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Original Contribution

COMPLEX ANALYSIS OF THE LIFE FORMS OF FLOWERING PLANTS IN MOUNT CHEPAN AND THEIR VERTICAL RANGES OF SPREAD IN ALTITUDE

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ABSTRACT

The distribution with altitude of every plant species gives an idea of its ecological plasticity. The life form of plants subsumes species, which have similarities in the complex of ecological conditions characteristic of their habitats. A model for doing a complex analysis of both indices was proposed and tested for the flora of Mount Chepan (Bulgaria). On the basis of complete inventory of the flora of Mount Chepan the life forms and the areas of spread in altitude of flowering plants were determined. All flowering plants of Mt Chepan were classified, according to their levels of distribution, with altitude into 21 groups, as proposed by Tashev. Every species was added to only one group, which described most exactly the borders of its spread in Bulgaria. The proposed model for complex analysis of the flora permitted most precise description and gave a clearer and accurate notion for the ecological conditions in the mountain. It made it possible to make a comparative analysis between the floras of different areas as well as investigate the dynamics of change of the same flora at different times.

Key words: flora, analysis of the flora, plant geography, areas of spread in altitude, floristics

INTRODUCTION

The distribution with altitude of every plant species gives an idea of its ecological plasticity The life form of plants subsumes species, which have similarities in the complex of ecological conditions characteristic of their habitats. The purpose of the present investigation is to do a complex analysis of both indices in order to determine the concrete ecological dependencies in the flora of Mount Chepan.

MATERIALS AND METHODS

Mt Chepan is situated in the north and the northeast of Dragoman town (Bulgaria). The altitude ranges from 700m at the foot of the mountain to 1206m at its highest point. The terrain is calcareous. This makes the soil naturally alkaline and provides the specific climatic and hydrological conditions.

Our unpublished data of the inventory of the flora of Mt. Chepan in the period 1998 – 2000 were used as the taxonomic basis of the analysis. The life forms were determined according to the classification of Raunkiaer [1]. All flowering plants of Mt. Chepan were classified into 21 groups proposed by Tashev and represented on **Table 3**, depending on the extent of their distribution with altitude and determined according to Conspectus of the Bulgarian Vascular Flora [2]. A complex analysis of these two indices was made. The percentage participation of every group of species was calculated in relation to the total number of flowering plants in the mountain. The participation of all life forms in every range of spread was calculated also. The distribution of the species from every range was represented as well within the framework of every one of the six life forms.

RESULTS AND DISCUSSION

Critical analysis of our data obtained in the 1998-2000 Mt. Chepan study enabled us establish the presence of 456 species and subspecies of flowering plants. We classified them into 21 groups according to their distribution with altitude. Every species was added to only one group, which described

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most exactly the borders of its spread in Bulgaria. The groups included ranges with extent of 500, 1000, 1500, 2000, 2500 and 2925 meters at intervals of 500 meters. The proposed 21 groups are represented on **Table 3**. Four of the groups do not fall into any of the flowering plants widespread in Mt. Chepan. Because of this we focused attention on the remaining 17 groups. The distribution of the species belonging to each of the 17 groups ranges in spread in altitude, depending on their life forms (in % from the total number of species from corresponding life form), is represented on **Table 1**.

Table 1. *Distribution of the species belonging to each of the 17 ranges of spread in altitude depending on their life forms (in % from the total number of species from corresponding life form)*

Ranges and Life forms	0-500 m	500-1000 m	1000-1500 m	1500-2000 m	0-1000 m	500-1500 m	1000-2000 m	1500-2500 m	0-1500 m	500-2000 m	1000-2500 m	0-2000 m	500-2500 m	1000-2925 m	0-2500 m	500-2925 m	0-2925 m	unclassified	Total
Ph	0	0	0	0	22.2	0	0	0	33.3	11.1	0	19.4	0	0	2.8	2.8	5.6	2.8	100
Ch	0	0	5	0	15	0	0	0	15	0	0	35	5	0	0	5	15.0	5	100
H	1.5	1.1	0.7	0	24.7	0.7	1.8	0.4	24.7	2.5	0.4	22.5	0.4	5.1	8.7	0.7	3.6	0.4	100
Cr	0	0	0	0	27.6	0	6.9	0	27.6	3.4	0	6.9	0	20.7	3.4	0	3.4	0	100
Th	3.9	0	0	0	44.7	0	0	0	35.3	0	0	6.6	0	2.6	2.6	0	2.6	1.3	100
Th-H	0	0	5	5	20	0	0	0	50	0	0	10	0	0	5	0	0	5	100

The phanerophytes (Ph) represent 7,9 % from all species and they are distributed in 7 ranges. Most are the species widespread in altitude from 0 to 1500 m – 33,3 % from all phanerophytes. After them with 22,2 % are the species ranging in altitude from 0 to 1000 m.

The chamephytes (Ch) represent 4,4 % from all species and they are also distributed in 7 ranges. Most are the chamephytes from the range 0 – 2000 m (35 %). Other 3 groups (0 – 1000 m, 0 – 1500 m and 0 – 2950 m) comprising 15 % share the second place.

The hemicriptopytes (H) are the numerous life forms in the flora of Mt. Chepan (60,3 % from all flowered plants). They include representatives from all ranges. Most hemicriptopytes are from the ranges of spread 0 – 1000 m and 0 – 1500 m (24,7 %). The second position with 22,5 % is for the group 0 – 2000 m.

The cryptophytes (Cr) represent 6,4 % from all flowering plants in Mt. Chepan and they are from 8 ranges of altitude. Compared to hemicriptopytes they are the most numerous and comprise 27,6 % of the species from the groups 0 – 1000 m and 0 – 1500 m. The second position with 20,7 % is for the cryptophytes widespread in the region, 1000 to 2925 m altitude.

The therophytes (Th) are the second numerically strong life forms and they represent 16,7 % of the flowering plants. The high presence of therophytes in Chepan, not typical for mountain floras, has attracted comments in our previous publications. This analysis suggests that they are present in 8 ranges of altitude. Most of the therophytes are distributed within 0 to 1000 meters altitude (44,7 %). The second place is also occupied by the therophytes spread within the range 0 – 1500 m.

The transitional group therophytes – hemicriptopytes (Th-H) represents 4,4 % among the flowering plants and it includes representatives from 7 ranges. Most are the species from the group 0 – 1500 m (50 %) and on the second position with 20 % is the group 0 – 1000 m.

For almost all life forms most numerous are the species from the ranges 0 – 1000 m and 0 – 1500 m. Within the framework of these ranges the ecological conditions are highly varied. In these groups fall species with high ecological plasticity, which are highly widespread in Bulgaria. The distribution of the flora of Mt Chepan of considerable quantity of species from the groups with much smaller extent of the ranges of spread in altitude testifies to the richness of different habitats in the mountain.

The distribution of the life forms of flowering plants in Chepan, depending on their ranges of spread in altitude (in % from the total number of species from the corresponding range), is represented on **Table 2**. The analysis of the data shows that the hemicriptopytes form the largest number of species distributed in all ranges of altitudes (from 20 % to 100 % from the total number of species from the corresponding range). These results are expected in view of the normal biological spectrum for the moderate latitudes in which the hemicriptopytes are the dominant life form. The second group in this same estimation comprises the therophytes

distributed in ranges (0 – 1000 m and 0 – 1500 m) with this percentage in the respective order, 27,2 % and 21,1 %.

Table 2. *Distribution of the life forms of flowering plants in Chepan depending on their ranges of spread in altitude (in % from the total number of species from the corresponding range)*

Ranges and Life forms	0-500 m	500-1000 m	1000-1500 m	1500-2000 m	0-1000 m	500-1500 m	1000-2000 m	1500-2500 m	0-1500 m	500-2000 m	1000-2500 m	0-2000 m	500-2500 m	1000-2925 m	0-2500 m	500-2925 m	0-2925 m	unclassified
Ph	0	0	0	0	6,4	0	0	0	9,3	33,3	0	8,2	0	0	3,4	25	11,1	20
Ch	0	0	25	0	2,4	0	0	0	2,3	0	0	8,2	50	0	0	25	16,7	20
H	57,1	100	50	0	54,4	100	71,7	100	53,1	58,3	100	72,9	50	63,6	82,8	50,0	55,6	20
Cr	0	0	0	0	6,4	0	28,6	0	6,3	8,3	0	2,4	0	27,3	3,4	0	5,6	0
Th	42,9	0	0	0	27,2	0	0	0	21,1	0	0	5,9	0	9,1	6,9	0	11,1	20
Th-H	0	0	25	100	3,2	0	0	0	7,8	0	0	2,4	0	0	3,4	0	0	20
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 3 shows the complex distribution of the flowering plants in Mt. Chepan depending on their ranges of spread in altitude and their life forms. In the same Table are presented data for the number of species from every group as well as for their percentage distribution in relation of the total number of flowering plants in Chepan (456 species). As is evident, the mass of species widespread in Chepan is from the range 0 – 1500 m. After this comes the flowering plants with 27,4 % with the range 0 – 1000 m; and in the third position with 18,6 % is the range 0 – 2000 m. As we mentioned already, four groups could not be adequately placed. This is normal, since these ranges do not include the altitudes of the mountain.

According to both examined indices the hemicriptopytes are the most numerous in distribution in Mt Chepan (14,9 % of the flowering plants) and are found within two ranges: 0 – 1000 m and 0 – 1500 m. The other hemicriptopytes in the range 0 – 2000 m come next with 13,6 %. The third and fourth positions are occupied by two forms of therophytes in the ranges of 0 – 1000 m (7,5 %) and 0 – 1500 m (5,9 %).

CONCLUSIONS

The proposed model for complex analysis of the flora of both indices – ranges of spread in altitude and life form permits most precise description and gives clearer and accurate notion for the ecological conditions in the mountain. The high distribution of therophytes in Mt Chepan commented on in our previous publications is not typical for mountain floras. The complex analysis shows that the therophytes in Chepan are mainly found in heights with ranges 0 – 1000 m (44,7 %) and 0 – 1500 m (35,3 %), i.e. species with high ecological plasticity.

Our results have shown that it is possible to use this model to make a comparative analysis between the floras of different areas, as well as to investigate the dynamics of change of the same flora at different times

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Table 3. *Complex distribution of the flowering plants in Mt Chepan depending on their ranges of spread in altitude and their life forms according to classification of Raunkiaer*

Ranges of spread in altitude and life forms according to Raunkiaer		**0-500 m**	**500-1000 m**	**1000-1500 m**	**1500-2000 m**	**2000-2500 m**	**2500-2925 m**	**0-1000 m**	**500-1500 m**	**1000-2000 m**	**1500-2500 m**	**2000-2925 m**	**0-1500 m**	**500-2000 m**	**1000-2500 m**	**1500-2925 m**	**0-2000 m**	**500-2500 m**	**1000-2925 m**	**0-2500 m**	**500-2925 m**	**0-2925 m**	**unclassified**	**Total**
Ph	Number of species							8					12	4			7			1	1	2	1	**36**
	% from 456							1,8					2,6	0,9			1,5			0,2	0,2	0,4	0,2	**7,9**
Ch	Number of species			1				3					3				7	1			1	3	1	**20**
	% from 456			0,2				0,7					0,7				1,5	0,2			0,2	0,7	0,2	**4,4**
H	Number of species	4	3	2				68	2	5	1		68	7	1		62	1	14	24	2	10	1	**275**
	% from 456	0,9	0,7	0,4				14,9	0,4	1,1	0,2		14,9	1,5	0,2		13,6	0,2	3,1	5,3	0,4	2,2	0,2	**60,3**
Cr	Number of species							8		2			8	1			2		6	1		1		**29**
	% from 456							1,8		0,4			1,8	0,2			0,4		1,3	0,2		0,2		**6,4**
Th	Number of species	3						34					27				5		2	2		2	1	**76**
	% from 456	0,7						7,5					5,9				1,1		0,4	0,4		0,4	0,2	**16,7**
Th-H	Number of species			1	1			4					10				2			1			1	**20**
	% from 456			0,2	0,2			0,9					2,2				0,4			0,2			0,2	**4,4**
Total	Number of species	**7**	**3**	**4**	**1**	**0**	**0**	**125**	**2**	**7**	**1**	**0**	**128**	**12**	**1**	**0**	**85**	**2**	**22**	**29**	**4**	**18**	**5**	**456**