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DIVERSITY OF VASCULAR FLORA IN PROTECTED HABITAT TIŠINA

Marić Nataša¹, Petronić Sladana¹

¹University of East Sarajevo, Faculty of Agriculture, East Sarajevo, Bosnia and Herzegovina
e.mail: natasa.bratic@yahoo.com

ABSTRACT

VelikaTišina swamp is located far north of the Republic of Srpska and Bosnia and Herzegovina, and belong to the territory of the Municipality of Šamac. The vascular flora was investigated within the Conservation Study, which was done in cooperation with the Republic Institute for the Protection of the Cultural and Historical Natural Heritage of the Republic of Srpska and GEF/UNEP as part of the project „Achieving Biodiversity Conservation through the Establishment and Effective Management of the Protected Area and Capacity Building for Nature Conservation Bosnia and Herzegovina“.

Research was carried out in the period 2010-2011. There were identified 236 species that were classified into 3 classes, 179 genera and 71 families. In phytogeographic view is dominated species of wider geographical distribution from the eurasian, cosmopolitan, boreal and adventive areal groups. The biological spectrum indicate the hemicryptophytes-terrophytic-hydrophytic character of life forms. According to the IUCN Red List, about 55% of the species are mostly of low concern (LC) category, those species have a stable population but are not designated as dependent on protection nor nearly endangered.

According to the Red List of Protected Species of the Flora and Fauna of the Republic of Srpska, in this area 22 taxa with no specific threat category were recorded and in the Red List of the Federation of BiH 6 species are in the vulnerable species (VU) category, 1 species in the LC category.

Keywords: *vascular flora, areal group, biological spectrum, protected plant species, Tišina*

INTRODUCTION

The decision on the spatial planning of the municipality of the Bosanski Šamac (Official Gazette of the municipality of Bosanski Šamac no.4/1985) [1] declared Tišina swamp as a "natural rarity". In the amendment of the Spatial Plan of the Republic of Srpska until 2025, Tišina swamp is on the list of areas proposed for protection [2].

The wetlands and swamps Velika Tišina, Mala Tišina and Odmut represent one of the last barrier-wetland complexes of Posavina with numerous relict, rare and endangered plant and animal species. The total area of the proposed Protected Habitat "Tišina" is 196.49h. According to the International Union for Conservation of Nature (IUCN), this area has a category IV– Habitat/species management area. The expert team of the project “Support for the implementation of the Birds Directive and the Habitats Directive in Bosnia and Herzegovina” proposed Tišina swamp for Natura 2000 and the IBA area. Tišina swamp for a long time has aroused the interest of scientists. The earliest data relating to

the research of flora of the Tisina swamp date from Sendtner, Formanek, Protic [3] and Maly, who collected plant material from Velika Tišina swamp and conducted a list of the flora. A more detailed study of vascular flora was done by Bjelcic [4] who recorded 150 plant species.

Geographical location

Protected habitat "Tišina" is located in the far north of the Republic of Srpska and Bosnia and Herzegovina, in the territory of the municipality of Šamac (Figure 1).



Figure 1. Position of Protected Habitat "Tisina"

The area of the municipality of Samac belongs to Posavina, the southern brim of the Pannonian Basin where the estuary of Bosnia into the Sava, as well as the meandering of the Sava, creates a natural wetland-swamp area. The most important swamps are Mala and Velika Tišina and Odmut swamp (Figure 2).

The central coordinates for the Gauss-Kruger are: 18 ° 30 '18.7772 "E, 45 ° 02' 36.0299" N 6540204 m, 4988890 m. Greenwich Boundary Tangent: extreme south 45 ° 02 '09.10 "N; extreme north 45 ° 03' 10.18" N; extreme west 18 ° 29 '07.19 "E; extreme east 18 ° 31' 35.86" E. Gaus-Kruger boundary tangent: a extreme southern point 4988067 m; extreme north point 4989939 m; extreme west point 6538634 m; extreme eastern point 6541894 m.

Geologically, this area is composed of Quaternary, Pleistocene and Holocene sediments. The largest surface, deposited along the right bank of the Sava River, is occupied by floodplain sediments. Younger swamp sediments are present in the Odmut Swamp and the Gandrak Waterfall, organogenically swamp sediments in Velika Tisina Swamp, while still water are widespread at the far edges of Velika Tišina Swamp. In geomorphological terms, the area is characterized by plain relief, while in geotectonic terms it belongs to Pannon [5].

The slope of the terrain is not pronounced and the altitude is 85 m. Velika Tišina, Mala Tišina and Odmut Swamp represent the bayou of the Sava River. Velika Tišina Swamp is in the shape of a horseshoe, with the middle parts oriented to the southwest and the prongs pointing to the northeast. The length of the swamp is about 2.5 km, the average width is 200-300 m. During the year, the depth varies from several cm in the coastal area to 1.5 m. Protic [3] measured the maximum depth in June, at

3.5 m, in the northwestern strait, with an average depth of 2 m. Odmut Swamp, which is predominantly impermanent and irregular, continues at Velika Tišina Swamp.



Figure 2. Topographic map of the area 1:25 000

The type of soil is black soil, rich in humus. There are, as well, present alluvial fluvisol soils, Gleysols, Eugley, Humogley and Semigley. The climate is temperate continental with clearly expressed seasons. The average annual temperature is 10.7 ° C. The average rainfall is 700-800 mm.

METHODOLOGY

Plant material was collected during the two growing seasons 2010-2011. Determination of plant material was made on the basis of morphological characteristics according to the usual literature [6-18]. Taxonomic position, family affiliation and nomenclature are given according to Euro+Med [19]. Floral elements were given according to Oberdorfer [20] and Gajic [21]. The grouping of floral elements was based on Oberdorfer's [20] division of Europe into floral areas. The identification of invasive plants in the study area was determined according to the list of invasive species for Europe [22] and the Global Invasive Species Database [23].

Plant life forms have been derived according to the Mueller-Dombois classification, D. Ellenberg, H. [24], based on the principles of Raunkie [25] given in Oberdorfer [20]. Protected species have been identified according to the Preliminary Red List of Bosnia and Herzegovina [26] and the Red List of protected flora and fauna species of the Republic of Srpska [27] and the World Red List [28].

RESULTS

Floristic research was carried out in 2010-2011. In different habitat types 236 vascular species have been identified (Annex 1). Taxonomic analysis showed that plant species were classified into 3 classes. The class Dicotyledones belongs to 193 species from 147 genera and 56 families. In second place are species from the class Monocotyledones with 42 species from 32 genera and 15 families. The Sphenopsid class has 1 species, 1 genus and 1 family (Tab. 1).

Table. 1 Representation of species, genera and families of particular classes in the vascular flora

Class	Family	Genera	Species
Sphenopsida	1	1	1
Dicotyledones	56	147	193
Monocotyledones	15	32	42
Total	72	180	236

The diversity of floral elements is conditioned by historical-geographical and ecological factors. The floral element is classified into 11 areal groups (Tab. 2). In the vascular flora of the areas of the Velika Tišina Swamp, the most represented species are from Eurasian, Cosmopolitan, Sub-Mediterranean, Boreal and Adventive areal groups.

Table. 2 Areal spectrum of vascular flora

Areal groups	Number of species	%Percent
Euras	71	30.08
Boreal	31	13.14
Smed	33	13.99
Kosm	36	15.25
Adrv	25	10.59
Subatl	15	6.35
Osmed	7	2.97
Med	6	2.54
Mod. Cont.	9	3.81
Pralp	2	0.85
Wsmmed	1	0.43
Total:	236	100

The vascular flora of the study area is part of the unique flora of Europe, the Balkan Peninsula and Bosnia and Herzegovina, so it is expected that the species of Eurasian distribution will dominate. The Eurasian areal group comprises 71 species or 30.08% of the total number of species. Thirty-six species or 15.25% belong to the species of cosmopolitan distribution.

The largest number of species, from the cosmopolitan areal group, have native areal in Eurasian (*Rumex crispus*, *Trifolium repens*, *Cichorium inthybus*, *Galium aparine*, *Typha latifolia*, *Alisma plantago-aquatica*, *Verbena officinalis*), Boreal (*Stellaria media*, *Agrostis stolonifera*) and the Mediterranean areal group.

A considerable number of cosmopolitan species inhabit ruderal and agricultural habitats, and a smaller number are related to aquatic habitats. Among the cosmopolitan hygro-heliophytes following species are present: *Ceratophyllum demersum*, *Lemna minor*, *Typha latifolia*, *Veronica anagalis aquatic*.

Species from the boreal areal group (31 or 13.14%) are most often involved in the construction of meadow and ruderal ecosystems. Sub-Mediterranean flora groups belongs 33 species or 13.90% widespread in the area of sub-Mediterranean deciduous forests, and their presence indicates the influence of the sub-Mediterranean climate in this area. Some of sub-Mediterranean species are: *Acer tataricum*, *Aristolochia clematitis*, *Populus nigra*, *Salix alba* and others.

Adventive floral group has 25 species or 10.50%, mostly of North American origin. Species *Ambrosia artemisifolia*, *Amorpha fruticosa*, *Helianthus tuberosus*, *Erigeron annus* i *Echinocistis lobata* stand out in their abundance and coverage. *Galinsoga parvifolia* are South American origin, and are building monodominant communities in this area. With Asian origin are: *Reynoutria japonica*, *Ailanthus altissima*, *Impatiens glandulifera*.

According to the data available in the "Review the State of Biodiversity and Landscape Diversity in Bosnia and Herzegovina" [29], this is an area of about 500 alien species in Bosnia and Herzegovina, many of which have adapted to natural habitats and become more invasive. According to the Preliminary List of Invasive Alien Plant Species (IAS), 50 species were recorded in Bosnia and Herzegovina [30], of which 24 species were recorded at Tisina Swamp. During the study of flora and vegetation Bjelcic [4], was noted the presence of 4 adventitious species of *Amorpha fruticosa*, *Abutilon theophrasi*, *Asclepias syriaca* and *Xsanthium italicum*, and after 55 years were recorded 8 times more adventive species, including a considerable number of invasive species. It is interesting to note that Bjelcic [4] did not indicate ambrosia at the time of the study.

According to the criteria for invasiveness assessment [31], the the invasive species are: *Ambrosia artemisifolia*, *Amorpha fruticosa*, *Asclepias syriaca*, *Conyza canadensis*, *Echinocystis lobata*, *Abutilon theophrasi*, *Ailanthus altissima* and *Reynoutria japonica*. Globally, alien invasive species represent the second largest threat to biodiversity, immediately after the destruction of natural habitats [32]. First of all these species reduce their diversity by surviving in a new area, replacing and displacing native species [31]. Analysis of the biological spectrum of the flora shows the dominance of hemicryptophytes (93 species or 39.41%). Therophytes (52 or 23.64%) occupy the second place. Phanerophytes (34 species or 15.00%) occupy the third place in the biological spectrum. The high proportion of hemicryptophytes is consistent with the temperate continental climate of the study area.

Significant percentages of the life form of the terophyte can be related to the ruderal and agricultural habitats located within or adjacent to the protected area. Phanerophytes mostly build Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, flooded forests of narrow-leaved ash (*Fraxinus angustifolia*, *Ulmus effusa*, *Ligustrum vulgare*, *Evonimus europaeus*, *Cornus sanguinea*), flooded forests of willow and poplar (*Populus alba*, *Populus nigra*, *Salix alba*, *Ulmus minor*, *Fraxinus angustifolia*) and floodplain deciduous mixed forests of *Quercus robur*.

Table 3. The biological spectrum of the vascular flora

Life forms	Number of species	Percent %
H	93	39.41
T	53	22.45
P	40	16.95
Hyd	32	13,56
G	14	5,93
Ch	4	1,70
Total:	236	100

Thirty two species or 13.64% belong to the hydrophyte life form. Of this group, the most significant qualitative and quantitative participation in the construction of emergent vegetation are species *Typha angustifolia*, *T.latifolia*, *Phragmites communis*, *Sparganium erectum* and *Schoenoplectus lacustris*. Flotant aquatic plants are edifying species that participate in the construction of aquatic communities (*Nymphaea alba*, *Nuphar lutea*, *Lemna minor* and *Hydrocharis morsus-rane*), submerged plants (*Utricularia vulgaris*, *Ceratophyllum submersum* i *Lemna trisulca* and *Myriophyllum verticillatum*). Geophytes are represented by 14 species or 5.90%. Four species, or 1.82%, belong to the life-form of the chamephytes.

Bosnia and Herzegovina does not have a Red Book or a Red List of Threatened Species. In order to preserve and improve the protection of nature, Šilić [26] proposed the List of Plant Species (Pteridophyta and Sprmatophyta) for the Red Book of Bosnia and Herzegovina with associated threat categories made according to former IUCN criteria. Conservation status of the species is shown in table 4.

In the Republic of Srpska Red List [27] contains 22 taxa for which no threat category has been determined, and in the Federation of BiH Red List [33] contains 7 species, 6 of which are in the

vulnerable species (VU) category, and 1 are close to the threat (LC). According to the IUCN Red List [28], 111 species globally have near-threatened (LC) status, and 13 in European, accounting for about 52% of the total registered species in the study area.

Table 4. Conservation status of the species

Species	RL (RS)	RL (FBiH)
<i>Butomus umbellatus</i>	+	LC
<i>Carex echinata</i>	+	-
<i>Carex riparia</i>	+	-
<i>Ceratophyllum demersum</i>	+	-
<i>Cyperus michellianus</i>	+	-
<i>Glyceria maxima</i>	+	-
<i>Hydrocharis morsus-ranae</i>	+	VU
<i>Leersia oryzoides</i>	+	-
<i>Lemna gibba</i>	+	-
<i>Lemna trisulca</i>	+	-
<i>Najas marina</i>	+	-
<i>Nuphar lutea</i>	+	VU
<i>Nymphaea alba</i>	+	VU
<i>Oenanthe aquatica</i>	+	-
<i>Rorippa amphibia</i>	+	-
<i>Roryoppa austriaca</i>	+	-
<i>Sagittaria sagittifolia</i>	+	VU
<i>Scripus lacustris</i> subsp. <i>tabernaemontani</i>	+	-
<i>Sium latifolium</i>	+	-
<i>Spyrodila polyrhiza</i>	+	-
<i>Utricularia australis</i>	+	-
<i>Utricularia vulgaris</i>	+	VU

Comparing the results reported by Bjelcic [4] with the results obtained by Petronic et al. [34] (2010-2011) observed that there was a decrease in the number of plant species from the hydrophytic group. Recent studies have not confirmed the presence of the species *Trapa natans* and *Marsilea quadrifolia*. Certain further investigations should determine whether these species have been permanently lost to this area. In particular, this check should relate to the mined Odmut area which has not been investigated. The Tišina area has been proposed as a potential NATURA 2000 site due to the presence of 6 habitats of endangered species at European level, these are habitat types of stagnant waters (3130 and 3150), flowing waters (3270), mesophilic grasslands (6510) and forests (91E0 and 91F0) [35].

CONCLUSION

Investigation of the vascular flora of Velika Tišina swamp identified 236 species that were classified into 3 classes, 179 genera and 71 families. In the phytogeographic view species of wider geographical distribution from the eurasian, cosmopolitan, boreal and adventive areal groups is dominant. The biological spectrum indicate the hemicryptophytes-terrophytic-hydrophytic character of life forms.

According to the IUCN Red List, about 55% of the species are mostly of low concern (LC) category, those species have a stable population but are not designated as dependent on protection or nearly endangered. According to the Red List of Protected Species of the Flora and Fauna of the Republic of Srpska, in this area were recorded 22 taxa with no specific threat category, and in the Red List of the Federation of BiH 6 species are in the vulnerable species (VU) category, 1 species in the LC category.

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Annex 1. List of recorded species of vascular plants in protected habitat Tišina

Alismataceae: *Alisma plantago-aquatica*, emerHydG rad, euras - smed (K);
 Amaranthaceae: *Amaranthus blitum* L., T, esmed; *Amaranthus retroflexus*, T, N - Am (adv)
 Amaryllidaceae: *Leucojum aestivum* L., G, smed - med;
 Apiaceae: *Aegopodium podagraria* L., H, G, euras (kont); *Angelica sylvestris* L., H, boreal - eurassuboceana;
Anthriscus sylvestris (L.) Hoffm., H, boreal - eurassuboceana; *Heracleum sphondylium* L., H, subatl; *Oenanthe aquatica* (L.) Poir., Hyd, euras - smed; *Pastinaca sativa* L., H, euras - smed; *Sium latifolium* L., Hyd, subatl;
 Araceae: *Arum maculatum* L., G, euras - med, circ;
 Araliaceae: *Hedera helix* L., Ch, Pn, subat - smed;
 Aristolochiaceae: *Aristolochia clematitis* L., G, smed;
 Asclepiadaceae: *Asclepias syriaca* L., G, N - Am (adv);
 Balsaminaceae: *Impatiens glandulifera* Royle, T, Az (adv);
 Betulaceae: *Alnus glutinosa* (L.) Gaertn., P, pralp;
 Boraginaceae: *Impatiens glandulifera* L., T, (e) med - smed; *Echium vulgare* L., H, euras - smed; *Symphytum officinale* L., H, eurassuboceana; *Symphytum tuberosum* L., smed (subatl);
 Brassicaceae: *Alliaria petiolata* (M. Bieb.) Cavara & Grande, H, eurassuboceana-smed; *Capsella bursa-pastoris* (L.) Medik., T, H, med - cont (K); *Draba verna* L., T, euras - smed; *Raphanus raphanistrum* L., T, med - smed; *Rorippa amphibia* Besser, Hyd(H), euras (-smed); *Rorippa austriaca* (Crantz.) Besser, H, mod.cont (osmed); *Rorippa sylvestris* (L.) Besser, H, eurassuboceana - smed;
 Butomaceae: *Butomus umbellatus* L., emerHydG rhiza, euras - smed;
 Campanulaceae: *Campanula patula* L., H, euras - (cont) (-smed);
 Caryophyllaceae: *Cerastium brachypetalum* Pers., T, smed; *Silene baccifera* (L.) Roth, H, smed (euras); *Silene flos-cuculi* (L.) Clairv., H, eurassuboceana; *Silene viscosa* (L.) Pers., H, (euras) cont; *Silene vulgaris* (Moench) Garcke, Ch, boreal - euras - smed; *Stellaria media* (L.) Vill., T, boreal - euras - med (K);
 Celastraceae: *Euonymus europaeus* L., P, subatl - smed;
 Ceratophyllaceae: *Ceratophyllum demersum* L., aersbmHydG, euras-smed (K)
 Chenopodiaceae: *Chenopodium album* L., T, boreal-euras (-med) (K); *Lipandra polysperma* (L.) S. Fuentes & al., T, eurassuboceana (-smed) (K); *Oxybasis rubra* (L.) S. Fuentes & al., T, euras (cont), circ; *Bassia scoparia* (L.) A. J. Scott, T, C, Az (adv);
 Clusiaceae: *Hypericum perforatum* L., H, eurassuboceana-smed;
 Compositae: *Achillea millefolium* L., H, boreal - eurassuboceana; *Ambrosia artemisiifolia* L., T, N - Am (adv); *Amorpha fruticosa* L., P, N - Am (adv); *Arctium lappa* L., H, euras (-smed); *Artemisia vulgaris* L., H (Ch) eurassuboceana; *Bellis perennis* L., H, subatl - smed; *Bidens cernuus* L., T, euras (cont), circ; *Bidens tripartita* L., T, euras - smed; *Cyanus segetum* Hill, T, boreal - euras - smed; *Matricaria chamomilla* L., T, eurassuboceana (smed) (K); *Cichorium intybus* L., H, eurassuboceana (smed) (K); *Cirsium arvense* (L.) Scop., G, boreal - eurassuboceana - smed; *Ereigeron canadensis* L., T, H, N - Am (adv); *Erigeron annuus* (L.) Pers., H, N - Am (adv); *Eupatorium cannabinum* L., H, eurassmed; *Galinsoga parviflora* Cav., T, S - Am (adv); *Helianthus tuberosus* L., T, C - Am (adv); *Lactuca serriola* L., T (H) smed (mod.cont); *Lapsana communis* L., T (H), eurassuboceana -smed; *Leucanthemum vulgare* Lam., H, esmed; *Picris hieracioides* L., T, H, euras (cont) smed; *Serratula tinctoria* L., H, med.cont (-esmed); *Sonchus asper* (L.) Hill, T, eurassuboceana (smed); *Tanacetum vulgare* L., H, eurassuboceana; *Taraxacum officinale* Weber, H, boreal - euras (suboceana) K; *Tussilago farfara* L., G (H), boreal - euras - smed; *Xanthium orientale* subsp. *italicum* (Moretti) Greuter, T, N - Am (adv);
 Convolvulaceae: *Calystegia sepium* (L.) R.Br., G, euras (suboceana) - smed (K); *Convolvulus arvensis* L., G (H), med - smed - euras (K);
 Cornaceae: *Cornus sanguinea* L., P, smed (-subatl);
 Corylaceae: *Carpinus betulus* L., P, mod.cont;
 Cucurbitaceae: *Echinocystis lobata* (Michx.) Torr. & A. Gray, T, N-Am (adv); *Cucurbita pepo* L., T, N-Am (adv);

Cyperaceae: *Carex echinata* Murray, H, boreal -euras (subocean); *Carex pseudocyperus* L., Hyd (H), euras (subocean) - smed; *Carex flava* L., H, boreal-eurassubocean, circ; *Carex riparia* Curtis, emerzHyd (H), euras (subocean) - med; *Elocharis palustris* (L.) R. Br., emer HydG rhiza, euras - med; *Schoenoplectus lacustris* (L.) Palla, emerzHydG rhiza, (boreal) euras -med; *Schoenoplectus lacustris* subsp. *glaucus* (Sm.) Bech., emerzHyd G rhiza, euras – med;

Dioscoreaceae: *Tamus communis* L., G, smed (atl);

Dipsacaceae: *Dipsacus sativus* (L.) Honck., G, smed-med;

Equisetaceae: *Equisetum palustre* L., G, boreal - euras, circ;

Fabaceae: *Amorpha fruticosa* L., P, N-Am (adv); *Coronilla varia* L., H, mod.cont – esmed; *Lathyrus pratensis* L., T, smed; *Galega officinalis* L., H, esmed (mod.cont); *Genista tinctoria* L., Ch, eurassubocean (-smed); *Lotus corniculatus* L., H, eurassubocean-smed; *Medicago lupulina* L., H, euras – smed; *Medicago sativa* L., H, C.Az (adv, kult); *Melilotus alba* Medik., H, euras (cont) (smed) (K); *Melilotus officinalis* (L.) Lam., H, eurassubocean-smed; *Robinia pseudacacia* L., P, N-Am (adv); *Trifolium hybridum* L., *Trifolium pretense* L., H, eurassubocean (smed); *Trifolium repens* L., H (Ch), eurassubocean - smed (K); *Vicia cracca* L., H, boreal - euras; *Vicia sativa* L., T, med (K);

Fagaceae: *Quercus robur* L., P, euras-smed;

Geraniaceae: *Erodium cicutarium* (L.) L H'er., T, med – euras; *Geranium robertianum* L., (H) T, eurassubocean-smed;

Halorogaceae: *Myriophyllum spicatum* L., Hyd, eurassubocean-smed; *Myriophyllum verticillatum* L., sbmHydG rad, euras (-smed), circ;

Hydrocharitaceae: *Hydrocharis morsus-ranae* L., Hyd, euras (- smed);

Iridaceae: *Iris pseudacorus* L., emer Hyd rhiz, euras (subocean) – smed;

Juglandaceae: *Juglans regia* L., P, esmed (- euras);

Juncaceae: *Juncus compressus* Jacq., H, euras; *Juncus bufonius* L., H, boreal-euras.suboc-smed, circ;

Lamiaceae: *Ajuga reptans* L., H, subatl – smed; *Clinopodium vulgare* L., H, euras – smed; *Galeopsis speciosa* Miller, H, boreal-eurascont; *Glechoma hederaceae* L., H (G), euras (subocean); *Lamium album* L., H, eurassubocean; *Lamium maculatum* L., H, evroaz (cont) smed; *Lamium purpureum* L., T, (boreal) euras-smed; *Lycopus europaeus* L., H/scap/emmerzHydG rhiza, euras – smed; *Lycopus exaltatus* L., H/scap/emmerzHydG rhiza, eurascont; *Mentha aquatic* L., H/scap/emmerzHydG rhiza, euras – smed; *Mentha longifolia* (L.) L., H, smed - euras; *Prunella vulgaris* L., H, boreal-euras; *Prunella laciniata* (L.) L., H, smed; *Scutellaria galericulata* L., H, boreal-euras, circ; *Stachys annua* (L.) L., T, esmed; *Stachys palustris* L., G, (boreal)-euras (-smed); *Stachys recta* L., H, smed (med.cont);

Lemnaceae: *Spirodela polyrhiza* (L.) Schleid., Nat Hyd T, euras – med; *Lemna gibba* L., nat Hyd T, med - smed (K); *Lemna minor* L., nat Hyd T, (boreal) euras - med (K); *Lemna trisulca* L., nat Hyd T, euras-circ (K);

Lentibulariaceae: *Utricularia australis* R. Br., Hyd, subatl – smed; *Utricularia vulgaris* L., Hyd, boreal - eurascont;

Lythraceae: *Lythrum salicaria* L., H; eurassubocean, circ (K);

Malvaceae: *Abutilon theophrasti* Medik., H, med (adv); *Althea officinalis* L., H, omed - cont; *Malva nrglecta* Wallr., T (H), eurassubocean (-smed); *Malva sylvestris* L., H, smed - euras (K);

Moraceae: *Morus alba* L., P, W - Asia (kult); *Humulus lupulus* L., H, (boreal) eurassmed, circ;

Nymphaeaceae: *Nuphar lutea* (L.) Sm., nat Hyd, (boreal) euras (smed); *Nymphaea alba* L., nat Hyd, subatl - smed;

Oleaceae: *Fraxinus angustifolia* Vahl, P, esmed; *Ligustrum vulgare* L., P, smed;

Onagraceae: *Epilobium parviflorum* Schreb., H (Ch), eurassubocean;

Papveraceae: *Chelidonium majus* L., H, eurassubocean (smed); *Papaver rhoeas* L., T, euras - smed;

Phytolaccaceae: *Phytolacca americana* L., H, N-Am (adv);

Plantaginaceae: *Cymbalaria muralis* P. Gaertn. , B. Mey. & Scherb., H, smed; *Linaria vulgaris* Miller, H, G, euras - smed; *Plantago lanceolata* L., H, smed – subatl; *Plantago major* L., H, boreal-eurassuboc (K); *Plantago media* L., H, euras (cont) – smed; *Veronica anagallis-aquatica* L., H scap/sbm HydG riz, euras-smed-med (K); *Veronica beccabunga* L., H scap/sbm HydG riz, euras – smed - med;

Poaceae: *Agrostis stolonifera* L., H, boreal-euras (- smed) (K); *Anisantha sterilis* (L.) Nevski, T, smed; *Arrhenatherum elatius* (L.) J. Presl & C. Presl, subatl – smed; *Cynodon dactylon* (L.) Pers., H (G), med (K); *Dactylis glomerata* L., H, eurassubocean-smed; *Echinochloa crus-galli* (L.) P. Beauv., T, med – smed - euras (K); *Elytrigia repens* (L.) Nevski, H (G), boreal-euras (-smed) (K), *Festuca rubra* L., H, boreal (subocean); *Glyceria maxima* (Hartm.) Holmb., emerHydG rhiza, euras (cont) - smed; *Holcus lanatus* L., H (Ch), subatl - smed; *Lolium perenne* L., subatl - smed; *Phragmites australis* (Cav.) Steud., emerHydG rhiza, boreal-euras-smed (K); *Poa annua* L., T, med - atl (K); *Setaria pumila* (Poir.) Roem. & Schult., H, smed-med (-cont); *Sorghum halepense* (L.) Pers., emed (adv);

Polygonaceae: *Polygonum hydropiper* L., T, euras - smed; *Persicaria lapathifolia* (L.) Delarbre L., T, euras – suboc; *Persicaria dubia* (Stein) Fourr., T, subatl (semd); *Polygonum aviculare* L., T, med - euras - boreal (K); *Persicaria maculosa* Gray, T, euras; *Reynoutria japonica* Houtt., G, E.Az (adv); *Rumex crispus* L., H, eurassuboc-smed (K); *Rumex hydrolapathum* Huds., emerzHydH, subatl – smed; *Rumex obtusifolius* L., H, mod.cont-subatl-smed;

Potamogetonaceae: *Potamogeton crispus* L., Hyd, eurassuboc; *Potamogeton natans* L., rad sbmHydT, euras (subocean -smed) (K);

Primulaceae: *Lysimachia nummularia* L., Ch, eurassuboc-smed; *Lysimachia vulgaris* L., H, (boreal) euras-smed; *Primula vulgaris* Hudson, H, smed-atl;

Ranunculaceae: *Clematis vitalba* L., P, smed-subatl (circ); *Clematis viticella* L., P, esmed; *Ranunculus repens* L., H, boreal - euras (smed); *Thalictrum lucidum* L., H, med.cont (-osmed);

Resedaceae: *Reseda lutea* L., T, smed – med;

Rhamnaceae: *Rhamnus alpina* L. subsp. *fallax* (Boiss.) Maire & Petit, P, wsmed;

Rosaceae: *Crataegus monogyna* Jacq., P, smed (-subatl); *Geum urbanum* L., H, eurassuboc-smed; *Fragaria vesca* L., H, boreal - euras - smed (subocean); *Malus sylvestris* L., P, eurassuboc - smed; *Potentilla reptans* L., H, euras - smed (K); *Prunus avium* L., P, subatl - smed; *Prunus cerasifera* Ehrh, P, Persia (adv); *Prunus domestica* L., P, med (adv); *Prunus spinosa* L., P, eurassuboc - smed; *Pyrus pyraeaster* Ehrh, P, smed; *Rubus caesius* L., P, pralp - mod.cont; *Rosa canina* L., P, smed - subatl; *Sanguisorba minor* Scop., H, smed;

Rubiaceae: *Galium aparine* L., H, euras (suboc) (K); *Galium palustre* L., H, boreal – eurassuboc;

Salicaceae: *Populus alba* L., P, med - smed - euras; *Populus nigra* L., P, smed - euras; *Populus tremula* L., P, boreal – euras; *Salix fragilis* L., P, euras (subocean); *Salix purpurea* L., P, smed - eurassuboc; *Salix alba* L., P, smed-eurassuboc;

Sapindaceae: *Acer campestre* L., P, smed-subatl; *Acer tataricum* L., P, smed;

Simaroubaceae: *Ailanthus altissima* Swingle, P, E.Az (adv);

Solanaceae: *Datura stramonium* L., T, C, N-Am (adv); *Physalis alkekengi* L., G, smed – euras; *Solanum dulcamara* L., Ch, euras – smed;

Tiliaceae: *Tilia cordata* L., P, mod cont;

Typhaceae: *Sparganium erectum* L., emerHyd rhiz, euras-smed; *Typha angustifolia* L., emerHyd rhiz, euras – smed - med, circ; *Typha latifolia* L., emerHyd rhiz euras, circ (K);

Ulmaceae: *Ulmus laevis* Pallas, P, mod.cont;

Urticaceae: *Urtica dioica* L., H, boreal-euras;

Verbenaceae: *Verbena officinalis* L., H (T), eurassuboc-smed-med (K);

Viburnaceae: *Sambucus ebulus* L., P, smed (-subatl); *Sambucus nigra* L., P, subatl; *Viburnum opulus* L., P, euras (subocean);

Violaceae: *Viola arvensis* Murra, T, eurassuboc; *Viola tricolor* L., T, boreal - euras (subalp);

Vitaceae: *Vitis vinifera* L., P, smed;