

Eco-Biological Characteristics of Medicinal Plants in the Protected Area "Nahodishte Na Blatno Kokiche", Gradina Village, Parvomay (Bulgaria)

Stoyan Georgiev^{1}, Alexander Tashev², Koycho Koev¹*

1 - University of Plovdiv, Faculty of Biology, 24 Tsar Asen Str., 4000 Plovdiv, BULGARIA

2 - University of Forestry, 10 Kliment Ohridski Blvd, 1756 Sofia, BULGARIA

* Corresponding author: stogeorgiev@abv.bg

Abstract. In the present work we investigated medicinal plants of the flora of the protected area "Nahodishte na blatno kokiche" the village of Gradina, Parvomay Municipality. Eco-biological characterization of the plants was done, and the species were grouped according to biological groups, life forms, floral elements and flowering time. Medicinal plants are also classified according to their attitude towards water, light and heat.

Key words: medicinal plants, herbs, eco-biological groups, protected area, Gradina Village

Introduction

The purpose of this study is, on the basis of fieldwork and literature data analysis, to make eco-biological characteristics of the medicinal plants found within the protected area "Nahodishte na blatno kokiche" at the village of Gradina.

The results of this study supplement the results of the studies of PAVLOV *et al.* (1990), TASHEV (1991) and GEORGIEV & KOEV (2012) in the protected area "Nahodishte na blatno kokiche" the village of Gradina, giving an idea about the genetic resources of medicinal plants in it as well.

The protected area is located in Plovdiv field of the Upper Thracian Valley. Floristic regions of Bulgaria are first published in Flora of NR Bulgaria (vol. 3, 1966). According this the study, the examined area falls into Thracian Lowland floristic region.

Climatic regionalization of the country (STANEV *et al.*, 1991) refers the protected

area "Nahodishte na blatno kokiche", Gradina Village, to the Eastern Thracian sub-region of Middle Eastern climatic region of Bulgaria, Transient-continental climatic subregion of the European-continental climatic region. It is characterized with relatively mild winters and hot summers, with well pronounced drought, especially during the months August - September, which are the driest months of the year. The annual rainfall is presented in Table 1. The average annual rainfall is 551 mm, which defines the area as places with little annual rainfall (GALABOV, 1982). The average annual temperature is about 12.1°C, which coincides with that of the country between 11 and 12°C (GALABOV, 1982). The average humidity is 72% and coincides with the average of the country (GALABOV, 1982).

Soils are mainly alluvial meadow, as at some places they are mixed with clay and fertile black earth vertisols.

Material and methods

We studied the medicinal plants in protected area "Nahodishte na blatno kokiche" Gradina, Parvomay Municipality (234.4417 ha), located in the middle reaches of the Maritza River. The protected area was declared with a major motive of protecting the habitat of summer snowflake (*Leucojum aestivum* L.) and natural lowland riparian forest of clear polish (*Fraxinus oxycarpa* Bieb. Ex Willd.), field elm (*Ulmus minor* Mill.) and summer oak (*Quercus robur* L.).

Table 1. The average monthly amount of precipitations, measured in station Sadovo

Months	mm
January	42
February	35
March	38
April	45
May	61
June	68
July	48
August	31
September	36
October	43
November	52
December	52
Per annum	551

The diversity of medicinal plants in the protected area "Nahodishte na blatno kokiche", Gradina Village, was investigated through the systematic collection of materials during the growing seasons of 2011-2012. The frequency of attendance was complied with the climatic conditions in the region and the phytorhythms conditioned by them. The earliest collecting started from the beginning of February, and the latest – by the end of September, which allowed us to range the taxonomic diversity and its seasonal dynamics. The identification of species was done by using Handbooks "Plants in Bulgaria" (DELIPAVLOV & CHESHMEDZHIEV 2003), "Flora of People Republic of Bulgaria" (YORDANOV, 1963-1979; VELCHEV, 1982-1989; KOZHUHAROV, 1995); "Flora of Bulgaria" (STOYANOV, 1966,

1967); "Qualifier of trees and bushes in Bulgaria" (GRAMATIKOV, 1992).

Processing of the factual material and floristic characteristics were made by standard methods (STANEV 1976; VASSILEV & ANDREEV 1992; GUSEV *et al.*, 2004). Characteristic of the healing plants was done according to: eco-biological structure (analysis of biological types) spectrum of life forms by RAUNKIER (1934), distribution of the floral elements by Walter (ASYOV, 2006), ecologic groups in terms of the water factor, time flowering and conservation significance of the flora. Conservation status of the species at national level was determined by the "Red Book of Bulgaria" (PEEV, 2012), "Biological Diversity Act" (2002, 2007) and internationally by Lucas (1983), ECE (1991) list of IUCN: "Red List of Threatened Plants" (1998), Appendix № 1 of the Convention on the Conservation of European wild flora and fauna and natural habitats (Bern Convention) and the Annexes of the Convention on International Trade with Endangered Species of Wild Fauna and Flora (CITES).

As a result of floristic research and literature reviews (PAVLOV *et al.* 1990; TASHEV 1991; GEORGIEV & KOEV 2012) in the period 2011-2012 on the territory of the protected area "Nahodishte na blatno kokiche", Gradina Village, 175 higher plant species from 119 genera and 50 families were found. Phytofund consists only of angiosperms from Division Magnoliophyta. 30 species of these belong to Class Liliopsida, distributed in 22 genera and 11 families, and 145 species belong to Class Magnoliopsida, distributed in 97 genera and 39 families.

Results

Basing on the analysis of literary publications on medicinal plants of the flora of Bulgaria (DELIPAVLOV & CHESHMEDZHIEV 2003; LAW ON MEDICINAL PLANTS IN BULGARIA, 2006; NIKOLOV, 2007; LANDZHEV, 2010), in the protected area "Nahodishte na blatno kokiche", Gradina Village, 95 species medicinal plants (Appendix 1) from 83 gen-

era and 43 families were found, representing 54.3% of the species, 69.7% of the genera and 86.0% of the families in the protected area. These plants represent 12.7% of the species included in Appendix № 1 of the Law on Medicinal Plants (2006).

The distribution of taxa, regarding biological types (Table 2), shows that perennial herbaceous plants have the most significant presence (49 species), representing 51.6% of the whole establishment listed, followed by trees with 10 species – 10.% and

Table 2. Distribution of medicinal plants regarding biological types.

Biological type	Number of taxa	% of medicinal plants in protected area
tree	10	10.5
tree - shrub	2	2.1
shrub - tree	3	3.1
shrub	9	9.5
shrub - perennial	0	0
perennial	49	51.6
biennial - perennial	2	2.1
biennial	6	6.3
annual - biennial	7	7.4
annual	7	7.4

9 species of shrubs – 9.5%.

Analysis of medicinal plants, regarding floral elements (Walter) (Table 3), shows dominant presence of the Euro-Asian

species (21), forming 22.1% of the sample group, followed by the Euro-Mediterranean – with 18 species or 18.9%, and Sub-Mediterranean – 10 species or 10.5%.

Table 3. Distribution of medicinal plants according to floral elements.

Floral elements by Walter	Number of taxa	% of medicinal plants in protected area
Adv	1	1.0
Boreal	8	8.4
Eur	7	7.4
Eur - As	21	22.1
Eur - Med	18	18.9
Eur - OT	2	2.1
Eur - Sib	6	6.3
Eur - subMed	1	1.0
Kos	7	7.4
Med	2	2.1
Med - CAs	1	1.0
Pont - Med	3	3.1
subBoreal	5	5.3
subMed	10	10.5
sPont	3	3.1

Hemicryptophytes, regarding the biological spectrum of the studied species (Table 4), are dominant – 42 species representing 44.2% of the total number of

medicinal taxa in the reserve, followed by phanerophytes – 23 species or 24.2%, and hemicryptophytes to therophytes – 8 species and 8.4%, respectively.

Table 4. Distribution of medicinal plants according to their life forms.

Life form	Number of taxa	% of medicinal plants in protected area
Phanerophytes (Ph)	23	24.2
Chamephytes (Ch)	1	1.0
Hemicryptophytes (H)	42	44.2
Cryptophytes (Cr)	7	7.4
Therophytes (T)	7	7.4
Therophytes to hemicryptophytes (T-H)	7	7.4
Hemicryptophytes to therophytes (H-T)	8	8.4

The distribution of the sample group of plants, regarding time of flowering (Table 5), shows the maximum density in months V-IX (81 taxa). Among them the flowering species are most during the months V-VII and V-VIII, with 11 species for each period; V-VIII - 11 species, and V-IX - 8 species.

Despite clearly less expressed flowering, in so-called months of relative peace: November, December, January and February - only 3 taxa, it is noteworthy that the vegetation of medicinal species is found within the area throughout the year.

Table 5. Distribution of medicinal plants according to the flowering period.

Flowering time, months of the year	Number of taxa	% of medicinal plants in protected area
I-XII	1	1.0
II-III	1	1.0
II-IV	1	1.0
III-IV	1	1.0
III-V	2	2.1
III-VI	1	1.0
III-VIII	1	1.0
III-IX	2	2.1
IV-V	9	9.5
IV-VI	5	5.3
IV-VII	5	5.3
IV-VIII	2	2.1
IV-X	1	1.0
V	2	2.1
V-VI	11	11.6
V-VII	4	4.2
V-VIII	11	11.6
V-IX	8	8.4
V-X	3	3.1
V-XI	1	1.0
VI-VII	4	4.2
VI-VIII	7	7.4
VI-IX	5	5.3
VI-X	3	3.1
VII-VIII	3	3.1
VII-X	1	1.0

Referring the territory of the protected area "Nahodishte na blatno kokiche", Gradina Village, to the category of floodplain or dense forests, we also determine a high percentage: total 32.6% of hygrophytes, hygromezophytes and

mezohygrophytes (Table 6). It should be noted, however, the dominance of mezophytes, represented by 56 species (59.0 %) that exceeds almost twice the previous groups.

Table 6. Distribution of medicinal plants by ecological groups regarding the water as a factor

Ecological group	Number of taxa	% of medicinal plants in protected area
Hygrophytes	20	21.0
Hygromezophytes	9	9.5
Mezohygrophytes	2	2.1
Mezophytes	56	59.0
Xeromezophytes	7	7.4
Xerophytes	1	1.0

Analysis of the distribution of medicinal plants, regarding ecological groups toward light as a factor (Table 7), shows the prevalence of helophytes - 52 or 54.7 %, followed by the groups of hemischiophytes with 26 species or 27.4%, and schiophytes represented by 17 species and 17.9%, respectively.

followed by the groups of hemischiophytes with 26 species or 27.4%, and schiophytes represented by 17 species and 17.9%, respectively.

Table 7. Distribution of medicinal plants by ecological groups regarding the light as a factor

Ecological group	Number of taxa	% of medicinal plants in protected area
Helophytes	52	54.7
Hemischiophytes	26	27.4
Schiophytes	17	17.9

Regarding the edaphic factor, the sample species are divided into 9 groups (Table 8). Indifferents are dominant - 69 species or 72.6%, followed by lithophytes 11 species -

11.6% and psamophytes 6 - 6.3%, respectively. All other groups are poorly represented - by 1 or 2 species.

Table 8. Distribution of medicinal plants to bedrock (substrate).

Groups	Number of taxa	% of medicinal plants in protected area
Indifferents	69	72.6
Calciophytes	2	2.1
Lithophytes	11	11.6
Lithophytes and Calciophytes	1	1.0
Lithophytes and Psamophytes	1	1.0
Halophytes	1	1.0
Psamophytes	6	6.3
Nitrophytes	1	1.0
Hydrophytes	3	3.1

Analysis of medicinal plants, regarding the heat as a factor, divides them into two

groups. The group of thermophytes, that are dominant - 69 species or 72.6 %, while the

remaining 26 species - 27.4% belong to the group mezotherms.

The distribution of medicinal plants in phytogeographic centers (Fig. 1) (STEFANOV, 1943) shows that with the largest percentage - 30.5% are the species from Southern

Continental Center, followed by those coming from the Mountainous one - 25.3%, Northern Continental Center and Sylvan boreal - 21.0%; and lastly are the types of Mediterranean Center - 2.1%.

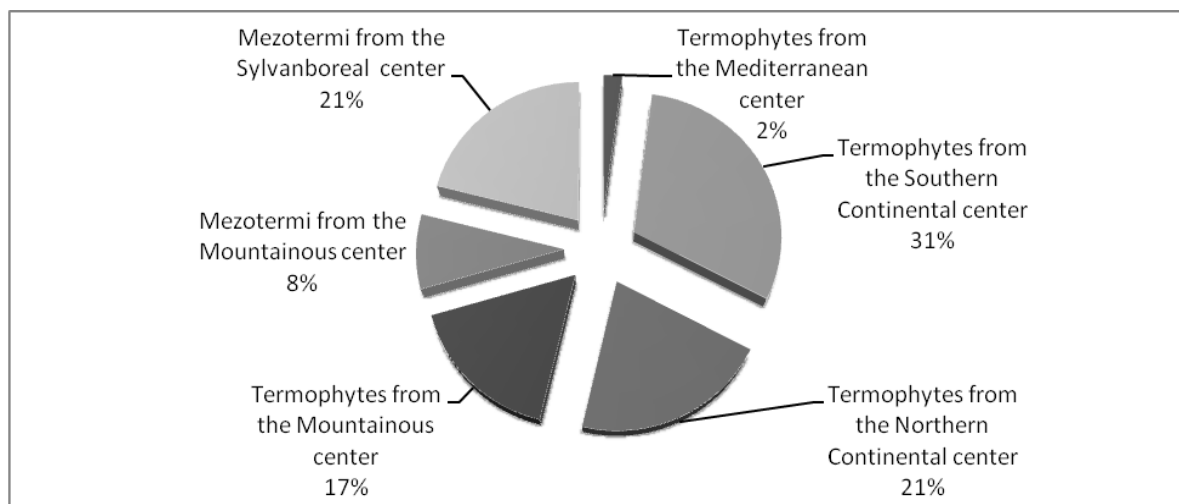


Fig. 1. Distribution of medicinal plants in phytogeographic centers (after STEFANOV, 1943)

On the basis of their structural-physiological characteristics and the vegetation activity, the plants fall into three groups (STEFANOV, 1943): fixed - 32 species, variable with secondary extended habitats - 27 species and those penetrated by secondary displacement - 36 species.

In the protected area we found four taxa of conservation importance, representing 4.2% of medicinal plants occurring in it: bear's breech (*Acanthus spinosus*) is an endangered species (*Endangered*) (DIMITROVA, 2009, following PEEV, 2011) and is included in Appendix 3 of Biodiversity Act of Bulgaria; summer snowflake (*Leucojum aestivum*) is vulnerable (*Vulnerable*) (EVSTATIEVA, 2009) and is included in Appendix 4 of Biodiversity Act of Bulgaria; and two other species are included in Appendix No 2 of the Convention on International Trade with Endangered Species of Wild Fauna and Flora: Loose-Flowered Orchid (*Orchis laxiflora* subsp. *elegans*) and Lesser Butterfly-orchid (*Platanthera bifolia*).

Discussion

The number of medicinal plants, found in the examined protected area (95 species), represents 12.7% of the total number of herbal plants, listed in LAW ON MEDICINAL PLANTS IN BULGARIA - 744 herb species; *Specialized encyclopedia of medicinal plants in Bulgaria* - 380 species (NIKOLOV, 2007); *Encyclopedia of medicinal plants in Bulgaria* - 224 species (LANDZHEV, 2010). This can be said as a very high concentration of these species in the research object, having in mind that the territorial correlation of 23.4 km² of protected area to the total area of the country (GALABOV, 1982) ranged of 0.021%

The reported dominant presence of hemicryptophytes gives us reason to assume relatively rapid negative change of the species establishment in acute changes in hydrostatic mode of the protected area "Nahodishte na blatno kokiche", Gradina Village, as there were significant decreases in rainfall and river level, observed in recent years. Moreover, about one third (32.6%) of those species, established during our study,

are highly dependent on moisture reserves of the edaphic factor.

The presence of nine different categories of plants, associated with the substrate type, suggests a mosaic distribution in horizontal and vertical direction of the typical for the protected area "alluvial-black soils" (GALABOV, 1982). The dominance of indifferent species is in direct correlation with these characteristics of the soil factor - 72.6%. The relatively poor performance of lithophytes and psamophytes is based on limited areas of sandy sediments and ballast (gravel) deposits, present locally in the territory and occupied by the species discussed.

The dominance of thermophile species is in direct correlation with the climatic characteristics of the region, typical with influence of Mediterranean warm currents along the Maritsa River (GALABOV, 1982).

The wide range of the vegetation season, covering the twelve months of the year, allows the available resources of medicinal plants to be fully exploited as a gene bank for the production of propagating material for cultivation experiments of wild species.

Conclusions

1. The protected area "Nahodishte na blatno kokiche", Gradina Village, is a significant depot of medicinal plants, including 12.7% of all wild plants in Bulgaria used for medical purposes;

2. The hemicryptophytes have a dominant position in the total amount of the herbal species reported;

3. Despite the well-known Mediterranean climatic influence in the region, the overwhelming amount from the analyzed group of plants remains the typical European and Euro-Asian forms;

4. Relatively high percentage of hydro- and hygrophytes shows a significant degree of vulnerability and change in species establishment in increasingly distinct tendencies of drought in the last decade;

5. Reporting the medicinal plants in the study area is a prerequisite for changing the status of the protected area in the

reserve according to Bulgarian Law for Environmental Protection and improving the care and conservation of plant diversity.

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Received: 21.05.2012

Accepted: 13.11.2012

Appendix 1: Systematic list of medicinal plants in protected area:

Class	Family	Species
Liliopsida	Alismataceae	<i>Alisma plantago-aquatica</i> L.
	Alliaceae	<i>Allium scorodoprasum</i> L.
	Amaryllidaceae	<i>Leucojum aestivum</i> L.
	Iridaceae	<i>Iris graminea</i> L.
		<i>Iris pseudacorus</i> L.
	Liliaceae	<i>Polygonatum latifolium</i> Desf.
		<i>Polygonatum odoratum</i> (Mill.) Druce
	Orchidaceae	<i>Orchis laxiflora</i> Lam. ssp. <i>elegans</i> (Heuff.) Soo
		<i>Platantera bifolia</i> (L.) Rich.
Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	
Thyphaceae	<i>Thypha latifolia</i> L.	
Number of species		11
Magnoliopsida	Acanthaceae	<i>Acanthus spinosus</i> L.
	Aceraceae	<i>Acer campestre</i> L.

	<i>Acer tataricum</i> L.
Apiaceae	<i>Bifora radians</i> Bieb.
	<i>Chaerophyllum bulbosum</i> L. ssp. <i>bulbosum</i> L.
	<i>Chaerophyllum temulentum</i> L.
	<i>Daucus carota</i> L.
	<i>Heracleum sibiricum</i> L.
	<i>Oenanthe angulosa</i> Griseb.
Aristolochiaceae	<i>Aristolochia clematitis</i> L.
Asteraceae	<i>Artium lappa</i> L.
	<i>Bellis perennis</i> L.
	<i>Carlina vulgaris</i> L.
	<i>Cichorium intybus</i> L.
	<i>Cirsium arvense</i> (L.) Scop. var. <i>incanum</i> Fisch.
	<i>Cirsium arvense</i> (L.) Scop. var. <i>vestitum</i> Wimm et Grab.
	<i>Lactuca serriola</i> L.
	<i>Taraxacum officinale</i> Weber
	<i>Tragopogon pratensis</i> L. ssp. <i>orientalis</i> (L.) Celak.
Boraginaceae	<i>Buglossoides purpureocaerulea</i> (L.) I. M. Johnston
	<i>Cynoglossum officinale</i> L.
	<i>Symphytum officinale</i> L.
Brassicaceae	<i>Capsella bursa-pastoris</i> (L.) Medik.
Cannabaceae	<i>Humulus lupulus</i> L.
Capryfoliaceae	<i>Sambucus ebulus</i> L.
	<i>Sambucus nigra</i> L.
	<i>Viburnum opulus</i> L.
Caryophyllaceae:	<i>Stellaria graminea</i> L.
	<i>Stellaria media</i> (L.) Cirillo.
Celastraceae	<i>Euonymus europaeus</i> L.
Convolvulaceae	<i>Convolvulus arvensis</i> L.
Cornaceae	<i>Cornus mas</i> L.
	<i>Cornus sanguinea</i> L. ssp. <i>sanguinea</i> L.
Corylaceae	<i>Carpinus betulus</i> L.
	<i>Corylus avellana</i> L.
Dipsacaceae	<i>Dipsacus fullonum</i> L.
Euphorbiaceae	<i>Euphorbia plathyphylus</i> L.
	<i>Euphorbia velenovskyi</i> Bornm. var. <i>trichocarpa</i> Bornm.
	<i>Euphorbia villosa</i> Waldst. & Kit. ex Willd.
Fabaceae	<i>Coronilla scorpioides</i> (L.) W. D. J. Koch
	<i>Galega officinalis</i> L.
	<i>Lotus corniculatus</i> L.
	<i>Melilotus alba</i> Medik
	<i>Ononis arvensis</i> L.
	<i>Trifolium pratense</i> L.
Fagaceae	<i>Quercus pedunculiflora</i> K. Koch
	<i>Quercus robur</i> L.
Lamiaceae	<i>Ajuga reptans</i> L.
	<i>Ballota nigra</i> L. ssp. <i>nigra</i> L.
	<i>Glechoma hederacea</i> L.

		<i>Lamium maculatum</i> L.
		<i>Lamium purpureum</i> L.
		<i>Mentha aquatica</i> L.
		<i>Mentha pulegium</i> L.
		<i>Prunella vulgaris</i> L.
		<i>Teucrium scordium</i> L.
	Malvaceae	<i>Althaea officinalis</i> L.
	Moraceae	<i>Morus alba</i> L.
	Oleaceae	<i>Fraxinus ornus</i> L.
		<i>Fraxinus oxycarpa</i> Willd.
		<i>Ligustrum vulgare</i> L.
	Plantaginaceae	<i>Plantago lanceolata</i> L.
		<i>Plantago major</i> L.
	Polygonaceae	<i>Persicaria hydropiper</i> (L.) Opiz
		<i>Polygonum patulum</i> Bieb.
	Ranunculaceae	<i>Clematis vitalba</i> L.
		<i>Ficaria verna</i> Hudson
	Rosaceae	<i>Agrimonia eupatoria</i> L.
		<i>Crataegus monodina</i> Jacq.
		<i>Geum urbanum</i> L.
		<i>Malus sylvestris</i> (L.) Mill.
		<i>Potentilla argentea</i> L.
		<i>Prunus spinosa</i> L.
		<i>Rosa canina</i> L.
	<i>Rubus caesius</i> L.	
	Rubiaceae	<i>Galium aparine</i> L.
	Salicaceae	<i>Populus alba</i> L.
		<i>Salix fragilis</i> L.
	Scrophulariaceae	<i>Pseudolysimachium orchideum</i> (Crantz) T. Wraber
		<i>Veronica anagallis-aquatica</i> L.
	Solanaceae	<i>Solanum dulcamara</i> L.
	Ulmaceae	<i>Ulmus minor</i> Mill.
	Urticaceae	<i>Urtica dioica</i> L.
	Violaceae	<i>Viola odorata</i> L.
Number of species		84
Total number of medicinal species		95