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ECO-BIOLOGICAL CHARACTERISTICS OF MEDICINAL PLANTS IN THE RESERVE GORNA TOPCHIYA (RIVER TUNDZHA HILLY VALLEY)

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Abstract

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Over a period of 3 years, medicinal plants were investigated in the reserve Gorna Topchiya, situated in the middle course of the river Toundzha near the village of Konevets, Yambol, Municipality Tundzha (Tundzha hilly valley). Vegetation seasons included the period from February to October, which guarantees the traceability of growing cycles of both annual and perennial species, as well as ephemeral and ephemeral-like species. In the present study we did eco-biological characteristics of these plants, as the species are divided into biological groups according to their life forms, floral elements and flowering time. Medicinal plants are also classified according to their relation to water, light and heat. We have made conclusions about the influence of hydrodynamics on the change of floristic composition and the changes that occur in cenosis characteristics of the protected area.

Key words: reserve Gorna Topchiya, River Tundzha hilly valley, floristic characteristics, environmental features, medicinal plants, conservation significance

Introduction

The purpose of this study is, as a result of our fieldwork and literature data analysis, to draw a list and to do floristic analysis and eco-biological characteristics of medicinal plants that were found within the reserve Gorna Topchiya.

Nikolay Stoyanov, in his article "The Forest Longoz at the River Kamchiya and longozes as plant formation" (Stoyanov, 1928), mentioned for the first time the riparian forests that are located in the valley of the river Tundzha, not far from the town of Elhovo. In his report under the contract: Assessment of conditions of the reserves Dolna Topchiya, Gorna Topchiya and Balabana (1995) Popov provided a list of 135 plants in the three reserves without distinguishing which of them can be found in each reserve.

Material and Methods

The subject of this study is the diversity, biological and ecological characteristics of medicinal plants in the Reserve (R) Gorna Topchiya that is located in the middle course of the river Tundzha, not far from the village of Konevets.

The reserve was declared by Council of Ministers Decree No.1171 of 24.09.1951 for the purpose of protecting the longoz forest. The size of the protected area was corrected twice. The first extension was made with Order № 754 of 07.19.1984 of the Committee for Environmental Protection at Council of Ministers, as the area increased to 160.2 ha; the second – with Order № РД -942 of 28.12.2007 of MEW, which increased the area of the reserve to 164.3777 ha.

The protected area is in the field of Elhovo in the hilly valley of the river Tundzha, N42 15 32.9 E26 34 16.9. According to the phytogeographic subdivision in Bulgaria, the reserve is located within the region of Sakar of Sakar-Dervenska phytogeographic region (Bondev, 1997).

The territory of R. Gorna Topchiya falls within the European continental climatic sub-region to the east region of Central Bulgaria (Sabev and Stanev, 1963), and according to Tishkov (1982) – in the southern Bulgarian subregion of the Continental-Mediterranean climatic region, and this implies a significant Mediterranean influence on the flora in the area.

We made characteristics of the main climatic components in the research area with the data from the meteorological

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station in Elhovo. The average annual temperature for the last 10 years (Table 1) is relatively high and it varies between 11.5°C – 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 from 400.5 to 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 is perishable and therefore soil sometimes freezes in winter.

The diversity of medicinal plants in R. Gorna 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 phytorhythmic. The earliest collecting started in the beginning of February 2010, and the latest collecting – 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 species identification was done using the Flora of Bulgaria (Yordanov, chief ed. 1963-1979; Velchev, chief ed. 1982 – 1989), Flora of Bulgaria (Kozhuharov, 1995), Flora of Bulgaria (Stoyanov et al., 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 with standard methods (Stanev, 1976; Vassilev and Andreev, 1992; Gusev et al., 2004). Classification of medicinal plants was done according to biological types and life forms by Raunkiaer (1934). Floral elements were characterized by the classification of Stefanov (1943) and the classification of Walter (Asyov and Petrova, 2006) adapted to the flora of Bulgaria. The identified taxa are divided into ecological groups that are related to the ecological factors – water, temperature and light. An account and analysis of the flowering period were done for all the species identified. The names of the plants are by The Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity (2011), Qualifier of Plants in Bulgaria (Delipavlov and Cheshmedzhiev, ed. 2011).

Table 1
Annual rainfall and average annual temperature in the region of R. Gorna Topchiya, basing on the data of the meteorological station Elhovo for the period 2002 – 2011

Year	Rainfall, mm/m2	Average annual temperature, °C
2002	656.9	12.5
2003	400.5	12
2004	824.2	12.3
2005	1018.6	12
2006	414,0	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

Results

As a result of the studies done in 2010-2012, on the territory of R. Gorna Topchiya, we found 187 species higher plants from 141 genera and 54 families. All the species belong to Division Magnoliophyta. Basing on the literature analysis of publications concerning medicinal plants of 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), we found that in R. Gorna Topchiya there are 132 species medicinal plants (Appendix 1) from 115 genera and 51 families, representing 70.5% of the species, 81.5% of the genera and 94.4 % of the families in the protected territory. These plants represent 17.7 % of the species listed in Appendix № 1 of the Law on Medicinal Plants (2000, 2006). From these, 17 species belong to Class Liliopsida, distributed in 15 genera and 8 families, and 115 species belong to class Magnoliopsida, distributed in 100 genera and 43 families.

The richest families of medicinal species in the reserve are: Asteraceae – 13 species, Lamiaceae – 11 species, Rosaceae – 10 species, Fabaceae with 8 species, etc. The genera with most medicinal plants – 3 are: *Acer* и *Plantago*.

The distribution of taxa according to their biological types showed that perennial herbaceous species are the most – 73 species, or 55.4 % of all medicinal plants, then trees – 16 species (12.1 %), shrubs – 12 species (9.1 %) and finally annual herbaceous – 8 species (6.0 %). The rest of the species belong to the transient biological types (Table 2).

According to the biological spectrum of the species we studied (Table 3), most were hemicryptophytes (H) – 51 species, or 38.6% of the total number of medicinal plants in the reserve, followed by phanerophytes (Ph) – 33 species (25.0%), cryptophytes (Cr) – 22 species (16.7%), therophytes (Th) – 8 species (6.0%), and chamephytes (Ch) which were only one species or only 0.8 %. The rest of the species are of transitional life forms – among them the most – 10 species (7.6%) 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 Stefanov (1943),

shows that the greatest part – 27.2% are thermophytes from the Southern Continental Center, followed by thermophytes and mesotherms of the Mountainous Center – 24.1 %, mesotherms of Silvo-boreal Center – 21.2%, thermophytes from the Northern Continental Center – 20.4%, thermophytes from Mediterranean Centre – 3.8%, which means that despite the good conditions for a presumable invasion of Mediterranean species, the mountain ranges of Sakar Mountains and Dervenski hills are a sufficiently strong barrier to higher temperatures typical for the Mediterranean region and finally the plants from other phytogeographic centers – 3.0% (Table 4).

According to their mobility the plants analyzed are distributed as follows: the fixed species are 50 species (37.9%), the moving ones with secondary broadened areas are 29 species (22.0%) and the species that have appeared by secondary displacement – 53 plants (40.1%) (Stefanov, 1943). These data are evidence of significant anthropogenic interference with the territory of the reserve in the past.

Analyzing higher plants by floral elements, distributed according to Walter's classification (Assyov and Petrova 2006), shows that geo-elements with European component are the most numerous – 72 species, or 54.5%, as among them the most numerous are Euro-Asian (*Eur-As*) – 30 species (22.8%), Euro-Mediterranean (*Eur-Med*) – 29 species (14.4%), European (*Eur*) - 10 species (7.6%) and Euro-Siberian (*Eur-Sib*) - 8 species (6.0%). Second is the group of species with Mediterranean component – 49 species, or 37.1%, among them most are Euro-Mediterranean (*Eur-Med*) with 19 species (14.4%), then sub-Mediterranean (*subMed*) – with 15 species (11.4%), Pontic Mediterranean (*Pont-Med*) are 6 species (4.5%), Mediterranean (*Med*) are 2 species (1.5%). Cosmopolitan (*Kos*) and boreal (*Boreal*) species equal in number – 10 species each, etc. (Table 5).

The distribution of the plants, according to their flowering period, showed that the most active period is from May to September. During this period, 104 taxa flowered or 78.7 % of all the plants. Among them, most species flowered in May-August – 17 species, June-August – 16 species, May-June – 12 species, June-September – 11 species, etc. (Table 6).

The reported decline of the total annual rainfall in the last decade, as well as the decrease of groundwater level, determine relatively low percentage of hygrophytes and

Table 2
Distribution of medicinal plants from R. Gorna Topchiya by biological types

Biological type	Number of taxa	% of MP in R "Gorna Topchiya"
tree	16	12.1
tree - shrub	2	1.5
shrub - tree	4	3
shrub	12	9.1
perennial	73	55.4
biennial - perennial	2	1.5
biennial	5	3.8
annual-perennial	1	0.8
annual - biennial	9	6.8
annual	8	6
Total	132	100

Table 3
Biological spectrum of higher plants from R. Gorna Topchiya

Biological form by Raunkiaer (1934)	Number of taxa	% of MP in R "Gorna Topchiya"
Phanerophytes (Ph)	33	25
Chamephytes (Ch)	1	0.8
Hemicryptophytes (H)	51	38.6
Cryptophytes (Cr)	22	16.7
Therophytes (Th)	8	6
Therophytes to hemicryptophytes (Th-H)	10	7.6
Hemicryptophytes to therophytes (H-Th)	7	5.3
Total	132	100

Table 4
Distribution of higher plants in phytogeographic centers (Stefanov, 1943)

Phytogeographic center	Number of taxa
1 Termophytes from the Mediterranean Center	5
2 Termophytes from the South Continental Center	36
3 Termophytes from the Northern Continental Center	27
4 Termophytes from the Mountainous Center	15
5 Mezotermi from the Mountainous Center	17
6 Mezotermi from the Silvo-boreal Center	28
7 Plants from other phytogeographic centers	4

hygromezophytes, respectively 11.4% and 12.1%. The considerable dominance of the group of mezophytes 68.2% implies a trend of change in the types of vegetation that is related to changes in ecological conditions (Table 7).

Analysis of medicinal plants distribution in terms of the light factor shows prevalence of heliophytes that are more than half of the species – 73 (55.3%), followed by the groups of hemi-scyophytes – 33 species and schyophytes represented with 26 species (Table 8).

According to their relation to heat the species are divided into only 2 groups. Thermophytes are the biggest group with 118 species (70.3%), and the rest – 50 species (29.7%) refer to the group of mesotherms (Table 9). The dominance of thermophilic species is directly related to the influence of the Mediterranean climate that penetrates along the river Tundzha (Galabov et al., 1982).

Only one species of the conservation significant plant species in the reserve is used in medicine. This is *Leucojum aestivum* L., 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).

Table 5
Distribution of higher plants from R. Gorna Topchiya by floral elements according to the adapted classification of Walter (Assyov and Petrova, 2006)

Floral elements by Walter (2006)	Number of taxa	% of MP in R "Gorna Topchiya"
Adv	4	3
Bal-Anat	1	0.8
Boreal	10	7.6
Eur	10	7.6
Eur-As	30	22.8
Eur-Med	19	14.4
Eur-Med-As	1	0.8
Eur-OT	1	0.8
Eur-Sib	8	6
Eur-subMed	3	2.2
Kos	10	7.6
Med	2	1.5
Med-As	2	1.5
Pont	3	2.2
Pont-Med	6	4.5
Pont-subMed	1	0.8
subBoreal	6	4.5
subMed	15	11.4
Total	132	100

Table 6
Distribution of plants from R. Gorna Topchiya according to their flowering period

Flowering period, months	Number of flowering species	% of MP in R "Gorna Topchiya"
I-XII	1	0.8
I-IV	1	0.8
II-III	2	1.5
II-IV	2	1.5
III-IV	7	5.3
III-V	3	2.2
III-VIII	1	0.8
IV-V	11	8.3
IV-VI	9	6.8
IV-VII	2	1.5
IV-VIII	2	1.5
IV-IX	3	2.2
V	2	1.5
V-VI	12	9.1
V-VII	9	6.8
V-VIII	17	12.9
V-IX	8	6
V-X	2	1.5
VI-VII	4	3
VI-VIII	16	12.1
VI-IX	11	8.3
VI-X	1	0.8
VII-VIII	1	0.8
VII-IX	1	0.8
VII-X	1	0.8
VIII-X	1	0.8
IX-X	1	0.8
IX-XI	1	0.8
Total	132	100

Table 7
Distribution of higher plants from R. Gorna Topchiya according to their relation to water

Ecological groups	Number of taxa	% of MP in R "Gorna topchiya"
Hydrophytes	0	0
Hygrophytes	15	11.4
Hygromezophytes	16	12.1
Mezohygrophytes	7	5.3
Mezophytes	90	68.2
Xeromezophytes	4	3
Xerophytes	0	0
Total	132	100

Table 8
Distribution of medicinal plants from R. Gorna Topchiya according to their relation to light

Ecological groups	Number of taxa	% of MP in R "Gorna Topchiya"
Heliophytes	73	55.3
Hemi-scyophytes	33	25
Scyophytes	26	19.7
Total	132	100

Table 9
Distribution of medicinal plants from R. Gorna Topchiya according to their relation to the thermal regime

Ecological groups	Number of taxa	% of MP in R "Gorna Topchiya"
Microtherms	0	0
Mesotherms	45	34.1
Thermophytes	87	65.9
Total	132	100

Conclusion

The study conducted in 2010 – 2012 on medicinal plants in R. Gorna Topchiya showed that there are 132 plant species from 115 genera and 51 families. Among these plants most are the perennial herbaceous plants, hemicryptophytes, the species of European and Mediterranean origins, thermophytes, mezophytes and heliophytes, which flowered most intensively from May to September. The relatively great part of 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 may be due to the droughts, especially in 2003, 2006 and 2008 (Table 1), due to decreased rainfall and the lower water level of the river Tundzha in the last decade, and also as a result of the increase in average annual temperatures for the same period. Nevertheless, a significant gene-fund is protected in R. Gorna Topchiya, and these valuable plant species are used in folk and official medicine.

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Appendix
A list of medicinal plants in the Reserve Gorna Topchiya

Liliopsida

Alliaceae: *Allium scorodoprasum* L.; Amaryllidaceae: *Galantus gracilis* Celak., *Leucojum aestivum* L.; Asparagaceae: *Asparagus tenuifolius* Lam.; Dioscoreaceae: *Tamus communis* L.; Iridaceae: *Crocus chrysantus* (Herb.) Herb., *C. pallasii* Goldb., *Iris graminea* L., *I. pseudacorus* L.; Liliaceae: *Colchicum autumnale* L, *Convallaria majalis* L., *Scilla bifolia* L., *Polygonatum multiflorum* (L.) All., *P. odoratum* (Mill.) Druce; Poaceae: *Anthoxanthum odoratum* L., *Cynodon dactylon* (L.) Pers., *Elymus repens* (L.) Gould; Smilacaceae: *Smilax excelsa* L.

Magnoliopsida

Aceraceae: *Acer campestre* L., *A. negundo* L., *A. tataricum* L.; Apiaceae: *Chaerophyllum temulentum* L., *Conium maculatum* L., *Daucus carota* L., *Heracleum sibiricum* L.; Araliaceae: *Hedera helix* L.; Aristolochiaceae: *Aristolochia clematitis* L.; Asclepiadaceae: *Periploca graeca* L., *Vincetoxicum hirundinaria* Medik.; Asteraceae: *Achillea millefolium* L., *Arctium lappa* L., *Artemisia vulgaris* L., *Carduus acanthoides* L., *Carlina vulgaris* L., *Centaurea solstitialis* L., *Chamomilla recutita* (L.) Rauschert, *Cichorium intybus* L., *Cirsium arvense* (L.) Scop., *Lactuca serriola* L., *Matricaria trichophylla* (Boiss.) Boiss., *Taraxacum officinale* F. H. Wigg., *Tragopogon pratensis* L.; Boraginaceae: *Buglossoides purpurocaerulea* (L.) I. M. Johnst., *Lithospermum officinale* L.; Brassicaceae: *Alliaria petiolata* (M. Bieb.) Cavara & Grande, *Capsella bursa-pastoris* (L.) Medik., *Thlaspi arvense* L.; Caesalpiniaceae: *Gleditsia triacanthos* L.; Cannabaceae: *Humulus lupulus* L.; Caprifoliaceae: *Sambucus ebulus* L., *S. nigra* L.; Caryophyllaceae: *Stellaria media* (L.) Cirillo; Celastraceae: *Euonymus europeus* L.; Convolvulaceae: *Convolvulus arvensis* L.; Cornaceae: *Cornus mas* L., *C. sanguinea* L.; Corylaceae: *Carpinus betulus* L., *Corylus avellana* L.; Euphorbiaceae: *Euphorbia cyparissias* L., *E. palustris* L., *Mercurialis ovata* Sternb. & Hoppe; Fabaceae: *Amorpha fruticosa* L., *Astragalus glycyphyllos* L., *Galega officinalis* L., *Lathyrus pratensis* L., *L. sylvestris* L., *Robinia pseudoacacia* L., *Trifolium pratense* L., *Vicia cracca* L., *V. grandiflora* Scop.; Fagaceae: *Quercus robur* L. subsp. *pedunculiflora* (K. Koch) Menitsky, *Q. robur* L. subsp. *robur* L.; Fumariaceae: *Corydalis solida* (L.) Clairv.; Geraniaceae: *Geranium pyrenaicum* Burm. f.; Hypericaceae: *Hypericum hirsutum* L., *H. perforatum* L.; Juglandaceae: *Juglans regia* L.; 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., *Scutellaria altissima* L., *Stachys germanica* L.; Lytraceae: *Lythrum salicaria* L.; Malvaceae: *Althaea officinalis* L., *Malva sylvestris* L.; Oleaceae: *Fraxinus angustifolia* subsp. *oxycarpa* (Willd.) Franco & Rocha Afonso, *F. ornus* L., *Ligustrum vulgare* L.; Papaveraceae: *Chelidonium majus* L., *Papaver rhoeas* L.; Plantaginaceae: *Plantago lanceolata* L., *P. major* L., *P. media* L.; Polygonaceae: *Persicaria hydropiper* (L.) Opiz, *Rumex crispus* L.; Primulaceae: *Lysimachia nummularia* L.; Ranunculaceae: *Anemone ranunculoides* L., *Clematis vitalba* L., *Consolida regalis* S. F. Gray, *Ficaria verna* Huds., *Ranunculus repens* L.; Rhamnaceae: *Paliurus spina-christ* Mill.; Rosaceae: *Agrimonia eupatoria* L., *Crataegus monogyna* Jacq., *Geum urbanum* L., *Malus sylvestris* (L.) Mill., *Potentilla argentea* L., *Prunus cerasifera* Ehrh., *P. spinosa* L., *Pyrus communis* subsp. *pyraster* (L.) Ehrh., *Rosa canina* L., *Rubus caesius* L.; Rubiaceae: *Cruciata laevipes* Opiz, *Galium aparine* L.; Salicaceae: *Populus alba* L., *P. nigra* L., *Salix alba* L., *S. fragilis* L.; Scrophulariaceae: *Veronica anagalis-aquatica* L.; Solanaceae: *Solanum dulcamara* L., *S. nigrum* L.; Ulmaceae: *Ulmus minor* Mill.; Urticaceae: *Urtica dioica* L.; Verbenaceae: *Verbena officinalis* L.; Violaceae: *Viola odorata* L.; Zygophyllaceae: *Tribulus terrestris* L.

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