

ECO-BIOLOGICAL CHARACTERISTICS OF THE FLORA IN THE FLOODPLAIN FORESTS OF THE MAINTAINED RESERVE “DOLNA TOPCHIYA” (THE RIVER TUNDZHA HILLY VALLEY)

K. KOEV¹, A. TASHEV² and S. GEORGIEV³

¹*Plovdiv University “Paisii Hilendarski”, Faculty of Biology, BG - 4000 Plovdiv, Bulgaria*

²*Forestry University, Faculty of Forestry, BG - 1756 Sofia, Bulgaria*

³*Agricultural University, Faculty of Plant Protection, BG - 4000 Plovdiv, Bulgaria*

Abstract

KOEV, K., A. TASHEV and S. GEORGIEV, 2015. Eco-biological characteristics of the flora in the floodplain forests of the maintained reserve “Dolna Topchiya” (the river Tundzha hilly valley). *Bulg. J. Agric. Sci.*, 21: 523–529

The floristic diversity of the maintained reserve “Dolna Topchiya” was studied for a period of 3 years; the reserve is located in the middle reaches of the river Tundzha near the town of Elhovo (Tundzha hilly valley). The vegetation seasons include the period from February to October, which guarantees tracking the cycles of development of annual and perennial species, as well as the ephemeral and ephemeral-like species. In the present study we made eco-biological characteristics of these plants, and the species are distributed in biological groups, life forms, floral elements and flowering time. Plant species are grouped according to their relation to water, light and heat. We draw conclusions about the influence of hydrodynamics on the changing floristic composition and also on the changes occurring in the cenosis characteristics of the protected area.

Key words: The maintained reserve “Dolna Topchiya“, floristic characteristics, eco-biological characteristics, medicinal plants, conservation significance

Introduction

The purpose of this study is on the basis of our fieldwork and analysis of literature data to be made a list, floristic analysis and eco-biological characteristics of the plants set within the maintained reserve (MR) “Dolna Topchiya” (Tundzha hilly valley).

Nikolay Stoyanov in his article “The Forest Longoz at the River Kamchiya and longozes as plant formation” (Stoyanov, 1928), where he first mentioned the riparian forests that are located in the valley of the Tundzha river, not far from Elhovo, whose flora is the subject of this study. Popov (1995) in its report under the contract: “Assessment of the state of the reserves ”Dolna Topchiya”, “Gorna Topchiya” and “Balabana” provides a list of 135 plants in the three reserves without distinguishing which ones can be found in each reserve. A more detailed study on plant diversity of MR “Dolna Topchiya”

was conducted in the development of its management plan (Berberova, 2001).

In 2002, Pavlov and Dimitrov (2002) studied and published two articles; in the first one they studied the syntaxonomic diversity in the reserve, and in the second – the phytogeographic elements and biological spectrum of the flora of the area commented.

The findings of our present study complement and correct the conclusions drawn by Berberova (2001) and Pavlov and Dimitrov (2002) and they are the first that generalize the genetic resources of higher plants in MR “Dolna Topchiya“

Subject and Methods of the Study

The subject of this study is to make characteristics of the flora in MR “Dolna Topchiya“(467.6 ha), located in the middle reaches of the river Tundzha, not far from the town of Elhovo.

The reserve was proclaimed with Order No 225/29.02.1960, at GFM with area of 763.3 ha with the purpose to restore and preserve natural habitats and places of nesting colonies of *Phasianus colchicus* L. In 1984 the boundaries of the reserve were corrected by adding a buffer zone including extra 270 ha. In 1998, the Protected Areas Act, by Order No RD-377/15.10.1998 of MEW, it was categorized as a “maintained reserve”.

The protected area is in the field of Elhovo of the river Tundzha hilly valley, between 41°15' and 41° 18' N, and 26° 2' and 27° 07' E. According to the phytogeographic subdivision of Bulgaria, the reserve is located within the region of Sakar of Sakar-Dervenska phytogeographic region (Bondev, 1997).

The territory of MR “DolnaTopchiya” falls within the European continental climatic sub-region to the east region of middle Bulgaria (Stanev et al., 1991), and according to Tishkov (1982) in the southern Bulgarian subregion of the Continental-Mediterranean climate region, and this implies the significant Mediterranean influence on the flora in the area.

We made characteristics of the main components of the climate in the research area with the data from the meteorological station in Elhovo. The average annual temperature for the last 10 years (Table 1) is relatively high and varies between 11.5°C and 13.3°C (average 12.5°C). For comparison, the average annual temperature for most of the country is 11-12°C (Galabov, 1982). The sum of annual rainfall varies within 400.5-1018.6 mm (average 629.1 mm). Their seasonal distribution is relatively constant with autumn-winter maximum (110-160 mm) and spring-summer minimum (100-140 mm). Precipitation is mostly rain. Snow cover does not last long and due to this fact the soils freeze at some times in winter.

Table 1
Annual rainfall and average annual temperature in the region of MR “Dolna Topchiya” based on the data of the meteorological station Elhovo for the period 2002-2011

Year	Rainfall, mm/m ²	Average annual temperature, °C
2002	656.9	12.5
2003	400.5	12.0
2004	824.2	12.3
2005	1018.6	12.0
2006	414	12.1
2007	568.1	13.3
2008	389.0	12.9
2009	728.3	12.9
2010	733.7	13.1
2011	556.8	11.5
Average	629.1	12.5

The diversity of vascular plants in MR “Dolna Topchiya” was explored through systematic observation and collection of materials during the vegetation seasons of 2010 – 2012. The frequency of visits was consistent with the climatic conditions in the area and the resulting phyto- rhythmic. The earliest collecting started in the beginning of February 2010, and the latest is from the end of September 2011. This allows the most complete taxonomic diversity of flora in the reserve and its seasonal dynamics to be covered. The identification of species was done using the Flora of the Republic of Bulgaria (Jordanov, chief editor 1963-1979; Velchev chief editor 1982 – 1989), Flora of Bulgaria (Kozuharov, 1995), Flora of Bulgaria (Stoyanov, etc. 1966 – 1967), Qualifier of trees and shrubs in Bulgaria (Gramatikov, 1992), Qualifier of Plants in Bulgaria (Delipavlov and Cheshmedzhiev, ed. 2011).

The processing of herbarium materials and characteristics of flora were carried out by standard methods (Stanev, 1976; Vassilev and Andreev 1992; Gusev et al., 2004). Characteristic of medicinal plants was done according to biological types and life forms of Raunkiaer (1934). Floral elements were characterized by the classification of Stefanov (1943) and the adapted to the flora of Bulgaria classification of Walter (Asyov and Petrova 2006). The identified taxa are divided into ecological groups in terms of the most important ecological factors – water, temperature and light. An account and analysis of the flowering period for all identified species were done. The names of the plants are by The Euro + Med Plant Base – the information resource for Euro-Mediterranean plant diversity (2011), Qualifier of Plants in Bulgaria (Delipavlov and Cheshmedzhiev ed. 2011).

Results

As a result of floristic studies in 2010-2012 on the territory of MR “Dolna Topchiya”, 263 species of higher plants from 181 genera and 67 families were found. All species belong to Division Magnoliophyta (Appendix 1). 55 species of these belong to Class Liliopsida, distributed in 38 genera and 15 families, and 208 species are related to Class Magnoliopsida, distributed in 143 genera and 52 families.

The most species-rich families in the reserve are: Fabaceae with 28 species, Asteraceae with 21 species, Poaceae with 20 species, Rosaceae – 15 species, Lamiaceae – 13 species, etc. The genera with the most species are: *Vicia* – 9 species, *Lathyrus* and *Veronica* – 5 species, *Acer*, *Carex* and *Trifolium* – 4 species.

The distribution of taxa in biological types shows that the perennial herbaceous species have the most significant presence – 143 or 54.4 % of all the plants, followed by the annual ones – 50 species (19.0%), trees – 24 species (9.1%), shrubs –

17 species (6.5%) and annual- biennial ones – 12 (4.5%). The remaining species belong to the transient biological types (Table 2).

According to the biological spectrum of the studied species (Table 3), most are hemicryptophytes (H) – 98 species or 37.1% of the total number of taxa in the reserve, followed by therophytes (Th) – 50 species (19.0%), cryptophytes (Cr) – 46 species (17.5%), phanerophytes (Ph) – 43 species (16.4%), and chamephytes (Ch) which are only 4 species (1.5%). The remaining species are of transitional life forms – among them

Table 2
Distribution of higher plants from MR “Dolna Topchiya” by biological types

Biological type	Number of taxa	% of the plants in MR “Dolna Topchiya”
Tree	24	9.1
tree-shrub	1	0.4
shrub-tree	5	1.9
Shrub	17	6.5
Perennial	143	54.4
biennial-perennial	4	1.5
Biennial	6	2.3
annual-perennial	1	0.4
annual-biennial	12	4.5
Annual	50	19.0
Total	263	100

Table 3
Biological spectrum of higher plants from MR “Dolna Topchiya”

Biological form by Raunkiaer (1934)	Number of taxa	% of the plants in MR “Dolna Topchiya”
Phanerophytes (Ph)	43	16.4
Chamephytes (Ch)	4	1.5
Hemicryptophytes (H)	98	37.1
Cryptophytes (Cr)	46	17.5
Therophytes (Th)	50	19.0
Therophytes to hemicryptophytes (Th-H)	14	5.3
Hemicryptophytes to therophytes (H-Th)	8	3.0
Total	263	100

the most – 14 species (5.3%) are those which can be therophytes or hemicryptophytes (Th-H), depending on the habitat conditions.

The distribution of higher plants in phytogeographic centers according to the classification of B. Stefanov (1943) shows that the greatest part – 30.8% are thermophytes from the Southern Continental Center, followed by the mesotherms of Silvo-boreal Center – 20.9%, the thermophytes and mesotherms from the Mountainous Center – 19.0%, thermophytes from the Northern Continental Center – 18.3%, thermophytes from Mediterranean Centre – 8.3%, which means that despite the good conditions for a presumable invasion of Mediterranean species, the mountain ranges of Sakar Mountains and Dervenski heights are sufficiently strong barriers to the higher temperatures typical for the Mediterranean region. Finally plants from other phytogeographic centers – 2.3% (Figure 1) are least. There is only one species that is not specified *Myrrhoides nodosa* (L.) Cannon.

According to their mobility the analyzed plants are distributed as follows: the fixed species are 98 (37.2%), the moving ones with secondary broadened areas are 64 species (24.4%) and the species that have appeared by secondary displacement – 100 plants (38.0%) (Stefanov, 1943). These data are evidence of significant anthropogenic interference within the territory of the reserve in the past.

Analyzing higher plants by floral elements, distributed according to the classification of Walter, shows that geo-elements with European component – 132 species, 50.1% are the greatest part, as among them most are Euro-Asian (*Eur-As*) – 54 species (20.5%), Euro Mediterranean (*Eur-Med*) – 40

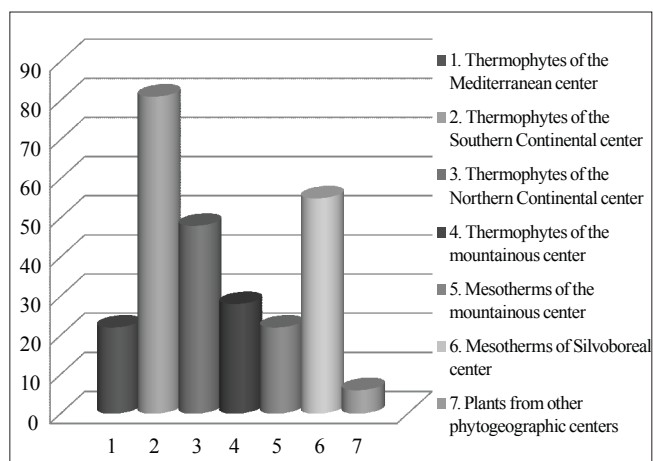


Fig. 1. Distribution of higher plants in phytogeographic centers (Stefanov, 1943)

species (15.2%), Euro Siberian (*Eur-Sib*) – 15 species (5.7%) and the European (*Eur*) – 14 species (5.3%). Second is the group of species with Mediterranean component – 99 species 37.6%, among them most are Euro Mediterranean (*Eur-Med*) – 40 species (15.2%), sub-Mediterranean (*subMed*) – 26 species (9.9%), Mediterranean (*Med*) are 10 species (3.9%), Pontic-Mediterranean (*Pont-Med*) are 8 species (3.0%). Cosmopolitan (*Kos*) and boreal (*Boreal*) species are nearly equal in number – 20 and 23 species, respectively, etc. (Table 4).

The distribution of the studied plants according to their period of flowering shows that the most active period is from May to September. During this period 194 taxa flower, 73.7% of all the plants. Among them, most species flower in June – August – 36 species, May – July – 30 species, May – June and May – August – 26 species, June – September – 19 species, etc. (Table 5).

The fact that a big part of the territory of MR “Dolna Topchiya” is covered with floodplain and dense forests (a map of the management plan, Berberova 2001) determines the high presence of water-dependent species. In the flora of the reserve mezophytes dominate, represented by 170 species (64.6%), followed by hygrophytes – 37 species (14.1%), hygromezophytes – 29 species (11.0%) and mezo-hygrophytes – 13 species (4.9%). Only 3 species can be related to xerophytes (Table 6).

The analysis of higher plants distribution in terms of the light factor shows prevalence of heliophytes that are more than half of the species – 182 (69.2%), followed by the groups of hemi-scyophytes – 49 species and schyophytes represented with 32 species (Table 7).

According to their relation to heat the species are divided into only 2 groups. Thermophytes go to the bigger group with 186 species (70.8%), and the remaining one fifth – 77 species (29.2%) refer to the group of mesotherms (Table 8). The dominance of thermophilic species is directly related to the influence of the Mediterranean climate, penetrating along the river Tundzha (Galabov et al., 1982).

Three species can be brought to conservation significant plant species in the reserve: *Epipactis purpurata* Sm., which is in the category “endangered” (*Endangered*) in “Red Data Book of the Republic of Bulgaria” (Peev, 2011), it is included in Appendix 3 of the Law of Biological Diversity (2002) and it is included in Appendix 2 of CITES.

Leucojum aestivum L. (the marsh snowdrop), which is in the category “vulnerable” (*Vulnerable*) in “Bulgarian Red Lists of vascular plants” (Evstatiieva, 2009) and it is included in Appendix 4 of the Law of Biological Diversity (2002).

Galanthus elwesii Hooker f. (*G. gracilis* Celak.) included with the endangered category (*Endangered*) in “Red Book of Bulgaria, Volume 1 Plants and fungi”, in Appendix 2 of the Convention on International Trade in Endangered Species of

Table 4
Distribution of higher plants from MR „Dolna Topchiya” by floral elements according to the adapted classification of Walter (Asyov, Petrova 2006)

Floral elements by Walter (2006)	Number of taxa	% of the plants in MR “Dolna Topchiya”
<i>Adv</i>	8	3.0
<i>Ap-Bal</i>	1	0.4
<i>Bal</i>	1	0.4
<i>Bal-Anat</i>	4	1.5
<i>Bal-Dac</i>	1	0.4
<i>Boreal</i>	23	8.7
<i>Eur</i>	14	5.3
<i>Eur-As</i>	54	20.5
<i>Eur-Med</i>	40	15.2
<i>Eur-Med-As</i>	3	1.1
<i>Eur-Nam</i>	1	0.4
<i>Eur-Pont</i>	1	0.4
<i>Eur-OT</i>	1	0.4
<i>Eur-Sib</i>	15	5.7
<i>Eur-subMed</i>	3	1.1
<i>Kos</i>	20	7.6
<i>Med</i>	10	3.9
<i>Med-As</i>	6	2.3
<i>Pont</i>	5	1.9
<i>Pont-Med</i>	8	3.0
<i>Pont-OT</i>	1	0.4
<i>Pont-subMed</i>	2	0.8
<i>subBoreal</i>	14	5.3
<i>subMed</i>	26	9.9
<i>subMed-As</i>	1	0.4
Total	263	100

Wild Fauna and Flora (CITES) and Annex 3 of the Law of Biological Diversity (2002).

On the basis of literature analysis of publications about medicinal plants from the flora of Bulgaria (Appendix № 1 of the Law on Medicinal Plants (2000, 2006); Nikolov, 2007; Tashev and Tsavkov, 2008; Landzhev, 2010; Delipavlov and Cheshmedzhiev ed., 2011), it was found that in MR “Dolna Topchiya” there are 143 species of medicinal plants from 107 genera and 47 families, which represents 63.7% of the species, 76.4% of the genera and 87.0% of the families in the protected area. These plants represent 17.3% of the species included in Appendix № 1 of the Law on Medicinal Plants (2000, 2006).

Table 5
Distribution of plants from MR “Dolna Topchiya”
according to their period of flowering

Flowering period, months	Number of flowering species	Percentage of the plants in MR “Dolna Topchiya”
I-XII	1	0.4
I-IV	1	0.4
II-III	2	0.8
II-IV	3	1.1
II-V	2	0.8
III-IV	11	4.1
III-V	5	1.9
III-VI	1	0.4
III-VIII	2	0.8
IV	1	0.4
IV-V	20	7.6
IV-VI	18	6.8
IV-VII	5	1.9
IV-VIII	2	0.8
IV-IX	5	1.9
IV-X	1	0.4
V	2	0.8
V-VI	26	9.9
V-VII	30	11.4
V-VIII	26	9.9
V-IX	12	4.5
V-X	5	1.9
VI	1	0.4
VI-VII	8	3.0
VI-VIII	36	13.6
VI-IX	19	7.2
VI-X	5	1.9
VII-VIII	2	0.8
VII-IX	7	2.6
VII-X	1	0.4
VIII-X	1	0.4
IX-X	1	0.4
IX-XI	1	0.4
Total	263	100

Conclusion

The study on the higher flora in MR “Dolna Topchiya”, conducted in the period 2010-2012, showed that there are 263 species of vascular plants from 181 genera and 67 families. Among these plants most are the perennial herbaceous plants, hemic-

Table 6
Distribution of higher plants from MR “Dolna Topchiya”
according to their relation to water

Ecological groups	Number of taxa	% of the plants in MR “Dolna Topchiya”
Hydrophytes	1	0.4
Hygrophytes	37	14.1
Hygromezophytes	29	11.0
Mezohydrophytes	13	4.9
Mezophytes	170	64.6
Xeromezophytes	10	3.9
Xerophytes	3	1.1
Total	263	100

Table 7
Distribution of higher plants from MR “Dolna Topchiya”
according to their relation to light

Ecological groups	Number of taxa	% of the plants in MR “Dolna Topchiya”
Heliophytes	182	69.2
Hemi-scyophytes	49	18.6
Scyophytes	32	12.2
Total	263	100

Table 8
Distribution of higher plants from MR “Dolna Topchiya”
according to their relation to the thermal regime

Ecological groups	Number of taxa	% of the plants in MR “Dolna Topchiya”
Microtherms	-	-
Mesotherms	77	29.2
Thermophytes	186	70.8
Total	263	100

ryptophytes, the species of European and Mediterranean origin, thermophytes, mesophytes and heliophytes, whose most intensive flowering time is from May to September. The relatively great involvement of the secondary and cosmopolitan plants within the studied territory points to the fact that there is a significant anthropogenic interference in the processes occurring

in the vegetation cover of the reserve. There are processes of xerophytization which result in changes in the floristic composition, even within a 10-year period. The differences found in the species composition of the flora in MR “Dolna Topchiya” over the period to 2001 (Berberova 2001; Pavlov and Dimitrov 2002), as well as a result of this study of 2010–2011, can be due to the observed dramatic climate drying, especially in 2003, 2006 and 2008 (Table 1), as a result of the reduced precipitation and lower water level of the river Tundzha in the last decade, and also as a result of the increase in mean annual temperature for the same period. However, a significant gene-fund of valuable plants is protected in the MR “Dolna Topchiya” to be used in folk and official medicine.

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Appendix 1: Systematic list of vascular plants in MR “Dolna Topchiya”

Liliopsida

Alismataceae: *Sagittaria sagitifolia* L.; Alliaceae: *Allium scorodoprasum* L.; Amaryllidaceae: *Galantus gracilis* Celak., *Leucocjum aestivum* L.; Araceae: *Arum elongatum* Steven; Asparagaceae: *Asparagus officinalis* L., *A. tenuifolius* Lam.; Cyperaceae: *Carex acutiformis* Ehrh., *C. divulsa* Stokes, *C. hordeistichos* Vill., *C. sylvatica* Huds., *Pycneus flavescens* (L.) Rchb.; Dioscoreaceae: *Tamus communis* L.; Iridaceae: *Crocus chrysantus* (Herb.) Herb., *C. flavus* Weston, *C. pallasii* Goldb., *Iris graminea* L., *I. pseudacorus* L., *I. sintenisii* Janka; Juncaceae: *Juncus effusus* L.; Lemnaceae: *Lemna minor* L.; Liliaceae: *Colchicum autumnale* L., *Convallaria majalis* L., *Fritilaria pontica* Wahlenb., *Muscari armeniacum* Leichtlin ex Baker, *Ornithogalum fimbriatum* Willd., *O. sibthorpii* Greuter, *O. umbellatum* L., *Scilla*

bifolia L., *Polygonatum latifolium* Desf., *P. multiflorum* (L.) All., *P. odoratum* (Mill.) Druce; Orchidaceae: *Epipactis purpurata* Sm., Poaceae: *Aegilops cylindrica* Host, *Agrostis capillaris* L., *Alopecurus geniculatus* L., *A. pratensis* L., *Anthoxanthum odoratum* L., *Arrhenatherum elatius* (L.) J. Presl & C. Presl, *Brachypodium sylvaticum* (Huds.) P. Beauv., *Bromus mollis* L., *B. ramosus* Huds., *B. sterilis* L., *Cynodon dactylon* (L.) Pers., *Dactylis glomerata* L., *Elymus repens* (L.) Gould, *Festuca pratensis* Huds., *Hordelymus europaeus* (L.) Harz, *Hordeum murinum* L., *Phragmites australis* (Cav.) Steud., *Poa annua* L., *P. nemoralis* L., *P. trivialis* L.; Smilacaceae: *Smilax excelsa* L.; Typhaceae: *Typha latifolia* L.

Magnoliopsida

Aceraceae: *Acer campestre* L., *A. negundo* L., *A. pseudoplatanus* L., *A. tataricum* L.; Apiaceae: *Aegopodium podagraria* L., *Chaerophyllum byzantinum* Boiss., *C. temulentum* L., *Conium maculatum* L., *Daucus carota* L., *Heracleum sibiricum* L., *Myrrhoides nodosa* (L.) Cannon, *Orlaya grandiflora* (L.) Hoffm., *Peucedanum alsaticum* L., *Physospermum cornubiense* (L.) DC., *Torilis japonica* (Houtt.) DC.; Araliaceae: *Hedera helix* L.; Aristolochiaceae: *Aristolochia clematitidis* L.; Asclepiadaceae: *Periploca graeca* L., *Vincetoxicum hirundinaria* Medik.; Asteraceae: *Achillea millefolium* L., *Anthemis arvensis* L., *A. cotula* L., *Arctium lappa* L., *Bellis sylvestris* Cirillo, *Carduus acanthoides* L., *Carlina vulgaris* L., *Chamomilla recutita* (L.) Rauschert, *Cichorium intybus* L., *Cirsium arvense* (L.) Scop., *C. creticum* (Lam.) d'Urv., *C. vulgare* (Savi) Ten., *Crepis setosa* Haller f., *Lactuca serriola* L., *Lapsana communis* L., *Matricaria trichophylla* (Boiss.) Boiss., *Senecio vulgaris* L., *Silybum marianum* (L.) Gaertn., *Taraxacum officinale* F. H. Wigg., *Tragopogon pratensis* L., *Xeranthemum annuum* L.; Berberidaceae: *Mahonia aquifolium* (Pursh) Nutt.; Boraginaceae: *Buglossoides purpureo-aerulea* (L.) I. M. Johnst., *Lithospermum officinale* L., *Myosotis ramosissima* Rochel, *M. scorpioides* L., *M. sicula* Guss., *Symphytum officinale* L.; Brassicaceae: *Alliaria petiolata* (M. Bieb.) Cavara & Grande, *Berteroa incana* (L.) DC., *Capsella bursa-pastoris* (L.) Medik., *Cardamine hirsuta* L., *Cardaria draba* (L.) Desv., *Erophila verna* (L.) Chevall., *Rorippa prolifera* (Heuff.) Neilr., *Thlaspi arvense* L.; Caesalpiniaceae: *Gleditsia triacanthos* L.; Campanulaceae: *Campanula trachelium* L.; Cannabaceae: *Cannabis sativa* L., *Humulus lupulus* L.; Caprifoliaceae: *Sambucus ebulus* L., *S. nigra* L.; Caryophyllaceae: *Myosoton aquaticum* (L.) Moench, *Saponaria officinalis* L., *Silene italica* (L.) Pers., *Stellaria media* (L.) Cirillo, *S. nemorum* L.; Celastraceae: *Euonymus europaeus* L.; Chenopodiaceae: *Chenopodium album* L.; Convolvulaceae: *Calystegia sylvatica* (Kit.) Griseb., *Convolvulus arvensis* L.; Cornaceae: *Cornus mas* L., *C. sanguinea* L.; Corylaceae: *Carpinus betulus* L., *Corylus avellana* L.; Euphorbiaceae: *Euphorbia cyparissias* L., *E. palustris* L., *E. serrulata* Thuill., *Mercurialis ovata* Sternb. & Hoppe; Fabaceae: *Amorpha fruticosa* L., *Astragalus glycyphyllos* L., *Coronilla varia* L., *Galega officinalis* L., *Lathyrus*

hirsutus L., *L. latifolius* L., *L. pratensis* L., *L. sativus* L., *L. sylvestris* L., *Lotus corniculatus* L., *Medicago orbicularis* (L.) Bartal., *Melilotus albus* Medik., *M. officinalis* (L.) Lam., *Ononis spinosa* L., *Robinia pseudoacacia* L., *Trifolium hybridum* L., *T. michelianum* var. *balansae* (Boiss.) Azn., *T. pratense* L., *T. repens* L., *Vicia cracca* L., *V. grandiflora* Scop., *V. sativa* L., *V. sepium* L., *V. serratifolia* Jacq., *V. tenuifolia* Roth, *V. tetrasperma* (L.) Schreb., *V. villosa* subsp. *varia* (Host) Corb., *V. villosa* Roth subsp. *villosa*; Fagaceae: *Quercus cerris* L., *Q. robur* L. subsp. *pedunculiflora* (K. Koch) Menitsky, *Q. robur* L. subsp. *robur* L.; Fumariaceae: *Corydalis solida* (L.) Clairv.; Geraniaceae: *Erodium cicutarium* (L.) L'Hér., *Geranium pyrenaicum* Burm. f.; Hypericaceae: *Hypericum hirsutum* L., *H. perforatum* L., *H. tetrapterum* Fr.; Lamiaceae: *Ajuga reptans* L., *Ballota nigra* L., *Glechoma hederacea* L., *Lamium maculatum* (L.) L., *L. purpureum* L., *Melissa officinalis* L., *Mentha aquatica* L., *M. pulegium* L., *Prunella vulgaris* L., *Salvia virgata* Jacq., *Scutellaria altissima* L., *Stachys officinalis* (L.) Trevis., *S. palustris* L.; Lytracaeae: *Lythrum salicaria* L.; Malvaceae: *Alcea pallida* (Willd.) Waldst. & Kit., *Althaea officinalis* L., *Malva sylvestris* L.; Moraceae: *Morus alba* L.; Oleaceae: *F. angustifolia* subsp. *oxycarpa* (Willd.) Franco & Rocha Afonso, *Fraxinus ornus* L., *Ligustrum vulgare* L.; Onagraceae: *Circea lutetiana* L., *Epilobium hirsutum* L.; Papaveraceae: *Chelidonium majus* L., *Papaver hybridum* L., *P. rhoeas* L.; Plantaginaceae: *Plantago lanceolata* L., *P. major* L., *P. media* L.; Polygonaceae: *Persicaria hydropiper* (L.) Opiz, *P. maculata* (Rafin.) S.F.Gray, *Polygonum aviculare* L., *Rumex acetosa* L., *R. conglomeratus* Murray, *R. crispus* L.; Primulaceae: *Lysimachia nummularia* L.; Ranunculaceae: *Anemone ranunculoides* L., *Clematis recta* L., *C. vitalba* L., *C. viticella* L., *Ficaria verna* Huds., *Ranunculus acris* L., *R. constantinopolitanus* (DC.) D'Urv., *R. neapolitanus* Ten.; Rhamnaceae: *Frangula alnus* Mill.; Rosaceae: *Agrimonia eupatoria* L., *Crataegus monogyna* Jacq., *Fragaria vesca* L., *Geum urbanum* L., *Malus sylvestris* (L.) Mill., *Potentilla argentea* L., *P. erecta* (L.) Rausch., *P. reptans* L., *Prunus cerasifera* Ehrh., *P. spinosa* L., *Pyrus communis* subsp. *pyraster* (L.) Ehrh., *Sorbus domestica* L., *Rosa canina* L., *Rubus caesius* L., *R. discolor* Weihe & Nees; Rubiaceae: *Asperula arvensis* L., *Cruciata laevipes* Opiz, *Galium album* Mill., *G. aparine* L., *G. verum* L.; Salicaceae: *Populus alba* L., *P. canescens* (Ait.) Sm., *P. nigra* L., *Salix alba* L., *S. fragilis* L., *S. purpurea* L.; Scrophulariaceae: *Pseudolysimachium longifolium* (L.) Opiz, *Verbascum xanthophoeniceum* Griseb., *Veronica anagalis-aquatica* L., *V. hederifolia* L., *V. officinalis* L., *V. polita* Fr., *V. triloba* (Opiz) Wiesb.; Simaroubaceae: *Ailanthus altissima* (Mill.) Swingle; Solanaceae: *Solanum dulcamara* L., *S. nigrum* L.; Tamaricaceae: *Tamarix tetrandra* Pallas ex Bieb.; Tiliaceae: *Tilia cordata* Mill.; Ulmaceae: *Ulmus laevis* Pall., *U. minor* Mill.; Urticaceae: *Urtica dioica* L., *U. urens* L.; Valerianaceae: *Valerianella microcarpa* Loisel.; Verbenaceae: *Verbena officinalis* L.; Violaceae: *Viola jordanii* Hanry, *V. odorata* L.; Vitaceae: *Vitis sylvestris* C. C. Gmelin; Zygophyllaceae: *Tribulus terrestris* L.