

ASN, Vol 2, No 1, Pages 39-47, 2015

## Acta Scientifica Naturalis

Former Annual of Konstantin Preslavsky University - Chemistry, Physics, Biology, Geography

Journal homepage: http://www.shu.bg

Received: 30.10.2014

Accepted: 11.03.2015

# The medicinal plants of Frangensko Plateau (Northeastern Bulgaria)

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**Abstract:** The Frangensko Plateau is located in the northeastern part of Bulgaria and covers an area of 360 km<sup>2</sup>. On the territory of the plateau there are two protected areas, as well as two areas of the European ecological network NATURA 2000. The study of the medicinal plants on the territory of the Frangensko Plateau is made for the first time. As a result of our research we found 362 species of vascular plants from 242 genera and 80 families. The most of the families and the genera are represented by a small number of inferior taxa. The analysis of their life form indicates that the hemicryptophytes dominate with 39.50%, followed by the phanerophytes (22.10%). The biological types are represented mainly by perennial herbaceous plants (52.21%), annual herbaceous plants (14.09%) and trees (10.50%). There are 8 types of floristic elements divided in 32 groups. The largest percentage of species is of European type (51.93%). Among the medicinal plants, there are two Balkan endemic species, one Bulgarian endemic species and 30 relic species. Thirty four species with protection statute are described. The anthropophytes among the medicinal plants are 242 species (66.85%).

Keywords: Frangensko Plateau, medicinal plants, analysis

## Introduction

The Frangensko Plateau is located in Northeastern Bulgaria, the eastern part of the Danube Plain (Figure). It is located southeast of the Dobrudja Plateau. The boundaries of the plateau are as follows: Varna–Beloslav Firth to south, the Black Sea to the east and the arched curve of the Batovska River valley to west and north. The maximum altitude is 356 m alt., marked about 2 km west of the Vaglen village [1]. In so delineated Frangensko Plateau covers an area of about 360 km<sup>2</sup>.

From botany-geographically terms the Frangensko Plateau is located in Western Black Sea coastal district of the Euxinian province of European deciduous forest area. It is located in two floristic

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regions: Black Sea coast (north) and Northeastern Bulgaria.

The first studies on the flora of the plateau conducted by Velenovski and his associates Hermengild Shkorpil and Anani Yavashev. In the 80s of the XIX century they held the first botanical studies in Northeastern Bulgaria, including in the vicinity of Varna sity. The results are reflected in the first Bulgarian flora and it's Supplement. Anani Yavashev carries out independent botanical studies near Varna in the period 1884 – 1905.



Figure. Geographical location of Frangensko Plateau

In 1901 the Bulgarian Literary Society (now the Bulgarian Academy of Sciences) assign Anani Yavashev, Andrey Toshev and Vaclav Stribarni preparing a monograph entitled Flora of Bulgaria by belts. Yavashev had to develop the flora of Eastern Bulgaria. The book and is not ready for printing, but it collected materials are kept in the archives of the Bulgarian Academy of Sciences. Hermengild Shkorpil also explores the flora in the vicinity of Varna and for years sent the collected materials to Joseph Velenovski.

Vaclav Stribarni, one of the most effective collaborators of Velenovski in Bulgaria, also collects and sends to Velenovski plants from the area between Varna and Kavarna in the period 1889 – 1904 [2].

On the territory of Golden Sands Nature Park are described 400 species of vascular plants, which is about one tenth of the flora of Bulgaria. These species belong to 271 genera and 79 families [3].

On Frangensko Plateau there are two protected areas: Aladza manastir Protected Site and Zlatni pyasatsi Nature Park as well two protected areas from Natura 2000 network: Dolinata na reka Batova Protected Area (BG0000102) and Zlatni pyasatsi Protected Area (BG0000118).

Aladza manastir Protected Site has an area of 17 ha. The objectives of its announcement are: 1. Protection of areas with spectacular landscapes; 2. Conservation of the habitats of endangered and rare plant and animal species and communities [4].

Zlatni pyasatsi Nature Park has an area of 1324.7 ha and has objective of its announcement conservation of plant and animal communities and characteristic earth formations and landscapes that have scientific and cultural value and significance [3].

Dolinata na reka Batova Protected Area (BG0000102) was declared by the Habitats Directive (Directive 92/43/ EEC), which overlaps a protected area of the Birds Directive (Directive 2009/147/EC). In announcing of the protected area in 2008 the total area is 18459.24 ha. It aims to preserve the area and the natural state of natural habitats and habitats of species and their populations under protection within the protected area, and if necessary their restoration. Subject to conservation are 12 natural habitats, 7 of which are located within the Frangensko Plateau. Besides them the subjects of conservation are *Himantoglossum caprinum* (M. Bieb.) Spreng. (Orchidaceae) and a number of animal species. Described are also other important plant species, including medicinal are as

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follows: Cyclamen coum Mill., Eryngium maritimum L., Leucojum aestivum L., Opopanax chironium ssp. bulgaricum (L.) Koch, Periploca graeca L., Smilax excelsa L. [5].

Zlatni pyasatsi Protected Area (BG0000118) was declared by the Habitats Directive (Directive 92/43/EEC), which overlaps a protected area of the Birds Directive (Directive 2009/147/EC). In announcing of the protected area in 2008 the total area is 1374.44 ha. It aims to preserve the area and the natural state of natural habitats and habitats of species and their populations under protection within the protected area, and if necessary their restoration. Subject to conservation are 11 natural habitats. Besides them the subjects of conservation are *Himantoglossum caprinum* (M. Bieb.) Spreng. (Orchidaceae) and a number of animal species. Described are also other important plant species, including medicinal are as follows: *Anacamptis pyramidalis* (L.) Rich., *Artemisia lerchiana* Weber, *Galanthus nivalis* L., *Ophrys cornuta* Steven, *Opopanax chironium* (L.) Koch, *Primula acaulis* (L.) L., *Seseli rhodopeum* Velen. [6].

Until now, no study has been performed of the medicinal plants of Frangensko plateau. The aim of this study is an inventory of medicinal plants and floristic analysis of the data to be used for comparison with other geographical features as the area and the territory of Bulgaria.

#### **Materials and Methods**

This survey was conducted on the route method in the period 2010 - 2014. The medicinal plants are under the Annex to the Medicinal Plants Act [7], supplemented with data from the literature on the medicinal plants in Bulgaria. In determining the species are used: Handbook for Vascular Plants in Bulgaria [8], Flora of PR Bulgaria, Volumes 1 to 9 [9, 10] and Flora of the Republic of Bulgaria, Volumes 10 and 11 [11, 12]. The names of the taxa are under Conspectus of the Bulgarian vascular flora [13].

The life forms are represented in the system of Raunkiaer [14]. For their determination are used Flora of PR Bulgaria, Volumes 1 to 9 [9, 10] and Flora of the Republic of Bulgaria, Volumes 10 and 11 [11, 12]. Biological types are defined by Handbook for Plants in Bulgaria [15]. The floristic elements and the endemics are under Conspectus of the Bulgarian vascular flora [13]. Relics are presented under Gruev & Kouzmanov [16], Peev & al. [17] Peev [18], Boža & al. [19].

The conservation statute is recognized using the following documents: Annex II to Council Directive 92/43/EEC of the European Community to protect natural habitats and of wild fauna and flora [20], Appendix I to *Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)* [21], Appendix II to *Convention on International Trade in Endangered Species* of Wild Fauna and Flora (CITES) [22], Red Data Book of the Republic of Bulgaria, Vol. 1. Plants and Fungi [23], IUCN Red List for Bulgaria [24], Annex III and Annex IV to Biological Diversity Act [25]. Described species are included in Order for special arrangements for the conservation and use of the medicinal plants [26].

The anthropophytes are presented by Stefanov & Kitanov [27].

## **Results and Discussion**

As a result of our investigations of Frangensko Plateau 362 species, belonging to 242 genera and 80 families were identified. This represents 42.89% of species, 54.50% of genera and 67.80% of families of the medicinal plants in Bulgaria. Systematic list of identified species is presented in Appendix 1.

The most of the families and genera are presented with smaller number of lower taxa: from 1 to 4. The majority of families, 67 (83.75%) were presented with 1–4 genera. Only 13 (16.25%) of the families included the 5 or more genera (Table 1).

#### Table 1. Families with most genera and species

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Семейство	Родове	Видове
Asteraceae	30	46
Lamiaceae	19	30
Fabaceae	15	29
Rosaceae	12	21
Apiaceae	17	19
Brassicaceae	10	12
Scrophulariaceae	5	12
Ranunculaceae	6	10
Orchidaceae	5	9
Boraginaceae	5	7
Oleaceae	-	7
Poaceae	7	7
Polygonaceae	-	7
Salicaceae	-	7
Caryophyllaceae	5	6
Aceraceae	-	5
Fagaceae	-	5
Liliaceae	5	5
Malvaceae	-	5

Most genera are found in the families: Asteraceae (30), Lamiaceae (19), Apiaceae (17), Fabaceae (15), Rosaceae (12), Brassicaceae (10). Most families, 61 (76.25%) have 1–4 species. Only 19 (23.75%) of the families are represented by 5 or more species (Table 1). Most species belong to the following families: Asteraceae (46), Lamiaceae (30), Fabaceae (29), Rosaceae (21), Apiaceae (19). Only 5 genera (2.07%), included 5 or more species: *Artemisia* L. (7), *Veronica* L. (6), *Acer* L. (5), *Lathyrus* L. (5) and *Orchis* L. (5).

In the analysis of the life forms (Table 2) was found dominant participation of the hemicryptophytes, 143 species (39.50%) and the phanerophytes, 80 species (22.10%). This can be

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explained by the location of the plateau in the temperate climatic zone and the significant contribution of forest habitats on its territory.

Group	Subgroup	Number of species	Percentage
Phanerophytes		80	22.10
(Ph)	Megaphanerophytes	7	1.93
	Mesophanerophytes	44	12.15
	Microphanerophytes	21	5.80
	Nanophanerophytes	8	2.21
Chamaephytes (Ch)		17	4.70
Hemicryptophytes (H)		143	39.50
Therophytes- Hemicryptophytes (Th-H)		23	6.35
Cryptophytes		48	13.26
(Cr)	Geophytes	39	10.77
	Helophytes	7	1.93
	Hydrophytes	2	0.55
Therophytes (Th)		51	14.09

Table 2. Distribution of the species by life form

Among the biological types (Table 3) dominated perennial herbaceous plants, 189 species (52.21%). Relatively large are the number of the annual herbaceous plants, 51 species (14.09%) and the number of the trees, 38 species (10.50%). The remaining groups are represented by a small number of species. The dominant presence of perennial herbaceous plants can be explained by the wide variety of communities and habitats of the Frangensko Plateau. The relatively high number of the annual herbaceous plants is the result of the presence of settlements and arable land, and human activity is an important factor for the penetration of new annual species. The tree species are relatively large number due to many forest habitats on the plateau.

## Table 3. Distribution of the species by biological type

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<b>Biological type</b>	Symbol	Number of species	Percentage
Annual herbaceous plant	а	51	14.09
Annual or biannual herbaceous plant	a-b	19	5.25
Annual or perennial herbaceous plant	a-p	4	1.10
Biannual herbaceous plant	b	12	3.31
Biannual or perennial herbaceous plant	b-p	10	2.76
Perennial herbaceous plant	р	189	52.21
Shrub	sh	24	6.63
Shrub or tree	sh-t	15	4.14
Tree	t	38	10.50

Regarding the phytogeographical structure (Table 4) the highest percentage of the species is of European type (51.93%), followed by species of Mediterranean (17.68%) and Boreal type (11.05%). This distribution can be explained by the location of Frangensko Plateau into the Continental-Mediterranean climatic region and the proximity to the border of the Transitional-Continental climatic region.

Type of floristic elements	Number of species	Percentage	
Boreal	40	11.05	
European	188	51.93	
Pontic	27	7.46	
Euxinian	1	0.28	
Mediterranean	64	17.68	

Table 4	. Phytoge	ographical	structure
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Cosmopolitan	22	6.08
Adventive	13	3.59
Endemic and sub-endemic	5	1.38
Other	1	0.28

Among the medicinal plants have two Balkan endemics (0.55%) and one Bulgarian endemic (0.28%). The Balkan endemics are: Achillea clypeolata Sm. and Angelica pancicii Vandas. The Bulgarian endemic is Opopanax chironium subsp. bulgaricum (Velen.) N. Andr. The relicts are 30 species (8.29%). Of the relict species 29 are Tertiary relicts: Acer campestre L., Acer pseudoplatanus L., Acer tataricum L., Alnus glutinosa (L.) Gaertn., Betula pendula Roth, Carpinus betulus L., Celtis australis L., Cercis siliquastrum L., Clematis vitalba L., Corylus avellana L., Cotinus coggygria Scop., Fagus orientalis Lipsky, Fraxinus excelsior L., Fraxinus ornus L., Hedera helix L., Populus alba L., Populus nigra L., Populus tremula L., Quercus dalechampii Ten., Ruscus aculeatus L., Salix alba L., Salix caprea L., Salix fragilis L., Salix purpurea L., Smilax excelsa L., Staphylea pinnata L., Syringa vulgaris L., Ulmus minor Mill. and Viscum album L. One species is a Quaternary relict: Galanthus nivalis L.

The species with conservation status are 34 (9.39%). One of them *Himantoglossum caprinum* (M. Bieb.) Spreng. is included in Annex II of Directive 92/43/EEC: Plant and animal species of Community interest whose conservation requires the designation of special areas of conservation and in Appendix I of the Bern Convention.

Two species are included in Annex V of Directive 92/43/EEC: Plant and animal species of Community interest whose taking in the wild and exploitation may be subject to management measures: *Galanthus nivalis* L. and *Ruscus aculeatus* L.

In Appendix II of CITES Convention are included 11 species: Anacamptis pyramidalis (L.) Rich., Galanthus elwesii Hook. f., Galanthus nivalis L., Himantoglossum caprinum (M. Bieb.) Spreng., Ophrys cornuta Steven, Orchis coriophora L., Orchis morio L., Orchis purpurea Huds., Orchis simia Lam., Orchis tridentata Scop. and Platanthera chlorantha (Cust.) Rchb.

In IUCN Red List for Bulgaria are included 17 species. In category Endangered are included 3 species: Anethum graveolens L., Galanthus elwesii Hook. f. and Galanthus nivalis L. In category Vulnerable are 9 species: Anacamptis pyramidalis (L.) Rich., Angelica pancicii Vandas, Ephedra distachya L., Fraxinus pallisiae Wilmott, Himantoglossum caprinum (M. Bieb.) Spreng., Leucojum aestivum L., Ophrys cornuta Steven., Opopanax chironium (L.) Koch subsp. bulgaricum (Velen.) Andreev and Primula acaulis (L.) L. rubra (Sm.) Greuter & Burdet. In category Near threatened are 4 species: Artemisia lerchiana Weber, Artemisia pontica L., Cercis siliquastrum L. and Vicia pisiformis L. In category Least concern is included only one species Tilia rubra DC.

In the Red Book of Bulgaria are included 5 species. In category Endangered are included 3 species: *Anethum graveolens* L., *Galanthus elwesii* Hook. f. and *Galanthus nivalis* L. In category Vulnerable are 2 species: *Himantoglossum caprinum* (M. Bieb.) Spreng. and *Opopanax chironium* (L.) Koch subsp. *bulgaricum* (Velen.) Andreev.

In the Biodiversity Act are included 25 species. In Annex III Protected species are included 8 species: Anacamptis pyramidalis (L.) Rich., Artemisia lerchiana Weber, Ephedra distachya L., Galanthus elwesii Hook. f., Galanthus nivalis L., Himantoglossum caprinum (M. Bieb.) Spreng., Opopanax chironium (L.) Koch subsp. bulgaricum (Velen.) Andreev and Ophrys cornuta Steven. In Annex IV Under the conservation and regulated use of the nature are included 17 species: Asparagus officinalis L., Bupleurum rotundifolium L., Crocus pallasii Goldb., Echinops sphaerocephalus L.,

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Helichrysum arenarium (L.) Moench, Leucojum aestivum L., Lilium martagon L., Orchis coriophora L., Orchis morio L., Orchis purpurea Huds., Orchis simia Lam., Orchis tridentata Scop., Paeonia peregrina Mill., Polygonatum odoratum (Mill.) Druce, Ruscus aculeatus L., Salix caprea L. and Scilla bifolia L.

Among the listed 34 species of medicinal plants with conservation status with the highest conservation value are as follows: *Himantoglossum caprinum* (M. Bieb.) Spreng. (included in 6 documents), *Galanthus nivalis* L. (included in 5 documents), *Galanthus elwesii* Hook. f. (included in 4 documents) and *Anacamptis pyramidalis* (L.) Rich., *Ophrys cornuta* Steven and *Opopanax chironium* (L.) Koch subsp. *bulgaricum* (Velen.) Andreev (included in 3 documents).

In Order №RD-83 of 03.02.2014 on special arrangements for conservation and use of the medicinal plants in 2014 included 14 species. Prohibited from gathering herbs from their natural habitats are 12 species: Althaea officinalis L., Angelica pancicii Vandas, Artemisia santonicum L., Asplenium trichomanes L., Convallaria majalis L., Inula helenium L., Orchis coriophora L., Orchis morio L., Orchis purpurea Huds., Orchis simia L., Orchis tridentata Scop. and Ruscus aculeatus L. Under restricted collection of herbs from their natural habitats are 2 species: Carlina acanthifolia All. and Paeonia peregrina Mill.

The anthropophytes among the medicinal plants are 242 species (66.85%). Many of them are distributed as weeds in the arable land or as ruderal plants: Agrimonia eupatoria L., Amaranthus retroflexus L., Anagallis arvensis L., Ballota nigra L., Capsella bursa-pastoris Moench., Centaurea solstitialis L., Chenopodium album L., Conium maculatum L., Elymus repens (L.) Gould., Galium aparine L., Geum urbanum L., Lamium purpureum L., Papaver rhoeas L., Rubus caesius L., Stellaria media (L.) Vill., Taraxacum officinale Web., Urtica dioica L., Xanthium strumarium L. and more.

#### Conclusions

The inventory of medicinal plants on the territory of Frangensko Plateau is made for the first time. It is only the first step in a long series of studies required: mapping of the distribution, inquiry status, threats and prospects of the population, identify conservation measures within the protected areas and territories located in the plateau. The obtained data can be used as a basis for comparison with the data of the medicinal plants of different geographical sites in Black Sea coast floristic region and Northeastern Bulgaria floristic region.

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