

ECO-BIOLOGICAL CHARACTERISTICS OF MEDICINAL PLANTS IN THE MAINTAINED RESERVE “BALABANA” (THE RIVER TUNDZHA HILLY VALLEY)

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Abstract

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In the present work we investigated medicinal plants of the flora of the maintained reserve “Balabana”, located in the middle reaches of the river Tundzha, near Elhovo (Tundzha hilly valley). A characteristic was made of the systematic structure of the eco-biological features of these plants. The species were grouped in biological groups, life forms, floral elements and flowering period. Medicinal plants were also classified according to their relation to water, light, heat and substrate.

Key words: the maintained reserve “Balabana”, flora, medicinal plants, eco-biological characteristics

Introduction

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

N. Stoyanov in his article “The Forest Longoz at the River Kamchia and longozes as plant formation” (Stoyanov, 1928), where he first mentioned the riparian forests that are located in the valley of the Tundzha, not far from Elhovo, the medicinal flora of which is subject of this study. A more detailed study of the flora of MR “Balabana” was done in developing its management plan (Berberova, 2001).

The article by Pavlov and Dimitrov (2002) concerned the syntaxonomic diversity in the reserve without studying its floristic composition. Our findings complement and correct the results of Berberova’s study (2001), as we make characteristics of the genetic resources of medicinal plants in MR “Balabana”.

The subject of this study is to make characteristics of medicinal plants in the maintained reserve (MR) “Balabana” (77.0 ha), located in the middle reaches of the river Tundzha, near the town of Elhovo. The reserve was proclaimed with Order No 2676/10.03.1961, of GDF, with the purpose to restore and preserve the natural habitats and places of nesting of one of the few colonies of the small white egret and the night heron, the glossy ibis and the common pheasant. In 1984, it was declared a buffer zone of the reserve with an area of 60 ha. In 1999, the Protected Areas Act, by Order No RD-376/15.10.1999 of MEW, it was categorized as a “maintained reserve”.

The protected area is located in Elhovo field, Tundzha hilly valley, between 42°08’38.99” and 42°09’16.34” N, and 26°32’5.12” and 26°32’50.72” E. According to the phytogeographic subdivision in Bulgaria, the reserve is located within the Sakar mountain region, Sakar-Dervenski phytogeographic region (Bondev, 1991).

The area of MR “Balabana” is within the European continental climatic subregion of the middle-eastern re-

gion of Bulgaria (Gulubov, 1982), and according to Tishkov (1982) in continental Mediterranean climatic region, south Bulgarian subregion. This means that the flora in this area is subjected to a Mediterranean influence.

On data of the meteorological station in the municipality, it was made characteristics of the main components of the climate in the research area. 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 (Gulubov, 1982). The amount of annual rainfall varies in 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.

The diversity of medicinal plants in MR “Balabana” was studied by doing systematic collection of materials during the growing seasons of 2010-2011. Frequency of collecting was consistent with the climatic conditions in the area and the resulting phyto- rhythmic. The earliest collecting started from the beginning of February 2010 and the latest – by the end of September 2011. This allowed 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

Table 1
Annual rainfall and average annual temperature in the area of MR “Balabana” based on data from 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
2004	824.2	12.3
2005	1018.6	12
2006	414.	12.1
2007	568.1	13.3
2008	389	12.9
2009	728.3	12.9
2010	733.7	13.1
2011	556.8	11.5
Average	629.1	12.5

Bulgaria (Jordanov, chief editor 1963-1979; Velchev chief editor 1982-1989), Flora of Bulgaria (Kozhuharov, 1995), Flora of Bulgaria (Stoyanov, etc. 1966-1967), Qualifier of trees and shrubs in Bulgaria (Gramatikov, 1992), Qualifier of Plants in Bulgaria (Delipavlov et al., 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 B. Stefanov (1943) and the adapted to the flora of Bulgaria classification of Walter (Asyov and Petrova, 2006). Medicinal plants are divided into ecological groups in terms of the most important ecological factors – water temperature, light and substrate. Plants are also divided into groups of their flowering time.

Results

Because of floristic studies in 2010-2011 on the territory of MR “Balabana”, 196 species of higher plants from 139 genera and 54 families were found. Only two species of these are representatives of higher spore plants and belong to the division Equisetophyta – *Equisetum arvense* L. and *E. palustre* L., and the remaining 194 species belong to the division Magnoliophyta (Appendix 1). 45 species of these belong to Class Liliopsida, distributed in 29 genera and 11 families and 149 species are related to class Magnoliopsida, distributed in 109 genera and 42 families.

In Appendix 2 there is a list of vascular plants, which are referred to the flora of the reserve management plan (Berberova, 2001), but they were not found during the field studies in 2010-2011. Appendix 3 shows a list of species that were found in the reserve during this study but they were not listed in the management plan (Berberova, 2001). The differences, found in the species composition of the flora of MR “Balabana” in the period up to 2001 (Berberova, 2001) and as a result of this study from 2010-2011, may be due to the observed climatic drying because of the reduced precipitation and lowering the water level of the river Tundzha in the last decade, and as a result of increase in average annual temperatures for the same period.

Basing on the literature analysis of publications on medicinal plants of the flora of Bulgaria (Appendix № 1

to Medicinal Plants Act, 2000, 2006; Nikolov, 2007; Tashchev and Tsavkov, 2008; Landzhev, 2010; Delipavlov et al., 2011) it was found that in MR “Balabana” there are 129 medicinal plant species from 107 genera and 47 families, representing 65.8% of the species, 76.9% 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). The most species-rich families in the reserve are: Poaceae with 22 species, only 3 of which are healing, Asteraceae and Fabaceae are with 16 species, respectfully 12 and 10 species of which are healing, Rosaceae – 12 species – all of which healing, Lamiaceae – 11 species, 10 of which have healing properties, etc. The genera with the most species – each with 4 are *Poa*, *Ranunculus* and *Vicia*, and only the latter have one representative among the medicinal plants.

The distribution of taxa in biological types shows that the most significant presence among the medicinal plants have the perennial herbaceous species – 74 or 57.3% of all plants, the annual plants follow them – 12 (9.3%), trees – 11 (8.5%) and shrubs with 10 species (7.8%). 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) – 59 species or 45.8% of the total number of medicinal taxa in the reserve, followed by phanerophytes (Ph) – 26 species (20.1%) cryptophytes (Cr) – 15 species (11.6%) therophytes (Th) – 12 species (9.3%) and chamephytes (Ch) which are only 2 species (1.6%). The remaining species are of tran-

sitional life forms – among them the most – 15 species (11.6%) are those, which can be therophytes or hemicryptophytes (Th-H), depending on the habitat conditions.

The distribution of medicinal plants in phytogeographic centers according to the classification of Stefanov (1943) shows that the greatest part – 31.8% are thermophytes from the South Mainland center, followed by the thermophytes from the Northern Continental Center – 24.0%; mesotherms of Silvo-boreal center – 20.1%, thermophytes and mesotherms of the mountainous center – 19.3%, thermophytes from Mediterranean Centre – 3.8% and finally the plants from other phytogeographic centers – 0.8% (Figure 1).

Table 3
Biological spectrum of medicinal plants from MR “Balabana”

Biological form by Raunkiaer (1934)	Number of taxa	% MP in MR “Balabana”
Phanerophytes (Ph)	26	20.1
Chamephytes (Ch)	2	1.6
Hemicryptophytes (H)	59	45.8
Cryptophytes (Cr)	15	11.6
Therophytes (Th)	12	9.3
Therophytes to hemicryptophytes (Th-H)	13	10
Hemicryptophytes to therophytes (H-Th)	2	1.6
Total	129	100

Table 2
Distribution of medicinal plants from MR “Balabana” by biological types

Biological type	Number of taxa	% MP in MR “Balabana”
tree	11	8.5
tree - shrub	2	1.6
shrub - tree	4	3.1
shrub	10	7.8
subshrub - perennial	1	0.8
perennial	74	57.3
biennial - perennial	2	1.6
biennial	6	4.6
annual - biennial	7	5.4
annual	12	9.3
Total	129	100

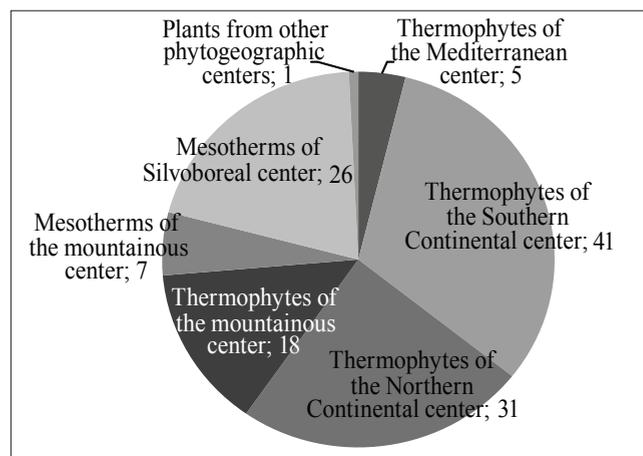


Fig. 1. Distribution of medicinal plants in phytogeographic centers (Stefanov, 1943)

According to their mobility the analyzed plants are distributed as follows: fixed species – 43 (33.3%), the moving ones with secondary broadened areas are 34 species (26.4%) and most species are those that have appeared by secondary displacement – 52 plants (40.3 %) (Stefanov, 1943). These data are evidence of significant anthropogenic interference with the territory of the reserve in the past.

Analyzing medicinal plants by floral elements, distributed according to the classification of Walter, shows that geo-elements with European component – 69 species or 53.6% are the greatest part, as among them most are Eurasian (*Eur-As*) – 31 species (24.0%) Euro Mediterranean (*Eur-Med*) – 16 species, Euro Siberian ones (*Eur-Sib*) are 10 species, while 8 species are pure European (*Eur*). Second is the group of species with Mediterranean component – 46 species or 35.6%, among them most are sub-Mediterranean (*subMed*) – 18 species (13.9%) Euro Mediterranean (*Eur-Med*) – 16 species, Pontic Mediterranean (*Pont-Med*) are 5 species and pure Mediterranean (*Med*) are only 3 species. Cosmopolitan (*Kos*) and boreal (*Boreal*) species are nearly equal in number – 12 and 11 species, etc. (Table 4).

Table 4
Distribution of medicinal plants from MR “Balabana” by floral elements according to the adapted classification of Walter (Asyov and Petrova, 2006)

Floral elements by Walter (2006)	Number of taxa	% MP in MR “Balabana”
<i>Adv</i>	2	1.6
<i>Boreal</i>	11	8.5
<i>Eur</i>	8	6.2
<i>Eur-As</i>	31	24
<i>Eur-Med</i>	16	12.4
<i>Eur-Med-CAs</i>	1	0.8
<i>Eur-OT</i>	2	1.6
<i>Eur-Sib</i>	10	7.8
<i>Eur-subMed</i>	1	0.8
<i>Kos</i>	12	9.3
<i>Med</i>	3	2.3
<i>Med-CAs</i>	1	0.8
<i>Pont-Med</i>	5	3.8
<i>Pont-subMed</i>	1	0.8
<i>subBoreal</i>	6	4.6
<i>subMed</i>	18	13.9
<i>sPont</i>	1	0.8
Total	129	100

The distribution of the studied plant group according to their period of flowering shows that the most active period is from May to September. During this period 104 taxa flower, 80.6% of all medicinal plants. Among them, most species flower in June-August – 13 species, May-June and May-August – 11 species, from May to September – 10 species, etc. (Table 5).

A large part of the maintained reserve “Balabana” is covered with bank and dense forests, which determines the

Table 5
Distribution of medicinal plants from MR “Balabana” according to their period of flowering

Flowering period, months	Number of flowering species	Percentage of medicinal plants in MR “Balabana”
I-XII	1	0.8
II-III	1	0.8
II-IV	2	1.6
II-V	1	0.8
III-IV	7	5.4
III-V	2	1.6
III-VIII	1	0.8
III-IX	1	0.8
IV-V	10	7.8
IV-VI	7	5.4
IV-VII	3	2.3
IV-VIII	4	3.1
IV-IX	1	0.8
IV-X	2	1.6
V	2	1.6
V-VI	11	8.5
V-VII	7	5.4
V-VIII	11	8.5
V-IX	10	7.8
V-X	5	3.8
V-XI	2	1.6
VI-VII	4	3.1
VI-VIII	13	10
VI-IX	7	5.4
VI-X	6	4.6
VI-XI	1	0.8
VII-VIII	2	1.6
VII-IX	1	0.8
VII-X	1	0.8
VIII-IX	2	1.6
IX-XI	1	0.8
Total	129	100

relation of the species, living there, to the water factor. In the flora of the reserve mezophytes dominate, represented by 88 species (68.3%), followed by hygrophytes – 18 species, mezohygrophytes and hygromezophytes – 16 species. Only 3 species can be grouped with xerophytes (Table 6).

Analysis of the distribution of medicinal plants in terms of the light factor shows prevalence of heliophytes that are more than half of the species – 69 (53.6%), while the groups of hemi-scyophytes and scyophytes are represented equally – with 30 species each (Table 7).

According to their relation to heat, the species are divided into only 2 groups. Thermophytes go to the biggest group with 97 species (75.2%), and the remaining one quarter – 32 species (24.8%) 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 and others, 1982).

Certain adherence to the bedrock or substrate was observed in 30 species, the other 98 species are indifferent. Most are lithophytes – 20 species, followed by psamophytes – 7 species, etc. (Table 9).

Only one species can be brought to conservation significant plant species in the reserve: *Leucojum aestivum* L. (marsh snowflake), which is in the category “vulnerable” (*Vulnerable*) in “Bulgarian Red Lists of vascular plants” (Evstatieva, 2009) and it is included in Appendix 4 of the Law of Biological Diversity (2002).

Conclusion

The study on vascular plants in MR “Balabana”, conducted in 2010-2011, showed that there are 196 species of vascular plants from 139 genera and 54 families. From these plants 129 are medicinal species from 107 genera and 47 families, representing 65.8% of the species, 76.9% of the genera and 87.0% of the families in the protected area. This represents 17.3% of the species included in Appendix № 1 of the Law on Medicinal Plants (2000, 2006). Among these plants most are the perennial herbaceous plants, hemicryptophytes, the species of European and Mediterranean origin, thermophytes, mesophytes, heliophytes, whose most intensive flowering time is from May to September. There are some lithophytes and psamophytes among them. The

Table 6
Distribution of medicinal plants from MR “Balabana” according to their relation to water

Ecological groups	Number of taxa	% MP in MR “Balabana”
Hygrophytes	18	13.9
Hygromezophytes	6	4.6
Mezohygrophytes	10	7.8
Mezophytes	88	68.3
Xeromezophytes	4	3.1
Xerophytes	3	2.3
Total	129	100

Table 7
Distribution of medicinal plants from MR “Balabana” according to their relation to light

Ecological groups	Number of taxon	% MP in MR “Balabana”
Heliophytes	69	53.6
Hemi-scyophytes	30	23.2
Scyophytes	30	23.2
Total	129	100

Table 8
Distribution of medicinal plants from MR “Balabana” according to their relation to the thermal regime

Ecological groups	Number of taxa	% MP in MR “Balabana”
Microtherms	-	-
Mesotherms	32	24.8
Thermophytes	97	75.2
Total	129	100

Table 9
Distribution of medicinal plants from MR “Balabana” according to their relation to bedrock (substrate)

Groups	Number of taxa	% MP in MR “Balabana”
Indifferent	98	75.9
Calciphytes	2	1.6
Lithophytes	19	14.7
Lithophytes and psamophytes	1	0.8
Halophytes	2	1.6
Psamophytes	6	4.6
Nitrophils	1	0.8
Total	129	100

relatively great involvement of the secondary and cosmopolitan plants in the studied flora 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 at the studied territory, which result in changes in the floristic composition, even within a 10-year period. However, a significant gene-fund of valuable plants is protected in the MR “Balabana” and they are used in folk and official medicine.

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

Divisio Equisetophyta

Equisetaceae: *Equisetum arvense* L.*, *E. palustre* L.

Divisio Magnoliophyta

Classis Magnoliopsida

Aceraceae: *Acer campestre* L., *A. negundo* L., *A. tataricum* L.; Apiaceae: *Chaerophyllum temulentum* L., *Conium maculatum* L., *Daucus carota* L., *D. guttatus* Sibth. et Sm., *Heracleum sibiricum* L., *Myrrhoides nodosa* (L.) Cannon, *Torilis japonica* (Hoffm.) DC; Araliaceae: *Hedera helix* L.; Aristolochiaceae: *Aristolochia clematidis* L.; Asclepiadaceae: *Vincetoxicum hirundinaria* Medic.; Asteraceae: *Achillea millefolium* L., *Arctium lappa* L., *Bellis sylvestris* Cyr., *Carduus acanthoides* L., *Carlina vulgaris* L., *Centaurea calcitrapa* L., *Cichorium intybus* L., *Cirsium arvense* (L.) Scop., *C. vulgare* (Savi) Ten., *Conyza canadensis* (L.) Cronq., *Lactuca serriola* L., *Lapsana communis* L., *Senecio vulgaris* L., *Sonchus arvensis* L., *Taraxacum officinale* Web., *Tragopogon pratensis* L.; Boraginaceae: *Buglossoides purpureoerulea* (L.) Johnst., *Lithospermum officinale* L., *Myosotis ramosissima* Rochel, *M. scorpioides* L., *M. sicula* Guss., *Symphythum officinale* L.; Brassicaceae: *Alliaria petiolata* (Bieb.) Cavara et Grande, *Capsella bursa-pastoris* (L.) Medic., *Rorippa prolifera* (Heuff.) Neir., *R. sylvestris* (L.) Besser, *Thlaspi arvense* L.; Campanulaceae: *Campanula trachelium* L.; Cannabaceae: *Cannabis sativa* L., *Humulus lupulus* L.; Caprifoliaceae: *Sambucus ebulus* L., *S. nigra* L.; Caryophyllaceae: *Saponaria officinalis* L., *Stellaria graminea* L., *S. media* (L.) Vill.; Celastraceae: *Euonymus europaeus* L.; Chenopodiaceae: *Chenopodium album* L.; Convolvulaceae: *Convolvulus arvensis* L.; Cornaceae: *Cornus mas* L., *C. sanguinea* L.; Corylaceae: *Corylus avellana* L.; Euphorbiaceae: *Euphorbia cyparissias* L., *E. serulata* Thuill., *E. velenovskyi* Bornm.; Fabaceae: *Astragalus glycyphyllos* L., *Coronilla cretica* L., *Galega officinalis* L., *Lathyrus hirsutus* L., *L. pratensis* L., *L. sylvestris* L., *Lotus corniculatus* L., *Medicago arabica* (L.) Huds., *Melilotus alba* Medic., *Ononis spinosa* L., *Trifolium pratense* L., *T. repens* L., *Vicia grandiflora* Scop., *V. sepium* L., *V. tetrasperma* (L.) Schreber, *V. varia* Host.; Fagaceae: *Quercus pedunculiflora* C. Koch., *Q. robur* L.; Fumariaceae: *Corydalis solida* (L.) Clairv.; Geraniaceae: *Erodium cicutarium* (L.) L'Her., *Geranium dissectum* L., *G. divaricatum* Erhr.; Hypericaceae: *Hypericum perforatum* L.; Lamiaceae: *Ajuga reptans* L., *Ballota nigra* L., *Betonica officinalis* L., *Glechoma hederacea* L., *Lamium purpureum* L., *Melissa officinalis* L., *Mentha aquatica* L., *Prunella vulgaris* L., *Salvia tomentosa* Mill., *Scutellaria altissima* L., *Stachys palustris* L.; Malvaceae: *Althaea officinalis* L.; Oleaceae: *Fraxinus oxycarpa* Willd., *Ligustrum vulgare* L.; Onagraceae: *Epilobium hirsutum* L.; Papaveraceae: *Chelidonium majus* L., *Papaver rhoeas* L., *P. rhoeas* Velen.; Plantaginaceae: *Plantago lanceolata* L., *P. major* L., *P. media* L.; Polygonaceae: *Persicaria hydropiper* (L.) Opiz., *P. maculata* S.F.Gray, *Polygonum aviculare* L., *Rumex conglomeratus* Murray, *R. pulcher* L.; Primulaceae: *Lysimachia vulgaris* L.; Ranunculaceae: *Anemone ranunculoides* L., *Clematis recta* L., *C. vitalba* L., *C. viticella* L., *Ficaria verna* Hudson, *Isopyrum thalictroides* L., *Ranunculus acris* L., *R. constantinopolitanus* (DC) D'urv., *R. neapolitanus* Ten., *R. nemorosus* DC.; Rosaceae: *Agrimonia eupatoria* L., *Crataegus monogyna* Jacq., *Fragaria vesca* L., *Geum urbanum* L., *Malus sylvestris* Mill., *Potentilla reptans* L., *Prunus cerasifera* Ehrh., *P. spinosa* L., *Pyrus pyraeaster* Burgsb., *Rosa canina* L., *Rubus caesius* L., *R. discolor* Weihe et Nees; Rubiaceae: *Galium album* Mill., *G. aparine* L., *G. verum* L.; Salicaceae: *Populus alba* L., *P. nigra* L., *Salix alba* L., *S. fragilis* L.; Scrophulariaceae: *Linaria vulgaris* Mill., *Verbascum xanthophoeniceum* Griseb., *Veronica anagallis-aquatica* L., *V. hederifolia* L.; Solanaceae: *Solanum dulcamara* L., *Solanum nigrum* L.; Ulmaceae: *Ulmus laevis* Pall., *U. minor* Mill.; Urticaceae: *Urtica dioica* L.; Valerianaceae: *Valerianella microcarpa* Loisel. Verbenaceae: *Verbena officinalis* L.; Violaceae: *Viola jordanii* Henry, *V. odorata* L.

Classis Liliopsida

Alliaceae: *Allium cyrilli* Ten., *A. rotundum* L., *A. scordoprasum* L.; Amaryllidaceae: *Leucojum aestivum* L.; Araceae: *Arum elongatum* Stev.; Asparagaceae: *Asparagus tenuifolius* Lam.; Cyperaceae: *Carex caryophyllea* Latourr., *C. otrubae* Podp., *C. remota* L., *C. riparia* Curtis, *Cyperus difformis* L.; Dioscoreaceae: *Tamus cammunis* L.; Juncaceae: *Juncus effusus* L.; Iridaceae: *Crocus flavus* West., *C. pallasii* Goldb., *Iris graminea* L.; Liliaceae: *Colchicum autumnale* L., *Muscari armeniacum* Leicht. ex Baker, *Polygonatum latifolium* (Jacq.) Desf., *P. multiflorum* (L.) All., *P. odoratum* (Mill.) Druce, *Scilla bifolia* L.; Poaceae: *Agrostis stolonifera* L., *Alopecurus geniculatus* L., *A. myosuroides* Huds., *A. pratensis* L., *Anthoxanthum*

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odoratum L., *Brachypodium distachion* (L.) P. B. Agrost., *B. sylvaticum* (Huds.) Beauv., *Bromus arvensis* L., *B. mollis* L., *B. sterilis* L., ***Cynodon dactylon*** (L.) Pers., *Cynosurus cristatus* L., *Dactylis glomerata* L., *Echinochloa crus-galli* (L.) Beauv., ***Elymus repens*** (L.) Gaubl., *Festuca arundinacea* Schreb., *Lolium perenne* L., *Melica ciliata* L., *Poa annua* L., *P. palustris* L., *P. pratensis* L., *P. trivialis* L.; Smilacaceae: ***Smilax excelsa*** L.

Note: * Plant species on the list, marked with bold, are healing.

Appendix 2: List of vascular plants listed in the composition of flora in the management plan for MR “Balabana” (Berberova, 2001) but undetected in this study

Hygrophytes: *Angelica sylvestris* L., *Lycopus europaeus* L., *Lythrum virgatum* L., *Mentha longifolia* (L.) Huds.; **Hygromezophytes:** *Periploca graeca* L.; **Mezohygrophytes:** *Anthriscus sylvestris* (L.) Hoffm., *Barbarea vulgaris* R. Br., *Bryonia alba* L., *Geranium pyrenaicum* Burm., *Lepidium latifolium* L.; **Mezophytes:** *Aegopodium podagraria* L., *Brassica juncea* (L.) Czern., *Centaurea solstitialis* L., *Coronilla varia* L., *Cruciata laevipes* Opiz., *Dipsacus fullonum* L., *Helleborus odoratus* Waldst., *Lamium maculatum* L., *Parietaria officinalis* L., *Primula veris* L., *P. vulgaris* Huds., *Scrophularia nodosa* L., *Scutellaria hastifolia* L., *Sylibum marianum* (L.) Gartn.; **Xeromezophytes:** *Mercurialis annua* L., *Onopordum acanthoides* L., *Tordylium maximum* L.; **Xerophytes:** *Alcea pallida* Waldst. et Kit., *Anagalis arvensis* L.

Appendix 3: List of vascular plants not listed in the composition of flora in the management plan for MR “Balabana” (Berberova, 2001), but found in this study

Hygrophytes: *Rorippa sylvestris* (L.) Besser; **Hygromezophytes:** *Althaea officinalis* L., *Heracleum sibiricum* L., *Smilax excelsa* L., *Symphythum officinale* L.; **Mezophytes:** *Asparagus tenuifolius* Lam., *Cannabis sativa* L., *Corydalis solida* (L.) Clairv., *Malus sylvestris* Mill., *Polygonatum odoratum* (Mill.) Druce, *Iris graminea* L.; **Xeromezophytes:** *Allium rotundum* L., *Crocus pallasii* Goldb., *Euphorbia cyparissias* L., *Salvia tomentosa* Mill.; **Xerophytes:** *Carlina vulgaris* L..

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