceetea*. Ukr. Phytosoc. Coll. Ser. A, 1 (17): 53–65. [in Ukrainian].

Kuzemko, A. A., Chorna, G. A. 2002: Forest vegetation of the Ros' river valley II. Floodplain forests (*Alnetea glutinosae*, *Salicetea purpureae*). Phytosoc. Coll. Ser. A, 1 (18): 15–31. [in Ukrainian].

Küzmič, F. & Šilc, U. 2017: Alien species in different habitat types of Slovenia: analysis of vegetation database. Periodicum Biologorum 119(3): 199–208. <https://www.researchgate.net/publication/320744056>

Lukash, O. V., Onyshchenko, V. A. 2006: Vegetation and floristic value of Radomska Dacha forest (Chernihiv region). Scientific Issues of Ternopil Volodymyr Hnatiuk National Pedagogical University. Biology, 3–4 (30): 18–27. [in Ukrainian].

Medvecká, J., Jarolímeck, I., Senko, D. & Svitok, M. 2014: Fifty years of plant invasion dynamics in Slovakia along a 2,500 m altitudinal gradient. Biological Invasions 16: 1627–1638. <https://www.researchgate.net/publication/259557868>

Melnik, V. I., Korinko, O. V. 2005: Beech forests of Podolian Upland. Phytosociocentre, Kyiv: p. 152. [in Ukrainian].

Mosyakin, S. L. & Yavorska, O. G. 2003: The nonnative flora of the Kiev (Kyiv) Urban Area, Ukraine: A checklist and brief analysis. Urban Habitats 1 (1): 45–65. [http://www.urbanhabitats.org/v01n01/nonnativekiev\\_pdf.pdf](http://www.urbanhabitats.org/v01n01/nonnativekiev_pdf.pdf)

National Atlas of Ukraine. 2008. Cartography, Kyiv, p. 440. [in Ukrainian].

Novák, P., Zukal, D., Večeřa, M., Pištková, K. 2017: Vegetation of oak-hornbeam, scree and ravine forests at lower altitudes in Transcarpathia, Western Ukraine. Tuexenia. 37: 47–63.

Onyshchenko, V. A. 1998: Wood Plants Communities (*Fagetalia sylvaticae* Pawł. 1928) of the Medobory Reserve. Ukr. Phytosoc. Coll. Ser. A, 1 (9): 97–115. [in Ukrainian].

Onyshchenko, V. A. 2002: Forest vegetation of division «Kremenetski Hory» of zapovidnyk «Medobory». Nature Reserves in Ukraine 6 (1): 27–39. [in Ukrainian].

Onyshchenko, V. A. 2007: Forest vegetation of the upper part of the Mala Uholka basin (Carpathian biosphere reserve). Naukovyi Visnyk Chernivetskoho Universytetu 343: 130–147. [in Ukrainian] <https://www.researchgate.net/publication/299358256>

Onyshchenko, V. A. 2009: Forests of order *Fagetalia sylvaticae* in Ukraine. Alterpress, Kyiv, p. 212. <https://www.researchgate.net/publication/262151987>

Onyshchenko, V. A. 2013a: Forest vegetation of Holiivskyi wood (Kyiv). Biological systems 5 (1): 93–115. [in Ukrainian] <https://www.researchgate.net/publication/287997709>

Onyshchenko, V. A. 2013b: Vegetation of Bychok Wood (Holiivskyi NNP, Kyiv). Biological systems 5 (3): 395–402. [in Ukrainian] <https://www.researchgate.net/publication/309585950>

Onyshchenko, V. A., Andrienko, T. L., Pryadko, O. I. 2009: Vegetation of the Somyno part of the Rivnensky zapovidnyk. Naukovyi Visnyk Volynskoho Natsionalnoho Universytetu imeni Lesi Ukrainky 9: 173–187. [in Ukrainian].

Onyshchenko, V. A., Andrienko, T. L., Pryadko, O. I. 2016: Vegetation of Biloozerska part of Rivnenskyi nature reserve. Biological systems 8 (1): 98–107. [in Ukrainian].

Onyshchenko, V. A., Budzhak, V. V. 2003: Forests of the class *Vaccinio-Piceetea* Br.-Bl. 1939 in the southern part of Ivano-Frankivsk region. – In: Vegetation of coniferous forests of Ukraine. Phytosociocentre, Kyiv, C. 131–145. [in Ukrainian].

Onyshchenko, V. A., Dyakova, O. V., Karpenko, Yu. O. 2007: Forests vegetation of Teplynska Dacha and Mayatska Dacha forests (national nature park “Svyaty Hory”). Chornomorski Botanical Journal 3 (2): 88–99. [in Ukrainian] <https://www.researchgate.net/publication/299358477>

Onyshchenko, V. A., Lubinska, L. G. 2006: Oak-hornbeam forests of Panivetska Dacha (Khmelytskyi region). Naukovyi Visnyk Chernivetskoho Universytetu 298: 128–135. [in Ukrainian].

Onyshchenko, V. A., Lukash, O. V. 2004: Forest vegetation of the Zhuravlivska Dacha wood (Tulchyn district of Vinnytsia region) // Naukovyi Visnyk Chernivetskoho Universytetu 223: 222–230. [in Ukrainian]

- Onyshchenko, V., Pryadko, O., Andrienko, T. 2015: Vegetation of Perebrody area of Rivnenskyi nature reserve. *Naukovyi Visnyk Shkhidnoevropeiskoho Universytetu imeni Lesi Ukrainky* 13: 32–49. [in Ukrainian].
- Onyshchenko, V., Sidenko, V. M. 2002: Classification of the forest vegetation of the Chornyi Lis (Zhamianka district, Kirovohrad region). *Naukovyi Visnyk Chervivetskoho Universytetu* 145: 178–194. [in Ukrainian].
- Onyshchenko, V. A., Yuglichek, L. S. 2010: Floritic classification of forest vegetation. – In.: Andrienko, T. L. (ed.): *Nature of unique land of Male Polissia*. V. S. Moshynskiy Publishing House, Kamianets-Podilskiy, p. 74–109. [in Ukrainian].
- Orlov, O. O., Yakushenko, D. M. 2005: Plant cover of projected Korostyshiv national nature park. *Phytosociocentre, Kyiv*, p. 180 [in Ukrainian].
- Panchenko, S. M. 2013: Forest vegetation of national nature park “Desniansko-Starohutskiy”. *Universytetska Knyha, Sumy*: p. 312 [in Ukrainian] [http://ashipunov.info/shipunov/school/books/panchenko2013\\_lesn\\_rastit\\_npr\\_desn-star.pdf](http://ashipunov.info/shipunov/school/books/panchenko2013_lesn_rastit_npr_desn-star.pdf)
- Panchenko, S. M., Onyshchenko, V. A. 2003: Alliances *Dicrano-Pinion* Libb. 1933 and *Pino-Quercion* Medw.-Korn. 1959 in the Starohutskiy forest. – In: *Vegetation of coniferous forests of Ukraine*. Phytosociocentre, Kyiv: 146–167. [in Ukrainian].
- Panchenko, S. M., Onyshchenko, V. A. 2003: Oak forests of Starohutskiy wood. *Nature Reserves in Ukraine* 9 (2): 11–16. [in Ukrainian].
- Protopopova, V. V. 1991: Synanthropic flora of Ukraine and its development. *Naukova Dumka, Kiev*, p. 240. [in Russian] [http://ashipunov.info/shipunov/school/books/protopopova1991\\_sinantr\\_flora\\_ukr.djvu](http://ashipunov.info/shipunov/school/books/protopopova1991_sinantr_flora_ukr.djvu)
- Ralo, V. M., Onyshchenko, V. A. 2008: *Anthriscio nitidi-Aceretum pseudoplatani* – a new association from West Podillia. *Naukovyi Visnyk Volynskoho Nationalniho Universytetu imeni Lesi Ukrainky* 3: 239–249. [in Ukrainian] <https://www.researchgate.net/publication/309585519>
- Schaminée, J. H. J., Chytrý, M., JiménezAlfaro, B., Mucina L. et al. 2014: Review of EUNIS forest habitat classification. Report to the European Environmental Agency. Alterra, Wageningen, p. 111. [http://www.sci.muni.cz/botany/chytry/Schaminee\\_et\\_al2013\\_EEA-Report-Forests.pdf](http://www.sci.muni.cz/botany/chytry/Schaminee_et_al2013_EEA-Report-Forests.pdf)
- Shelyag-Sosonko Yu. R., Dubyna, D. V., Dziuba, T. P., Tymoshenko, P. A. 2003: Syntaxonomy of Samara region (Dnieper's Basin) pine forests. – In: *Vegetation of coniferous forests of Ukraine*. Phytosociocentre, Kyiv: 204–222. [in Ukrainian].
- Shevchyk, V. L., Bakalyna, L. V., Solomakha, V. A. 1996a: Syntaxonomy of forest vegetation of the right-bank part of Kaniv nature reserve. *Ukr. Phytosoc. Coll. Ser. A*, 1: 73–88. [in Ukrainian]
- Shevchyk, V. L., Senchylo, O. O., Vorobyov, Ye. O., Kondratiuk, I. M. 1997: Vegetation of the northeastern part of the Irdyn mire. *Ukr. Phytosoc. Coll. Ser. A*, 1: 92–100. [in Ukrainian].
- Shevchyk, V. L., Solomakha, I. V., Voytyuk Yu. O. 1996b: The syntaxonomy of vegetation and list of the flora of Kaniv nature reserve. *Ukr. Phytosoc. Coll. Ser. B*, 1: 1–119. [in Ukrainian].
- Solomakha, I. V., Senchylo, O. O., Vorobyov, Ye. O. 1996: Forest vegetation of Zhukiv Khutir Wood. *Ukr. Phytosoc. Coll. Ser. A*, 3: 63–78. [in Ukrainian].
- Solomakha, I. V., Vorobyov, Ye. O., Moysiienko, I. I. 2015: Flora and vegetation of forests and shrubs of Northern Black Sea region. *Phytosociocentre, Kyiv*, p. 387. [in Ukrainian].
- Solomakha, V. A., Yakushenko, D. M., Kramarets, V. O., Milkina, L. I., Vorontsov, D. P., Vorobyov, Ye. O., Voityuk, B. Yu, Vynychenko, T. S., Kokhanets, M. I., Solomakha, I. V., Solomakha, V. A. 2004: National nature park “Skolivski Beskydy”. *Plant Kingdom. Phytosociocentre, Kyiv*, p. 240 [in Ukrainian].
- Solomakha, V. A., Vorobyov, Ye. O., Derbak Yu. Yu., Tyukh, Yu. Yu, Solomakha, T. D., Shevchyk, V. L., Senchylo, O. O., Solomakha, I. V. 2016: National Nature Park “Synevyr”. *Plant Kingdom. Phytosociocentre, Kyiv*, p. 332.
- Soroka, M. I. 2008: Vegetation of the Ukrainian Roztochia. *Svit, Lviv*, p. 434 [in Ukrainian].
- Vilá, M., Pino, J. & Font, X. 2007: regional assessment of plant invasions across different habitat types. *Journal of Vegetation Science* 18: 35–42. <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1654-1103.2007.tb02513.x>
- Vorobyov, Ye. O., Balashov, L. S., Solomakha, V. A. 1997: Syntaxonomy of vegetation of Poliskyi Nature Reserve. *Ukr. Phytosoc. Coll. Ser. B*, 1 (8): p. 128. [in Ukrainian].
- Vorobyov, Ye. O., Grygora, I. V., Melnyk, I. I. 2002: Alliance *Vaccinio-Piceion* Br.-Bl., Siss. et Vlieger 1939 in Ukrainian Polissia. *Ukr. Phytosoc. Coll. Ser. A*, 1 (18): 76–86. [in Ukrainian].
- Vorobyov, Ye. O., Liubchenko, V. M., Solomakha V. M. 2008: Classification of hornbeam forests of Ukraine. *Phytosociocentre, Kyiv*, p. 252. [in Ukrainian] [http://ashipunov.info/shipunov/school/books/vorobjev2008\\_klassif\\_grabov\\_lesov\\_ukr.djvu](http://ashipunov.info/shipunov/school/books/vorobjev2008_klassif_grabov_lesov_ukr.djvu)
- Wagner, V., Chytrý, M., Jiménez-Alfaro, B. et al. 2017: Alien plant invasions in European woodlands. *Diversity and Distribution* 23 (9): 969–981. <http://onlinelibrary.wiley.com/doi/10.1111/ddi.12592/epdf>
- Yakushenko, D. M. 2003: Syntaxonomy of pine forests of the *Vaccinio-Piceetea* Br.-Bl. 1939 class in Zhytomyr Polissia. – In: *Vegetation of coniferous forests of Ukraine*. Phytosociocentre, Kyiv: 244–271. [in Ukrainian].
- Yena, A. V. 2012: Spontaneous Flora of the Crimean Peninsula. N. Orianda, Simferopol, – p. 232 [in Russian]. <https://www.researchgate.net/publication/304987404>
- Yuglichek, L. S., Onyshchenko, V. A. 2003: Oak-hornbeam forest on the boundary of Male and Zhytomyr Polissia. *Naukovyi Visnyk Chernivetskoho Universytetu* 169: 151–162. [in Ukrainian].

## Appendix

All forest habitats	Biogeographical region and subregion	Habitat type	Geographical group of relevés	Latitude	Longitude	Radius (km)	Year(s)	Number of plots	Mean % of kenophytes	Number of plots in subregion
*	steppic: Crimean mountains	G1.6a	Ai-Petri	44,499	34,026	2	2004-2005	9	0,00	32
*	steppic: Crimean mountains	G1.Aa	Anharskyi Pass	44,791	34,341	4	2005	5	0,00	32
*	continental: forest-steppe	G1.Aa	Bernashivka	48,587	27,489	2	2002	1	0,00	657
*	continental: deciduous forest	G3.4a	Bile Ozero	51,506	25,728	4	2004	15	0,00	1276
*	alpine	*	Bukovyna alpine	48,197	25,694	32	1995-2005	86	0,73	530
	alpine	G1.6a	Bukovyna alpine	48,214	25,664	29	1995-2005	59	0,60	530
	alpine	G1.Aa	Bukovyna alpine	48,181	25,734	25	2000-2005	22	0,88	530
	alpine	G3.1b	Bukovyna alpine	48,214	25,664	29	1995-2005	5	1,68	530
*	continental: deciduous forest	*	Bukovyna deciduous	48,325	25,880	10	2003-2005	21	0,52	1276
	continental: deciduous forest	G1.6a	Bukovyna deciduous	48,317	25,797	5	2003-2005	14	0,52	1276
	continental: deciduous forest	G1.Aa	Bukovyna deciduous	48,325	25,880	10	2004-2005	3	0,00	1276
	continental: deciduous forest	G1.Ab	Bukovyna deciduous	48,317	25,797	10	2003-2005	4	0,93	1276
*	continental: forest-steppe	*	Bukovyna forest-steppe	48,046	25,946	28	2000-2005	21	0,25	657
	continental: forest-steppe	G1.6a	Bukovyna forest-steppe	48,024	25,901	25	2000-2005	7	0,75	657
	continental: forest-steppe	G1.Aa	Bukovyna forest-steppe	48,048	25,969	26	2000-2005	11	0,00	657
	continental: forest-steppe	G3.1b	Bukovyna forest-steppe	48,024	25,901	29	1995-2005	3	0,00	530
*	continental: deciduous forest	*	Cheremskyi	51,526	25,539	5	1998-2001	46	0,00	1276
	continental: deciduous forest	G3.4a	Cheremskyi	51,526	25,539	5	1998-2001	29	0,00	1276
	continental: deciduous forest	G3.Da	Cheremskyi	51,526	25,539	5	1998-2001	9	0,00	1276
	continental: deciduous forest	G3.A	Cheremskyi	51,526	25,539	5	1998-2001	8	0,00	1276
*	alpine	G3.1a	Chornohora	48,076	24,646	13	2002	7	0,00	530
*	continental: forest-steppe	G1.Aa	Chornukhynshchyna	50,206	33,018	9	1997	25	0,00	657
*	continental: forest-steppe	G1.Aa	Chornyi Lis	48,774	32,581	6	2001	41	0,00	657
*	alpine	*	Chyvchyny	47,849	24,838	16	2002, 2003	20	0,21	530
	alpine	G3.1a	Chyvchyny	47,849	24,838	16	2002, 2003	18	0,21	530
	alpine	G1.6a	Chyvchyny	47,849	24,838	16	2002, 2003	2	0,21	530
*	steppic: flatland	G1.1	Danube delta	45,404	29,634	23	2003	7	10,16	180
*	alpine	G1.A4	Dubyno	48,544	22,803	5	2016	4	0,00	530
*	alpine	*	Gorgany	48,441	24,344	8	2005	53	0,11	530
	alpine	G1.2a	Gorgany	48,441	24,344	8	2005	5	0,00	530
	alpine	G1.6a	Gorgany	48,441	24,344	8	2005	7	0,84	530
	alpine	G3.1a	Gorgany	48,441	24,344	8	2005	27	0,00	530
	alpine	G3.1b	Gorgany	48,441	24,344	8	2005	9	0,00	530
	alpine	G3.2	Gorgany	48,441	24,344	8	2005	5	0,00	530
*	continental: forest-steppe	G1.Aa	Hadiach	50,333	34,027	22	2011-2016	40	1,03	657
*	continental: deciduous forest	*	Halych	49,140	24,620	25	2010-2011	23	1,89	1276
	continental: deciduous forest	G1.1	Halych	49,083	24,667	9	2010-2011	3	7,89	1276
	continental: deciduous forest	G1.2b	Halych	49,182	24,597	5	2010-2011	4	0,00	1276
	continental: deciduous forest	G1.6a	Halych	49,076	24,600	9	2010-2011	6	0,56	1276
	continental: deciduous forest	G1.Aa	Halych	49,163	24,620	11	2010-2011	10	1,64	1276

*	alpine	*	Hutsulshchyna	48,335	24,953	21	2006-2008	73	0,75	530
	alpine	G1.1	Hutsulshchyna	48,339	25,280	5	2008	3	5,34	530
	alpine	G1.2a	Hutsulshchyna	48,335	24,953	21	2006-2008	11	2,10	530
	alpine	G1.6a	Hutsulshchyna	48,335	24,953	21	2006, 2007	20	0,17	530
	alpine	G1.6b	Hutsulshchyna	48,335	24,953	21	2006, 2007	9	0,00	530
	alpine	G1.Aa	Hutsulshchyna	48,335	24,953	21	2006, 2008	18	0,69	530
	alpine	G3.1a	Hutsulshchyna	48,335	24,953	21	2006, 2007	12	0,00	530
*	continental: forest-steppe	G1.Aa	Ichnia	50,719	32,317	28	2004	6	0,00	657
*	continental: forest-steppe	G1.4	Irdyn	49,496	31,819	3	1996	3	0,00	657
*	continental: deciduous forest	G1.Aa	Ivano-Frankivsk	48,972	24,683	10	2006-2007	7	0,29	1276
*	continental: forest-steppe	*	Kaniv	49,775	31,535	14	1990-1995	53	4,91	657
	continental: forest-steppe	G1.1	Kaniv	49,719	31,569	2,5	1990-1995	15	16,17	657
	continental: forest-steppe	G1.7a	Kaniv	49,855	31,549	1,7	1990-1995	9	0,00	657
	continental: forest-steppe	G1.Aa	Kaniv	49,717	31,500	4	1990-1995	26	0,67	657
	continental: forest-steppe	G3.4a	Kaniv	49,855	31,549	1,7	1990-1995	3	0,00	657
*	steppic: flatland	*	Kherson	46,483	32,291	54	1999-2010	60	3,13	180
	steppic: flatland	G1.1	Kherson	46,482	32,676	25	2000-2010	12	4,29	180
	steppic: flatland	G1.2a	Kherson	46,484	32,144	42	1999-2010	16	2,49	180
	steppic: flatland	G1.2b	Kherson	46,484	32,144	42	1999-2010	8	1,39	180
	steppic: flatland	G1.7a	Kherson	46,484	31,911	21	1998-2009	24	3,56	180
*	continental: forest-steppe	*	Khmelnyskyi	49,418	27,052	12	2004	28	1,23	657
	continental: forest-steppe	G1.7a	Khmelnyskyi	49,325	27,007	0,5	2004	3	1,15	657
	continental: forest-steppe	G1.Aa	Khmelnyskyi	49,418	27,052	12	2004	25	1,24	657
*	continental: forest-steppe	*	Khorol	50,0580	33,6073	67	2001-2004	60	2,77	657
	continental: forest-steppe	G1.1	Khorol	50,0580	33,6073	67	2001-2004	8	8,21	657
	continental: forest-steppe	G1.2a	Khorol	50,0580	33,6073	67	2001-2004	11	5,37	657
	continental: forest-steppe	G1.4	Khorol	50,0580	33,6073	67	2001-2004	8	1,35	657
	continental: forest-steppe	G1.Aa	Khorol	50,0580	33,6073	67	2003-2004	33	0,93	657
*	continental: deciduous forest	*	Korostyshiv	50,270	29,095	25	2001-2004	23	0,48	1276
	continental: deciduous forest	G1.7a	Korostyshiv	50,270	29,095	25	2001-2004	10	0,42	1276
	continental: deciduous forest	G1.Aa	Korostyshiv	50,270	29,095	25	2001-2004	6	0,00	1276
	continental: deciduous forest	G1.Ab	Korostyshiv	50,270	29,095	25	2004	7	3,65	1276
*	continental: forest-steppe	G1.7a	Kotovsk	47,807	29,493	12	2007	15	2,25	657
*	continental: forest-steppe	*	Kremenchuk	49,053	33,428	9	2000-2005	24	7,85	657
	continental: forest-steppe	G1.1	Kremenchuk	49,053	33,428	9	2000-2005	17	9,84	657
	continental: forest-steppe	G1.4	Kremenchuk	49,053	33,428	9	2000-2005	7	3,02	657
*	continental: deciduous forest	G1.Aa	Kremenets	50,074	25,655	2	1999	7	0,00	1276
*	continental: deciduous forest	*	Kyiv west	50,506	30,302	10	2015-2017	48	4,91	1276
	continental: deciduous forest	G1.7a	Kyiv west	50,506	30,302	10	2015-2018	14	4,42	1276
	continental: deciduous forest	G1.2a	Kyiv west	50,506	30,302	10	2015-2019	9	5,83	1276
	continental: deciduous forest	G1.2b	Kyiv west	50,506	30,302	10	2015-2020	9	5,75	1276
	continental: deciduous forest	G1.4	Kyiv west	50,506	30,302	10	2015-2021	5	2,53	1276
	continental: deciduous forest	G1.Aa	Kyiv west	50,506	30,302	10	2015-2022	3	5,84	1276
	continental: deciduous forest	G3.4a	Kyiv west	50,506	30,302	10	2015-2022	8	6,84	1276
*	continental: forest-steppe	*	Kyiv south	50,302	30,544	23	2003-2017	154	4,35	657
	continental: forest-steppe	G3.4a	Kyiv south	50,291	30,577	9	2003-2017	33	4,71	657
	continental: forest-steppe	G1.7a	Kyiv south	50,333	30,541	8	2008-2014	4	1,99	657
	continental: forest-steppe	G1.4	Kyiv south	50,333	30,541	8	2003-2015	15	4,42	657

	continental: forest-steppe	G1.Aa	Kyiv south	50,333	30,541	8	2003, 2009	53	3,89	657
	continental: forest-steppe	G1.2a	Kyiv south	50,333	30,541	8	2003-2016	7	4,20	657
	continental: forest-steppe	G1.2b	Kyiv south	50,333	30,541	8	2003-2016	42	4,88	657
*	continental: forest-steppe	G3.4a	Kyiv plato	49,941	30,673	60	1996-1991	8	0,00	657
*	steppic: Crimean mountains	G1.6a	Laspi	44,419	33,756	3	2004-2005	5	0,00	32
*	continental: deciduous forest	*	Lviv	49,827	24,025	12	1992-1997	17	2,37	1276
	continental: deciduous forest	G1.6a	Lviv	49,827	24,025	12	1992-1997	10	3,09	1276
	continental: deciduous forest	G1.Aa	Lviv	49,827	24,025	12	1992-1997	7	1,34	1276
*	alpine	*	Mala Uholka	48,262	23,632	6	2005-2006	34	0,08	530
	alpine	G1.6a	Mala Uholka	48,275	23,658	4	2005-2006	31	0,00	530
	alpine	G1.Ab	Mala Uholka	48,245	23,618	4	2016	3	0,93	530
*	continental: deciduous forest	*	Medobory	49,282	26,164	15	1995-1998	80	0,24	1276
	continental: deciduous forest	G1.6a	Medobory	49,282	26,164	15	1995-1998	4	0,00	1276
	continental: deciduous forest	G1.Aa	Medobory	49,282	26,164	15	1995-1998	49	0,36	1276
	continental: deciduous forest	G1.Ab	Medobory	49,282	26,164	15	1995-1998	27	0,07	1276
*	alpine	*	Mukachevo alpine	48,473	22,740	3	2003-2004	20	0,63	530
	alpine	G1.6a	Mukachevo alpine	48,478	22,746	3	2003-2004	10	0,98	530
	alpine	G1.Aa	Mukachevo alpine	48,469	22,740	6	2003-2004	10	0,28	530
*	pannonian	G1.Aa	Mukachevo pannonian	48,399	22,670	3	2003-2004	12	0,23	26
*	continental: forest-steppe	*	Mykhailivka	49,609	31,509	7	1998-2003	17	0,00	657
	continental: forest-steppe	G1.7a	Mykhailivka	49,609	31,509	7	2003	5	0,00	657
	continental: forest-steppe	G3.4a	Mykhailivka	49,609	31,509	7	1998-2003	12	0,00	657
*	alpine	*	Mykulychyn	48,401	24,594	8	2002	14	0,89	530
	alpine	G1.6a	Mykulychyn	48,384	24,574	8	2002-2003	6	2,20	530
	alpine	G3.1a	Mykulychyn	48,403	24,570	6	2002	4	0,00	530
	alpine	G3.1b	Mykulychyn	48,392	24,613	4	2002	4	1,79	530
*	continental: deciduous forest	G1.Aa	Panivetska Dach	48,619	26,594	3	2004	14	0,30	1276
*	continental: deciduous forest	*	Perebrody	51,689	27,100	12	2004	19	2,16	1276
	continental: deciduous forest	G1.4	Perebrody	51,689	27,100	12	2004	3	0,00	1276
	continental: deciduous forest	G3.4a	Perebrody	51,689	27,100	12	2004	8	5,13	1276
	continental: deciduous forest	G3.Da	Perebrody	51,689	27,100	12	2004	8	0,00	1276
*	continental: forest-steppe	G1.7a	Poltava	49,552	34,632	1	1997	2	0,00	657
*	continental: deciduous forest	G1.Aa	Radomska Dach	51,948	32,483	5	2002	28	0,00	1276
*	continental: forest-steppe	*	Ros	49,721	30,403	90	1998-2000	43	3,00	657
	continental: forest-steppe	G1.1	Ros	49,721	30,403	90	1999-2000	15	6,72	657
	continental: forest-steppe	G1.4	Ros	49,721	30,403	90	1999-2000	13	1,15	657
	continental: forest-steppe	G3.4a	Ros	49,556	30,885	52	1998-2000	15	0,88	657
*	continental: deciduous forest	*	Roztochia	50,001	23,668	20	1990-2000	179	0,25	1276
	continental: deciduous forest	G1.2a	Roztochia	50,001	23,668	20	1996, 2000	13	0,28	1276
	continental: deciduous forest	G1.4	Roztochia	50,001	23,668	20	1990-1996	12	0,00	1276
	continental: deciduous forest	G1.6a	Roztochia	50,001	23,668	20	1990-1999	44	0,38	1276
	continental: deciduous forest	G1.7a	Roztochia	50,001	23,668	20	1996, 2000	9	0,00	1276
	continental: deciduous forest	G1.8	Roztochia	50,001	23,668	20	1990-1998	6	0,00	1276
	continental: deciduous forest	G1.Aa	Roztochia	50,001	23,668	20	1990-2000	40	0,31	1276
	continental: deciduous forest	G1.Ab	Roztochia	50,108	23,701	4	1996, 2004	2	0,00	1276
	continental: deciduous forest	G3.4a	Roztochia	50,001	23,668	20	1990-1998	53	0,21	1276
*	continental: deciduous forest	G3.A	Rys	51,261	25,384	1,5	1997	6	0,00	1276
*	steppic: flatland	G3.4a	Samara	48,656	35,329	17	2003	49	5,17	180

*	continental: forest-steppe	*	Sestrynivska Dacha	49,756	28,886	3	2003-2004	6	1,01	657
	continental: forest-steppe	G1.2b	Sestrynivska Dacha	49,756	28,886	3	2003-2004	5	0,74	657
	continental: forest-steppe	G1.Aa	Sestrynivska Dacha	49,756	28,886	3	2003-2004	1	2,33	657
*	continental: deciduous forest	*	Shepetivka	50,250	26,908	36	1999-2001	59	0,00	1276
	continental: deciduous forest	G1.2a	Shepetivka	50,250	26,908	36	1999-2001	3	0,00	1276
	continental: deciduous forest	G1.2b	Shepetivka	50,250	26,908	36	1998-2001	6	0,00	1276
	continental: deciduous forest	G1.4	Shepetivka	50,250	26,908	36	1999-2001	3	0,00	1276
	continental: deciduous forest	G1.7a	Shepetivka	50,250	26,908	36	1999-2001	3	0,00	1276
	continental: deciduous forest	G1.8	Shepetivka	50,250	26,908	36	1999-2001	4	0,00	1276
	continental: deciduous forest	G1.Aa	Shepetivka	50,250	26,908	36	1999-2001	15	0,00	1276
	continental: deciduous forest	G3.4a	Shepetivka	50,250	26,908	36	1997-2001	6	0,00	1276
	continental: deciduous forest	G3.Da	Shepetivka	50,250	26,908	36	1997-2001	19	0,00	1276
*	alpine	*	Skole	49,055	23,359	17	1990-2001	85	0,14	530
	alpine	G1.2a	Skole	49,055	23,359	17	1990-2001	8	0,66	530
	alpine	G1.6a	Skole	49,055	23,359	17	1990-2001	49	0,14	530
	alpine	G1.6b	Skole	49,055	23,359	17	1990-2001	5	0,00	530
	alpine	G1.Aa	Skole	49,055	23,359	17	1990-2003	9	0,00	530
	alpine	G1.Ab	Skole	49,055	23,359	17	1990-2003	3	0,00	530
	alpine	G3.1b	Skole	49,055	23,359	17	1990-2001	11	0,00	530
*	steppic: flatland	G1.Aa	Snizhne	48,035	38,783	1	2003	11	1,46	180
*	continental: deciduous forest	G3.4a	Somyno	51,414	26,916	8	2004	13	0,00	1276
*	continental: deciduous forest	*	Stara Huta	52,277	33,567	21	2012	176	0,45	1276
	continental: deciduous forest	G1.1	Stara Huta	52,333	33,343	1	2012	4	7,03	1276
	continental: deciduous forest	G1.2a	Stara Huta	52,297	33,551	13	2012	2	0,00	1276
	continental: deciduous forest	G1.2b	Stara Huta	52,242	33,364	5	2000-2010	16	1,16	1276
	continental: deciduous forest	G1.4	Stara Huta	52,292	33,541	12	1998-2010	12	0,57	1276
	continental: deciduous forest	G1.7a	Stara Huta	52,277	33,567	21	2001-2012	6	1,87	1276
	continental: deciduous forest	G1.8	Stara Huta	52,339	33,763	7	1997-2010	16	0,00	1276
	continental: deciduous forest	G1.Aa	Stara Huta	52,328	33,732	5	1997-1999	30	0,00	1276
	continental: deciduous forest	G3.4a	Stara Huta	52,276	33,620	18	1997-2012	72	0,19	1276
	continental: deciduous forest	G3.Da	Stara Huta	52,342	33,698	10	1997-2012	18	0,00	1276
*	steppic: Crimean mountains	G1.Aa	Staryi Krym	45,021	35,072	4	2007	13	0,00	32
*	continental: forest-steppe	*	Sumy	50,678	34,859	55	1996-2002	59	0,12	657
	continental: forest-steppe	G1.2b	Sumy	50,678	34,859	55	1996-2002	5	0,00	657
	continental: forest-steppe	G1.4	Sumy	50,678	34,859	55	1996-2002	4	0,00	657
	continental: forest-steppe	G1.7a	Sumy	50,678	34,859	55	1996-2002	19	0,38	657
	continental: forest-steppe	G1.Aa	Sumy	50,678	34,859	55	1996-2002	20	0,00	657
	continental: forest-steppe	G3.4a	Sumy	50,678	34,859	55	1996-2002	11	0,00	657
*	steppic: flatland	*	Sviati Hory	48,956	37,644	25	2006	44	0,12	180
	steppic: flatland	G1.7a	Sviati Hory	48,988	37,493	11	2006	3	0,51	180
	steppic: flatland	G1.Aa	Sviati Hory	48,988	37,493	11	2006	24	0,15	180
	steppic: flatland	G3.4b	Sviati Hory	49,029	37,493	7	2001	17	0,00	180
*	alpine	*	Synevyr	48,508	23,705	16	1990-2016	96	0,00	530
	alpine	G1.2a	Synevyr	48,508	23,705	16	1990-2016	5	0,00	530
	alpine	G1.Ab	Synevyr	48,508	23,705	16	1990-2016	2	0,00	530
	alpine	G1.6a	Synevyr	48,508	23,705	16	1990-2016	22	0,00	530
	alpine	G1.6b	Synevyr	48,508	23,705	16	1990-2016	14	0,00	530
	alpine	G3.1a	Synevyr	48,508	23,705	16	1990-2016	49	0,00	530



	alpine	G3.1b	Synevyr	48,508	23,705	16	1990-2016	4	0,00	530
*	steppic: flatland	G1.7a	Tarutyno	46,206	29,146	4	2007	4	5,21	180
*	continental: deciduous forest	G3.A	Tkhoryn	51,415	28,317	15	1999	3	0,00	1276
*	continental: deciduous forest	*	Tsuman	50,926	25,884	9	2002-2003	15	0,00	1276
	continental: deciduous forest	G1.7a	Tsuman	50,875	25,965	0,5	2002-2003	3	0,00	1276
	continental: deciduous forest	G1.Aa	Tsuman	50,926	25,884	8	2002-2003	12	0,00	1276
*	continental: forest-steppe	G1.Aa	Uman	48,719	30,243	5	2004-2005	22	1,81	657
*	continental: forest-steppe	G1.Aa	Vasyshevo	49,826	36,278	1	2006	8	0,00	657
*	continental: deciduous forest	*	Verkhniobuzki Lisy	49,914	24,941	9	2002-2006	387	0,17	1276
	continental: deciduous forest	G1.6a	Verkhniobuzki Lisy	49,914	24,941	9	2002-2005	143	0,11	1276
	continental: deciduous forest	G1.Aa	Verkhniobuzki Lisy	49,914	24,941	9	2002-2006	223	0,17	1276
	continental: deciduous forest	G1.Ab	Verkhniobuzki Lisy	49,914	24,941	9	2002-2005	21	0,48	1276
*	pannonian	G1.Ab	Vynohradiv-Shaian	48,131	23,227	13	2016	14	1,69	26
*	alpine	*	Vyzhnytsia	48,192	25,208	8	1999-2004	38	0,00	530
	alpine	G1.2a	Vyzhnytsia	48,192	25,208	8	2002-2004	3	0,00	530
	alpine	G1.6a	Vyzhnytsia	48,192	25,208	8	1999-2004	11	0,00	530
	alpine	G1.6b	Vyzhnytsia	48,192	25,208	8	2004	9	0,00	530
	alpine	G1.Ab	Vyzhnytsia	48,192	25,208	8	2002	3	0,00	530
	alpine	G3.1a	Vyzhnytsia	48,192	25,208	8	2002	4	0,00	530
	alpine	G3.1b	Vyzhnytsia	48,192	25,208	8	1999-2004	8	0,00	530
*	steppic: flatland	G1.7a	Zaporizki Balky	47,817	35,201	35	2003-2006	5	1,66	180
*	continental: deciduous forest	G1.7a	Zhukiv Khutir	50,483	30,080	2	1996	13	3,68	1276
*	continental: forest-steppe	G1.Aa	Zhuravlivska Dacha	48,597	28,714	4	2003	21	1,70	657
*	continental: deciduous forest	*	Zhytomyrska	50,840	28,334	81	2000-2003	77	0,06	1276
	continental: deciduous forest	G3.4a	Zhytomyrska	50,840	28,334	81	2000-2003	53	0,09	1276
	continental: deciduous forest	G3.Da	Zhytomyrska	50,840	28,334	81	2000-2002	24	0,00	1276

Title string	Biogeographical region	Habitat type	Geographical group of relevés	Latitude	Longitude	Radius (km)	Year(s)	No. of relevés	Mean % of kenophytes	Area of habitat in Ukraine (thousands ha)	Mean for dataset	Mean for geographical groups	Median for geographical groups	Mean for European dataset	Product of number of relevés in group by mean % of kenophytes in group	Number of relevés in subregion
*			G1.1					84		100,00	9,13	8,41	7,89	4,7		
	steppic: flatland		G1.1 Danube delta	45,404	29,634	23	2003	7	10,16						71,12	180
	continental: deciduous forest		G1.1 Halych	49,083	24,667	9	2010-2011	3	7,89						23,66	1276
	alpine		G1.1 Hutsulshchyna	48,339	25,280	5	2008	3	5,34						16,02	530
	continental: forest-steppe		G1.1 Kaniv	49,719	31,569	2,5	1990-1995	15	16,17						242,55	657
	steppic: flatland		G1.1 Kherson	46,482	32,676	25	2000-2010	12	4,29						51,48	180
	continental: forest-steppe		G1.1 Khorol	50,0580	33,6073	67	2001-2004	8	8,21						65,68	657
	continental: forest-steppe		G1.1 Kremenchuk	49,053	33,428	9	2000-2005	17	9,84						167,28	657
	continental: forest-steppe		G1.1 Ros	49,721	30,403	90	1999-2000	15	6,72						100,80	657
	continental: deciduous forest		G1.1 Stara Huta	52,333	33,343	1	2012	4	7,03						28,12	1276
*			G1.2a					93		300,00	2,29	1,74	0,47	1,3		
	alpine		G1.2a Gorgany	48,441	24,344	8	2005	5	0,00						0,00	530
	alpine		G1.2a Hutsulshchyna	48,335	24,953	21	2006-2008	11	2,10						23,08	530
	steppic: flatland		G1.2a Khetson	46,484	32,144	42	1999-2010	16	2,49						39,84	180
	continental: forest-steppe		G1.2a Khorol	50,0580	33,6073	67	2001-2004	11	5,37						59,07	657
	continental: forest-steppe		G1.2a Kyiv south	50,333	30,541	8	2003-2016	7	4,2						29,4	657
	continental: deciduous forest		G1.2a Kyiv west	50,506	30,302	10	2015-2019	9	5,83						52,47	1276
	continental: deciduous forest		G1.2a Roztochia	50,001	23,668	20	1996, 2000	13	0,28						3,64	1276
	continental: deciduous forest		G1.2a Shepetivka	50,250	26,908	36	1999-2001	3	0,00						0,00	1276
	alpine		G1.2a Skole	49,055	23,359	17	1990-2001	8	0,66						5,28	530
	continental: deciduous forest		G1.2a Stara Huta	52,297	33,551	13	2012	2	0,00						0,00	1276
	alpine		G1.2a Synevyr	48,508	23,705	16	1990-2016	5	0,00						0,00	530
	alpine		G1.2a Vyzhnytsia	48,192	25,208	8	2002-2004	3	0,00						0,00	530
*			G1.2b					95		40,00	3,05	1,74	0,95	1,8		
	continental: deciduous forest		G1.2b Halych	49,182	24,597	5	2010-2011	4	0,00						0,00	1276
	steppic: flatland		G1.2b Khetson	46,484	32,144	42	1999-2010	8	1,39						11,12	180

continental: forest-steppe	G1.2b Kyiv south	50,333	30,541	8	2003-2016	42	4,88	204,96	657			
continental: deciduous forest	G1.2b Kyiv west	50,506	30,302	10	2015-2020	9	5,75	51,75	1276			
continental: forest-steppe	G1.2a Sestrynivska Dacha	49,756	28,886	3	2003-2004	5	0,74	3,70	657			
continental: deciduous forest	G1.2b Shepetivka	50,250	26,908	36	1998-2001	6	0,00	0,00	1276			
continental: deciduous forest	G1.2b Stara Hutra	52,242	33,364	5	2000-2010	16	1,16	18,56	1276			
continental: forest-steppe	G1.2b Sumy	50,678	34,859	55	1996-2002	5	0,00	0,00	657			
*												
	G1.4						85	300,00	1,46	1,19	0,57	0,9
continental: forest-steppe	G1.4 Irdyn	49,496	31,819	3	1996	3	0,00	0,00	657			
continental: forest-steppe	G1.4 Khorol	50,0580	33,6073	67	2001-2004	8	1,35	2,22	657			
continental: forest-steppe	G1.4 Kremenchuk	49,053	33,428	9	2000-2005	7	3,02	21,14	657			
continental: deciduous forest	G1.4 Kyiv west	50,506	30,302	10	2015-2021	5	2,53	12,65	1276			
continental: forest-steppe	G1.4 Kyiv south	50,333	30,541	8	2003-2015	15	4,42	66,3	657			
continental: deciduous forest	G1.4 Perebrody	51,689	27,100	12	2004	3	0,00	0,00	1276			
continental: forest-steppe	G1.4 Ros	49,721	30,403	90	1999-2000	13	1,15	14,95	657			
continental: deciduous forest	G1.4 Roztochia	50,001	23,668	20	1990-1996	12	0,00	0,00	1276			
continental: deciduous forest	G1.4 Shepetivka	50,250	26,908	36	1999-2001	3	0,00	0,00	1276			
continental: deciduous forest	G1.4 Stara Hutra	52,292	33,541	12	1998-2010	12	0,57	6,84	1276			
continental: forest-steppe	G1.4 Sumy	50,678	34,859	55	1996-2002	4	0,00	0,00	657			
*												
	G1.6a						459	650,00	0,34	0,56	0,21	0,3
steppic: Crimean mountains	G1.6a Ai-Petri	44,499	34,026	2	2004-2005	9	0,00	0,00	32			
alpine	G1.6a Bukovyna alpine	48,214	25,664	29	1995-2005	59	0,60	35,40	530			
continental: deciduous forest	G1.6a Bukovyna deciduous	48,317	25,797	5	2003-2005	14	0,52	7,28	1276			
continental: forest-steppe	G1.6a Bukovyna forest-steppe	48,024	25,901	25	2000-2005	7	0,75	5,25	657			
alpine	G1.6a Chyvyhyny	47,849	24,838	16	2002, 2003	2	0,21	0,43	530			
alpine	G1.6a Gorgany	48,441	24,344	8	2005	7	0,84	5,88	530			
continental: deciduous forest	G1.6a Halych	49,076	24,600	9	2010-2011	6	0,56	3,33	1276			
alpine	G1.6a Hursulshchyna	48,335	24,953	21	2006, 2007	20	0,17	3,44	530			
steppic: Crimean mountains	G1.6a Laspi	44,419	33,756	3	2004-2005	5	0,00	0,00	32			
continental: deciduous forest	G1.6a Lviv	49,827	24,025	12	1992-1997	10	3,09	30,90	1276			
alpine	G1.6a Mala Uholka	48,275	23,658	4	2005-2006	31	0,00	0,00	530			

continental: deciduous forest	G1.6a Medobory	49,282	26,164	15	1995-1998	4	0,00				0,00	1276
alpine	G1.6a Mukachevo	48,478	22,746	3	2003-2004	10	0,98				9,8	530
alpine	G1.6a Mykulychyn	48,384	24,574	8	2002-2003	6	2,20				13,19	530
continental: deciduous forest	G1.6a Roztochia	50,001	23,668	20	1990-1999	44	0,38				16,90	1276
alpine	G1.6a Skole	49,055	23,359	17	1990-2001	49	0,14				6,81	530
alpine	G1.6a Synevyr	48,508	23,705	16	1990-2016	22	0,00				0,00	530
continental: deciduous forest	G1.6a Verkhniobuzki Lisy	49,914	24,941	9	2002-2005	143	0,11				16,30	1276
alpine	G1.6a Vyzhnytsia	48,192	25,208	8	1999-2004	11	0,00				0,00	530
	G1.6b					37		80,00	0,00	0,00	0,00	0,9
alpine	G1.6b Vyzhnytsia	48,192	25,208	8	2004	9	0,00				0,00	530
alpine	G1.6b Hutsulshchyna	48,335	24,953	21	2006, 2007	9	0,00				0,00	530
alpine	G1.6b Skole	49,055	23,359	17	1990-2001	5	0,00				0,00	530
alpine	G1.6b Synevyr	48,508	23,705	16	1990-2016	14	0,00				0,00	530
	G1.7a					151		200,00	1,94	1,51	0,83	0,4
continental: forest-steppe	G1.7a Kaniv	49,855	31,549	1,7	1990-1995	9	0,00				0,00	657
steppic: flatland	G1.7a Khetson	46,484	31,911	21	1998-2009	24	3,56				85,44	180
continental: forest-steppe	G1.7a Khmelnytskyi	49,325	27,007	0,5	2004	3	1,15				3,45	657
continental: deciduous forest	G1.7a Korostyshiv	50,270	29,095	25	2001-2004	10	0,42				4,20	1276
continental: forest-steppe	G1.7a Kotovsk	47,807	29,493	12	2007	15	2,25				33,75	657
continental: deciduous forest	G1.7a Kyiv west	50,506	30,302	10	2015-2018	14	4,42				61,88	1276
continental: forest-steppe	G1.7a Kyiv south	50,333	30,541	8	2008-2014	4	1,99				7,96	657
continental: forest-steppe	G1.7a Mykhailivka	49,609	31,509	7	2003	5	0,00				0,00	657
continental: forest-steppe	G1.7a Poltava	49,552	34,632	1	1997	2	0,00				0,0	657
continental: deciduous forest	G1.7a Roztochia	50,001	23,668	20	1996, 2000	9	0,00				0,00	1276
continental: deciduous forest	G1.7a Shepetivka	50,250	26,908	36	1999-2001	3	0,00				0,00	1276
continental: deciduous forest	G1.7a Stara Huta	52,277	33,567	21	2001-2012	6	1,87				11,22	1276
continental: forest-steppe	G1.7a Sumy	50,678	34,859	55	1996-2002	19	0,38				7,22	657
steppic: flatland	G1.7a Sviati Hory	48,988	37,493	11	2006	3	0,51				1,53	180
steppic: flatland	G1.7a Tarutyno	46,206	29,146	4	2007	4	5,21				20,84	180
continental: deciduous forest	G1.7a Tsuman	50,875	25,965	0,5	2002-2003	3	0,00				0,00	1276

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steppic: flatland	G1.7a Zaporizki Balky	47,817	35,201	35	2003-2006	5	1,66					8,30	180
continental: deciduous forest	G1.7a Zhukiv Khutir	50,483	30,080	2	1996	13	3,68					47,84	1276
	G1.8					26		800,00	0,00	0,00	0,00		1,4
continental: deciduous forest	G1.8 Stara Hura	52,339	33,763	7	1997-2010	16	0,00					0,00	1276
continental: deciduous forest	G1.8 Shepetivka	50,250	26,908	36	1999-2001	4	0,00					0,00	1276
continental: deciduous forest	G1.8 Roztochia	50,001	23,668	20	1990-1998	6	0,00					0,00	1276
	G1.Aa					911		1800,00	0,64	0,71	0,28		0,8
steppic: Crimean mountains	G1.Aa Anharskyi Pass	44,791	34,341	4	2005	5	0,00					0,00	32
continental: forest-steppe	G1.Aa Bernashivka	48,587	27,489	2	2001	1	0,00					0,00	657
alpine	G1.Aa Bukovyna alpine	48,181	25,734	22	2000-2005	22	0,88					19,36	530
continental: deciduous forest	G1.Aa Bukovyna deciduous	48,325	25,880	10	2004-2005	3	0,00					0,00	1276
continental: forest-steppe	G1.Aa Bukovyna forest-steppe	48,048	25,969	26	2000-2005	11	0,00					0	657
continental: forest-steppe	G1.Aa Chornukhynshchyna	50,206	33,018	9	1997	25	0,00					0	657
continental: forest-steppe	G1.Aa Chornyi Lis	48,774	32,581	6	2001	41	0,00					0	657
continental: forest-steppe	G1.Aa Hadiach	50,333	34,027	22	2011-2016	40	1,03					41,2	657
continental: deciduous forest	G1.Aa Halych	49,163	24,620	11	2010-2011	10	1,64					16,40	1276
alpine	G1.Aa Hursulshchyna	48,335	24,953	21	2006, 2008	18	0,69					12,40	530
continental: forest-steppe	G1.Aa Ichnia	50,719	32,317	28	2004	6	0,00					0	657
continental: forest-steppe	G1.Aa Kaniv	49,717	31,500	4	1990-1995	26	0,67					17,42	657
continental: forest-steppe	G1.Aa Khmelnytskyi	49,418	27,052	12	2004	25	1,24					31	657
continental: forest-steppe	G1.Aa Khorol	50,0580	33,6073	67	2003-2004	33	0,93					30,69	657
continental: deciduous forest	G1.Aa Korostyshiv	50,270	29,095	25	2001-2004	6	0,00					0,00	1276
continental: deciduous forest	G1.Aa Kremenets	50,074	25,655	2	1999	7	0,00					0,00	1276
continental: deciduous forest	G1.Aa Kyiv west	50,506	30,302	10	2015-2022	3	5,84					17,52	1276
continental: forest-steppe	G1.Aa Kyiv south	50,333	30,541	8	2003, 2009	53	3,89					206,17	657
continental: deciduous forest	G1.Aa Lviv	49,827	24,025	12	1992-1997	7	1,34					9,38	1276
continental: deciduous forest	G1.Aa Medobory	49,282	26,164	15	1995-1998	49	0,36					17,40	1276
alpine	G1.Aa Mukachevo alpine	48,469	22,740	6	2003-2004	10	0,28					2,8	530
pannonian	G1.Aa Mukachevo pannonian	48,399	22,670	3	2003-2004	12	0,23					2,76	26
continental: forest-steppe	G1.Aa Panivetska Dacha	48,619	26,594	3	2004	14	0,30					4,2	657

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continental: deciduous forest	G1.Aa Radomska Dacha	51,948	32,483	5	2002	28	0,00	0,00	1276	
continental: deciduous forest	G1.Aa Roztochia	50,001	23,668	20	1990-2000	40	0,31	12,40	1276	
continental: deciduous forest	G1.Aa Ivano-Frankivsk	48,972	24,683	10	2006-2007	7	0,29	2,03	1276	
continental: forest-steppe	G1.Aa Sestryniwska Dacha	49,756	28,886	3	2003-2004	1	2,33	2,33	657	
continental: deciduous forest	G1.Aa Shepetivka	50,250	26,908	36	1999-2001	15	0,00	0,00	1276	
alpine	G1.Aa Skole	49,055	23,359	17	1990-2003	9	0,00	0	530	
stepptic: flatland	G1.Aa Snizhne	48,035	38,783	1	2003	11	1,46	16,06	180	
continental: deciduous forest	G1.Aa Stara Huta	52,328	33,732	5	1997-1999	30	0,00	0,00	1276	
stepptic: Crimean mountains	G1.Aa Staryi Krym	45,021	35,072	4	2007	13	0,00	0	32	
continental: forest-steppe	G1.Aa Sumy	50,678	34,859	55	1996-2002	20	0,00	0,00	657	
stepptic: flatland	G1.Aa Sviati Hory	48,988	37,493	11	2006	24	0,15	3,6	180	
continental: deciduous forest	G1.Aa Tsuman	50,926	25,884	8	2002-2003	12	0,00	0,00	1276	
continental: forest-steppe	G1.Aa Uman	48,719	30,243	5	2004-2005	22	1,81	39,82	657	
continental: forest-steppe	G1.Aa Vasyshchevo	49,826	36,278	1	2006	8	0,33	2,64	657	
continental: deciduous forest	G1.Aa Verkhniobuzki Lisy	49,914	24,941	9	2002-2006	223	0,17	38,80	1276	
continental: forest-steppe	G1.Aa Zhuravliwska Dacha	48,597	28,714	4	2003	21	1,70	35,7	657	
*	G1.Ab					90	5,00	0,41	0,07	0,8
alpine	G1.Ab Dubyno	48,565	22,824	3	2016	4	0,00	0,00	530	
continental: deciduous forest	G1.Aa Korostyshiv	50,270	29,095	25	2001-2004	7	0,43	3,01	1276	
alpine	G1.Ab Mala Uholka	48,245	23,618	4	2016	3	0,93	2,78	530	
continental: deciduous forest	G1.Ab Medobory	49,282	26,164	15	1995-1998	27	0,07	2,00	1276	
continental: deciduous forest	G1.Ab Roztochia	50,108	23,701	4	1996, 2004	2	0,00	0,00	1276	
alpine	G1.Ab Skole	49,055	23,359	17	1990-2003	3	0,00	0,00	530	
alpine	G1.Ab Synevir	48,508	23,705	16	1990-2016	2	0,00	0,00	530	
continental: deciduous forest	G1.Ab Verkhniobuzki Lisy	49,914	24,941	9	2002-2005	21	0,48	9,98	1276	
continental: deciduous forest	G1.Ab Bukovyna deciduous	48,317	25,797	5	2003-2005	4	0,93	3,72	1276	
pannonian	G1.Ab Vynohradiv-Shaian	48,131	23,227	13	2016	14	1,69	23,66	26	
alpine	G1.Ab Vyzhnytsia	48,192	25,208	8	2002	3	0,00	0,00	530	
*	G3.1a					121	500,00	0,03	0,03	0,1
alpine	G3.1a Chornohora	48,076	24,646	13	2002	7	0,00	0,00	530	

alpine	G3.1a	Chyvychny	47,849	24,838	16	2002, 2003	18	0,21											3,85	530
alpine	G3.1a	Gorgany	48,441	24,344	8	2005	27	0,00											0,00	530
alpine	G3.1a	Hursulshchyna	48,335	24,953	21	2006, 2007	12	0,00											0,00	530
alpine	G3.1a	Mykulychyn	48,403	24,570	6	2002	4	0,00											0,00	530
alpine	G3.1a	Synevr	48,508	23,705	16	1990-2016	49	0,00											0,00	530
alpine	G3.1a	Vyzhnytsia	48,192	25,208	8	2002	4	0,00											0,00	530
		G3.1b					44		130,00	0,35	0,50	0,00	0,00	0,1						
alpine	G3.1b	Bukovyna alpine	48,214	25,664	29	1995-2005	5	1,68											8,40	530
continental: forest-steppe	G3.1b	Bukovyna forest-steppe	48,024	25,901	25	2000-2005	3	0,00											0,00	657
alpine	G3.1b	Gorgany	48,441	24,344	8	2005	9	0,00											0,00	530
alpine	G3.1b	Mykulychyn	48,392	24,613	6	2002	4	1,79											7,14	530
alpine	G3.1b	Skole	49,055	23,359	17	1990-2001	11	0,00											0,00	530
alpine	G3.1b	Synevr	48,508	23,705	16	1990-2016	4	0,00											0,00	530
alpine	G3.1b	Vyzhnytsia	48,192	25,208	8	1999-2004	8	0,00											0,00	530
		G3.2					5		0,18	0,00	0,00	0,00	0,00	0						
alpine	G3.2	Gorgany	48,441	24,344	8	2005	5	0,00											0,00	530
		G3.4a					388		2700,00	1,41	1,45	0,05	1,4							
continental: deciduous forest	G3.4a	Bile Ozero	51,506	25,728	4	2004	15	0,00											0,00	1276
continental: deciduous forest	G3.4a	Cheremskyyi	51,526	25,539	5	1998-2001	29	0,00											0,00	1276
continental: forest-steppe	G3.4a	Kaniv	49,855	31,549	1,7	1990-1995	3	0,00											0,00	657
continental: deciduous forest	G3.4a	Kyiv west	50,506	30,302	10	2015-2022	8	6,84											54,72	1276
continental: forest-steppe	G3.4a	Kyiv south	50,291	30,577	9	2003-2017	33	4,71											155,43	657
continental: forest-steppe	G3.4a	Kyiv plato	49,941	30,673	60	1996-1991	8	0,00											0,00	657
continental: forest-steppe	G3.4a	Mykhailivka	49,609	31,509	7	1998-2003	12	0,00											0,00	657
continental: deciduous forest	G3.4a	Perebrody	51,689	27,100	12	2004	8	5,13											41,04	1276
continental: forest-steppe	G3.4a	Ros	49,556	30,885	52	1998-2000	15	0,88											13,20	657
continental: deciduous forest	G3.4a	Roztochia	50,001	23,668	20	1990-1998	53	0,21											11,13	1276
steppic: flatland	G3.4a	Samara	48,656	35,329	17	2003	49	5,17											253,33	180
continental: deciduous forest	G3.4a	Shepetivka	50,250	26,908	36	1997-2001	6	0,00											0,00	1276
continental: deciduous forest	G3.4a	Somyno	51,414	26,916	8	2004	13	0,00											0,00	1276

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continental: deciduous forest	G3.4a	Stara Huta	52,276	33,620	18	1997-2012	72	0,19										13,90	1276
continental: forest-steppe	G3.4a	Sumy	50,678	34,859	55	1996-2002	11	0,00										0,00	657
continental: deciduous forest	G3.4a	Zhytomyrska	50,840	28,334	81	2000-2003	53	0,09										4,98	1276
*		G3.4b					17		12,00	0,00	0,00	0,00	0,00	0,00	0,00	0,1			
steppic: flatland	G3.4b	Sviati Hory	49,029	37,493	7	2001	17	0,00										0,00	180
*		G3.A					17		0,50	0,00	0,00	0,00	0,00	0,00	0,00	0			
continental: deciduous forest	G3.A	Cheremskyi	51,526	25,539	5	1998-2001	8	0,00										0,00	1276
continental: deciduous forest	G3.A	Rys	51,261	25,384	1,5	1997	6	0,00										0,00	1276
continental: deciduous forest	G3.A	Tkhoryn	51,415	28,317	15	1999	3	0,00										0,00	1276
*		G3.Da					78		500,00	0,00	0,00	0,00	0,00	0,00	0,00	0			
continental: deciduous forest	G3.Da	Cheremskyi	51,526	25,539	5	1998-2001	9	0,00										0,00	1276
continental: deciduous forest	G3.Da	Perebrody	51,689	27,100	12	2004	8	0,00										0,00	1276
continental: deciduous forest	G3.Da	Shepetivka	50,250	26,908	36	1997-2001	19	0,00										0,00	1276
continental: deciduous forest	G3.Da	Stara Huta	52,342	33,698	10	1997-2012	18	0,00										0,00	1276
continental: deciduous forest	G3.Da	Zhytomyrska	50,840	28,334	81	2000-2002	24	0,00										0,00	1276