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INVESTIGATION OF SOME STRUCTURAL AND FUNCTIONAL PARAMETERS OF AN OAK FOREST FROM THE NORTH-EAST RHODOPA MOUNTAINS

Mariana LJUBENOVA

Department of Ecology and Environment protection University of Sofia, Faculty of Biology D. Tzankov bvd., 8-1421, Sofia

ABSTRACT

Ljubenova, M, (1996). Ingestigation of some structural and functional parameters of an oak forest from North-East Rhodopa Mountains, Ekol, Zašt, Život, Sred., Vol. 4, No. 1, Skopje.

Nowadays, humanity gets more and more conscious of the fact that condition of the biosphere, as well as further existence of man are determined by the condition of our planet vegetation cover. The study of space and functional structure of the vegetation associations is a basic precondition for increasing the biological productivity, the stability of the biogeocoenoses and their importance for the healing of the ecological environment in separate districts as well as of the Earth as a whole.

The object of this study are some structural (species, composition, plenitude, numbers of the cenopopulations, layer structure of the phytocoenose, layer and functional structure of the phytomass) and functional (overground annual production, dynamics of wood accumulation, net assimilation, intensity of the biological turnover) parameters of a xerothermal association from the North-eastern Rhodopa mountains.

Key words: oak forest, layer and fractional structure, primary production, biomass, biological turnover, dynamics of wood accumulation, net assimilation.

ИЗВОД

Љубенова, М. (1996). Истражувања на некои структурни и функционални параметри на дабова шума од североисточните Родопи. Екол. Заšт. Живот, Сред., Том 4, Бр. 1., Скопје,

Човештвото денеска станува се посвесно за фактот дека состојбата на биосферата, а и понатамошниот опстанок на човекот се одредени од состојбата на растителниот покров на нашата планета, Проучувањето на просторната и функционалната структура на растителните заедници е основен предуслов за зголемување на биолошката продуктивност, стабилноста на биогеоценозата и нивното значење за унапредувањето на животната средина во одделни региони, но и на Земјата во целина.

Предмет на ова истражување се некои структурни (видови, состав, богатство, број на ценопопулации, структура на катовите на фитоценозата, катова и функционална структура на фитомасата) и функционални (годишна надземна продукција, динамика на пораст на дрвната маса, нето асимилација и интензивност на биолошкото кружење) параметри за ксеротемната асоцијација од североисточниот дел на родопскиот масив,

Клучни зборови: дабова шума, катова структура, примарна продукција, биомаса, биолошко кружење, динамика на акумулација на дрво, нето асимилација.

OBJECT OF THE STUDY

Quercus frainetto phytocoenose was studied, covering a surface of 11.2 ha on the land of the village of Virbovo, near the town of Harmanli, Haskovo district The forest is situated in the upper part of a hill, sloping at 6°, facing west-noith-west and at 300 m above the sea level,
The soils are chromic luvisols (Пенков 1992). Concerning the climate, the region pertains

to the Down Maritza river, Down Tundja river climatic region, which belong to South Bulgarian climatic sub region with Mediterranean climatic influence, being part of the continental Mediterranean climatic region (Тишков 1982; Fig 1). The humidity factor appears as limiting for the phytocoenose under investigation and determines its xerophitic character.

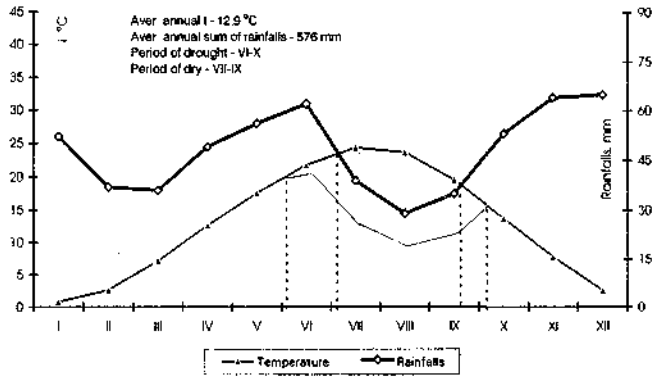

Fig. 1 Ombrothermal diagram of the region
Сл. 1 Омбротермички дијаграм на регионот

METHODS

The evaluation of the ove ground phytomass and the annual production is done after the methodological directions of Newbould (1967), Родин et all. (1968) and Молчанов and Смирнов (1967) The study was carried out on a representative experimental plot covering 0.25 ha of the association. The sample trees (3 samples *Q. frainetto* and 1 *Q. cerris)* are representative of classes with equal sums of the sections of trunks at 1.3 m (Молчанов and Смирнов 1967) and were cut in 1995. The periodic growth of the trunks and the perennial branches are calculated using the complex and simple Hubber's formula (Илиев 1980) respectively. The leaves surface of the tree layer is determined with the aid of the weight method (Молчанов and Смирнов 1967) and the net assimilation (An) after formula of Gregory (Jlapxep 1978). In the evaluation of the over ground phytomass and the annual production of the bush layer sample bushes have been used (3 numbers of each species), determined by measuring the height and the diameter - in the middle of the first level branches. The aboveground phytomass and the net annual production of the herb layer are determined after the method of experimental surfaces (Родин et all. 1968) for a two years period, and because of the significant homogeneity and the horizontal structure of the layer, 6 sample surfaces have been used, each one of them covering 0.25 m^2.

The quantity of the annual litter fall in the phytocoenose was testimated by 10 litter traps with a surface of 1 m^2 each, the litter collected 4 times a year for a period of 2 years. The mulch reserves were calculated after the method of Смольнов and the intensity of the biological turnover - by means of the litter fall-mulch coefficient (a) and the use of the 10 forces scale of Базилевич (after Воробьов 1967). The oxygen produced annually by the phytocoenose under study is evaluated using the data of the net abovegr ound phytomass production after Одум (1975). The phytomass units were expressed as absolutely dry weight. The data were statistically processed.

RESULTS AND DISCUSSION

The forest under study consists of offshoots, from 3 bonitation, canopy 0.8-0.9; fullness - 0.9; average age 56.5 years; average height of trees -13.5 m and average diameter of the trunks - 15.7 m. The vegetation species and the phytocoenose structure are given in Table 1. The average parameters of the model of *Quercus cerris L.* are: d – 16.4 cm; h - 14.2 m and age - 53 years. By *Q, frainetto Ten.* trees of 1 class prevail (d - 13 cm, h - 13.2 m and age 55 years) - 29.6%. The contribution of the second class trees (d -17 cm; h -13 m and age of 53 years) is weaker - 20,6% of the numbers of *Q. frainetto Ten* The bush layer covers 1.5%, the young undergrowth of *Carpinus orientalis Mill,* and *Sorbus torminalis (L.) Crantz-* prevailing. It is interesting to note that the contribution of young undergrowth of *Fraxinus ornus L.* is much greater (2.96%) than that of the undergrowth of the edificatory species *Q frainetto Ten.:* 0.25% of the total amount of the layer.

Tab. 1 Composition of the species
Таб. 1 Состав на видовите

Layer distibution of species Распоред на видовите по катови	Number Бројност per ha / на ha	%
Tree layer / кат на дрвја	820	100.00
Quercus cerris L.	28	3.42
Q. frainetto Ten.	792	96.58
Bush layer / кат на грмушки	4862	100.00
Carpinus orientalis Mill.	3564	73.30
Crataegus monogyna Jacq.	35	0.72
Fraxinus ornus L.	144	2.96
Querqus frainetto Ten.	12	0.25
Sobrus torminalis (L.) Crantz	1107	22.77
Herb layer / тревест кат	33	100.00
Grass species/треви	2.15	6.52
Brachypodium pinnatum (L.) Beauv.	0.3	0.91
Cynosurus echinatus L.	0.1	0.30
Dactylis glomerata L.	0.3	0.91
Festuca heterophylla Lam.	0.1	0.30
Melica uniflora Retz.	0.1	0.30
Poa compressa L.	1.25	3.79
Sedges / ципераци	0.1	0.30
Carex cuspidata Host.	0.1	0.30
Legumes species / легуминози	1.25	3.79
Chamaetytisus hirsitus (L.) Link.	0.5	1.52
Trifolium alpestre L.	0.75	2.27
Mixoherbosa / разни тревести	21.25	64.39
Allium rotundum L.	1.00	3.03
Calamintha sylvatica Bromf.	0.4	1.21
Centaurea phrigia L.	0.2	0.61
Crocus flavus West.	0.5	1.52
Dianthus cruentus Grsb.	1.1	3.33
Fragaria viridis Duch.	0.4	1.21
Galium aparine L.	0.2	0.61
Galium schultesii West.	0.15	0.45
Hieracium echioies Lumn.	0.8	2.42
Hieracium praeltum ssp. bauchinii (Best) Petun	0.2	0.61
Hieracium racemosum W. et K.	1.00	3.03
Hypericum montbretti Spach.	0.1	0.30
Hypericum olimpicum L.	1.1	3.33
Hypericum perforatum L.	2.45	7.42
Inula hirta L.	1.15	3.48
Lactuca seriolla L.	0.35	1.6
Lamium purpurem L.	0.3	0.91
Lapsana communis L.	0.95	2.88
Leontodon cichoraceus Ten.	0.5	1.52
Muscari bothrydes (L.) Mill.	2.2	6.67

Tab. 1 Continuation
Таб. 1 Продолжение

Layer distibution of species Распоред на видовите по катови	Number Бројност	%
	per m² / на m²	
Myosotis arvensis (L.) Hill.	0.1	0.30
Physospermum cornubiensis (L.) DC	0.30	0.91
Prunella vulgaris L.	0.25	0.76
Ranunculus ficaria L.	1.90	5.76
Silene viridiflora L.	0.2	0.61
Tanacetum corymbosum (L.) Schultz-Bip	0.5	1.52
Tamus communis L.	0.3	0.91
Taraxacum erythrospermum Andrz ex Bess.	0.1	0.30
Teucrium chamaedrys L.	0.05	0.15
Thymus atticus Celak	1.5	4.55
Thymus striatus Vahl	0.7	2.12
Viola reichenbachiana Jord ex Boreau	0.2	0.61
Sprouts / изданоци	8.25	25.00
Cornus mas L.	0.1	0.30
Crataegus monogyna Jacq.	0.1	0.30
Rosa canina L.	0.05	0.15
Rosa gallica L.	0.3	0.91
Rubus canescens DC	0.15	0.45
Acer monospessulanum L.	0.65	1.97
Carpinus orientalis Mill	0.6	1.82
Fraxinus ornus L.	3.6	10.91
Quercus frainetto Ten.	1.5	4.55
Sorbus domestica L.	0.3	0.91
Sorbus torminalis (L.) Crantz	0.5	1.52
Tilia tomentosa Moench.	0.4	1.21

The herb layer is very well developed, with 95% cover. The group of mixoherbosa sp. dominates in number (64.39%) Sprouts of 5 tree and 7 bush species (25% of the total amount) have been established, the *Fraxinus ornus L.* sprouts prevailing (10.91%) The total aboveground phytomass of the phytocoenose studied is 194.376 $t \cdot ha^{-1}$, i.e. the vegetation community refers to 7 force (from

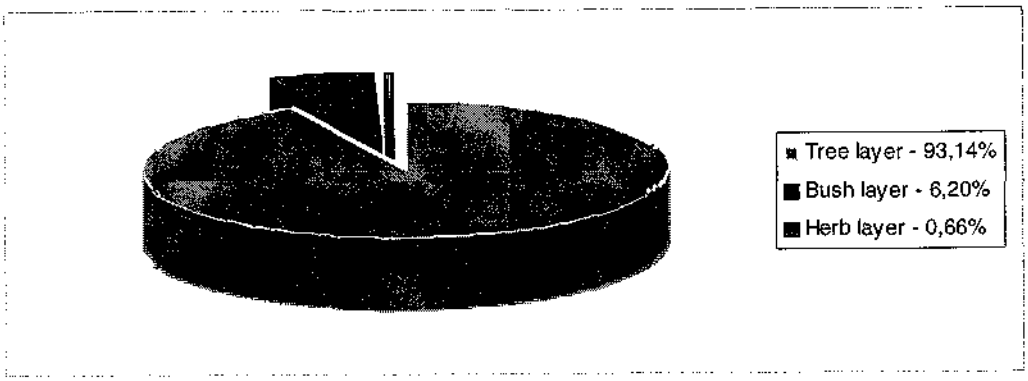

Fig. 2 Layer phytomass distribution (%)
Сл. 2 Распоред на фитомасата по катови (%)

ten possible forces) in the scale of Базилевич. The phytomass distribution in layers is given in Fig.2. The biomass of the tree layer (181.028 t ha^{-1}) is formed mainly by *Q.frainetto Ten* (95.73%. Its distribution in fractions is given in Fig, 3.1. It is interesting to note that the quantity of the dry mass is significant in the layer (27.4%). The contribution of bark and one year branches phytomass is lower compared to other tree layers (Любенова 1995) and that of the tree leaves fraction is within the ranges cited in literature (Базилевич and Родин 1971). The total aboveground phytomass of the bush layer is 12.056 tha^{-1}, in which *Carpinuus orientalis Mill,* prevails - 97.78%. The contribution of *Sorbus torminalis (L.) Crantz.* (0.79%) is weaker, although it dominates in numbers and the contribution of *Fraxinus ornus L.* is 0 84% and the *Q, frainetto Ten.* - 0.49%, The prevalence of the fraction of perennial branches (6.05%) and the weak contribution of the leaves fraction, dry mass and annual branches (Fig. 3.2.) express a structure, characteristic for xerophytic bush communities The calculated phytomass of the herb layer is 1 283 0.651 tha^{-1} More than a half of it (54.39%) is concentrated in the sprouts of the tree species, mainly in *Carpinus orientalis Mill,* and *Fraxinus ornus L* The grass species predominate in the phytomass of herb species - 45.61% (Fig. 3.3).

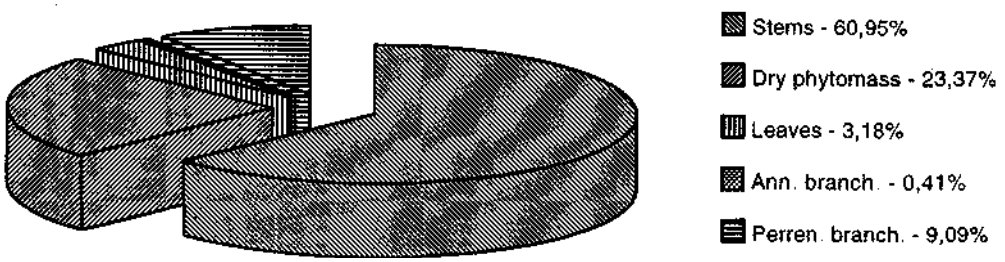

Fig. 3.1, Tree layer / Кат на дрвја

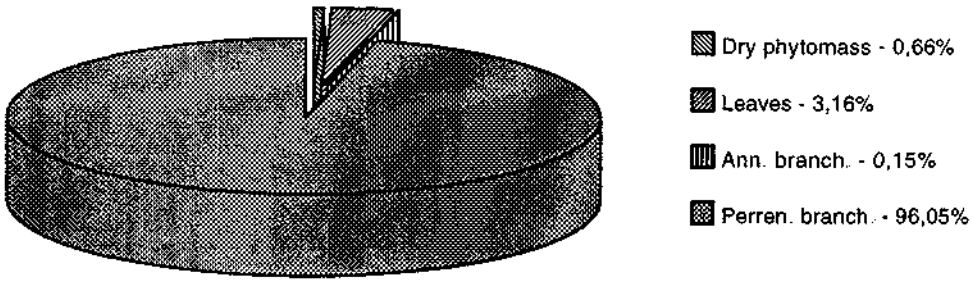

Fig. 3.2. Bush layer/ Кат на грмушки

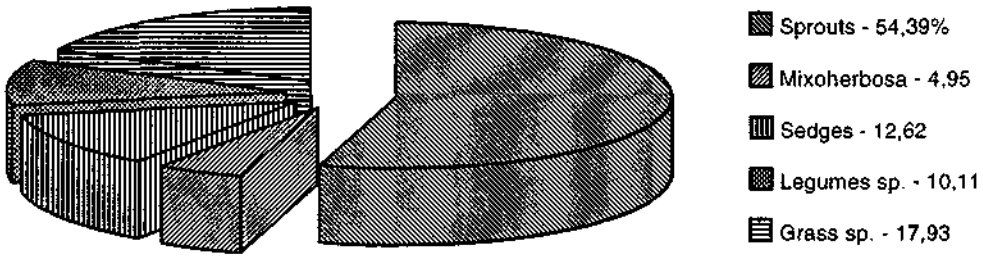

Fig. 3.3. Herb layer/ Приземен кат

Fig 3 Layer phytomass distribution in fraction (%)
Сл 3 Распоред на фитомасата на катовите по фракции (%)

The total aboveground of phytomass for the phytocenose is established to be 13.495 $t \cdot ha^{-1}$, i.e. 6.94% of the reserves are annually renewed (6%, 10.6% ad 90% for' the tree, bush and herb layer respectively). After the classification of the vegetation communities according their production (Базилевич and Родин 1971), the phytocoenose refers to the average productive communities (7 force of ten possible forces), the decidious forest communities pertaining to this group. The annual production of oxygen of a forest community is 18 $t \cdot ha^{-1}$. The distribution of the annual production in layers is given at Fig. 4. The *Q frainetto Ten.* contributes with 96.63% to the annual production of the tree layer (11.097 $t \cdot ha^{-1}$), which is similar to its contribution to above'ground phytomass reserves The contribution of the leaves phytomass and the branches in the annual production is respectively 16 and 3 times greater that the contribution of these fractions to the aboveground phytomass and the contribution of the bark phytomass - about 3 times lower. The wood production is about 5 times greater than the bark production (Fig. 5.1)

The annual production of the bush layer is 1.272 $t \cdot ha^{-1}$. The contribution of *Carpinus orientalis Mill,* is the greatest - 96.24%. The annual growth of the other species is insignificant: *Fraxinus ornus* - 1.6%; *Sorbus torminalis (L.) Crantz,* -1.73% and *Quercus frainetto Ten* - 0.24%.

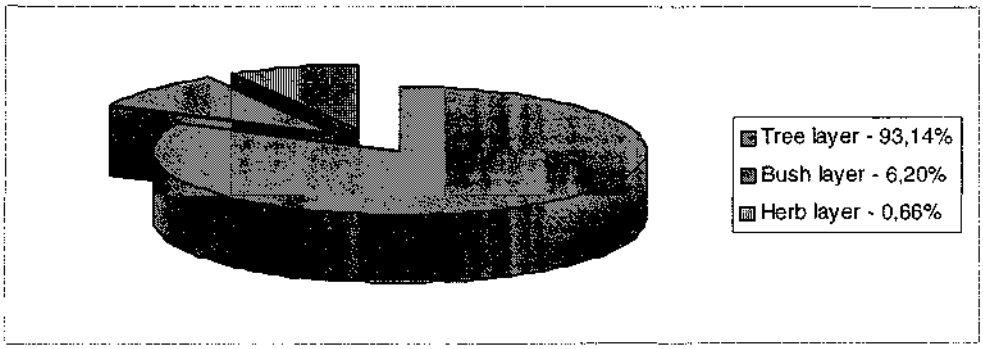

Fig. 4 Layer annual productions distribution (%)
Сл. 4 Распоред на годишната продукција по катови (%)

The fraction distribution of the annual production of the layer is represented in Fig. 5.2.

The annual production of the herb layer is 1.166 $t \cdot ha^{-1}$, herb species and sprouts forming about 50% of it (Fig 5.3). The contribution of agro-biological groups to the layer production is similar to their contribution to the phytomass: grass species -19.73%; sedges -13.88%; legumes sp. -12% and mixoherbosa - 5.44%.

The forest reaches its maximum in wood accumulation at the age of 40-50 years, the reserves growing with 18% (Fig. 6). The average annual growth normally decreases and at age of 55-60 it is 2.7%, i.e. the forest has reached its functional maximum. The dynamics of wood accumulation in the two tree species reflects their competition for the habitation conditions. It is better for *Q cerris L,* at the age of 15-20, 30-40 and 50-60 years, and for the *Q. frainetto Ten,* - respectively at the age of 25-30, 40-50 and 60-65 years. The absolute maximum of wood accumulation in the community (3.55% annual growth) for the *Q frainetto Ten.* is observed at the age of 45-50 years. The average annual growth for all periods is higher for *Q, cerris L.* as compared with *Q. frainetto Ten.* - 1.96% and 1.73% respectively, which is connected with the ecological and biological features, but the xerophyting condition of the habitation put it in a position of co dominant in the tree layer.

The leaves surface of the tree layer is $5.994 \cdot 10^6$ $dm^2 \cdot ha^{-1}$, Q. frainetto contributing with 97.6% in it. The calculated An is 0.005 $g \cdot dm^{-2}$ per day, i.e. it is lower than that cited by JIapxep (1976) for decidous forests. The annual litter fall in the association under study is 6.030 3.217 $t \cdot ha^{-1}$ and the mulch reserves are 11.858 1.995 $t \cdot ha^{-1}$, i.e. about 50% of the mulch is annually renewed through the fall.

According it is total intensity, the biological turnover in the phytoceonose is hindered, being at the 6-th force (α- 1.97 - Воробьов 1967). The intensity that was obtained is characteristic for the zone deciduous forests.

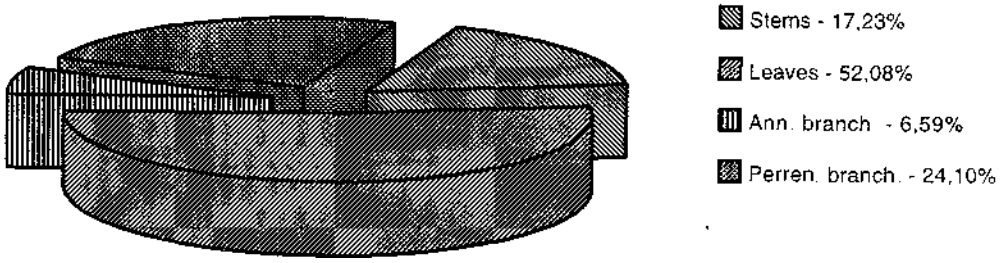

Fig. 5.1. Tree layer / Кат на дрвја

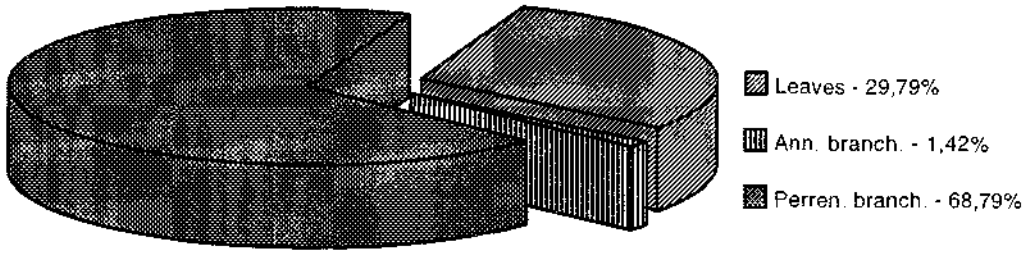

Fig. 5.2. Bush layer / Кат на грмушки

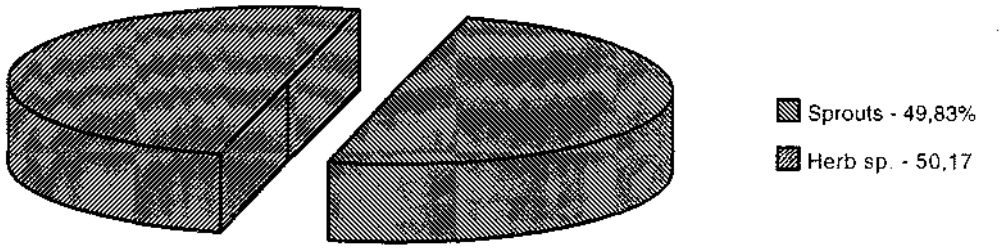

Fig. 5.3. Herb layer/ Приземен кат

Fig. 5 Annual production distribution in fractions (%)
Сл. 5 Распоред на годишната продукција по фракции (%)

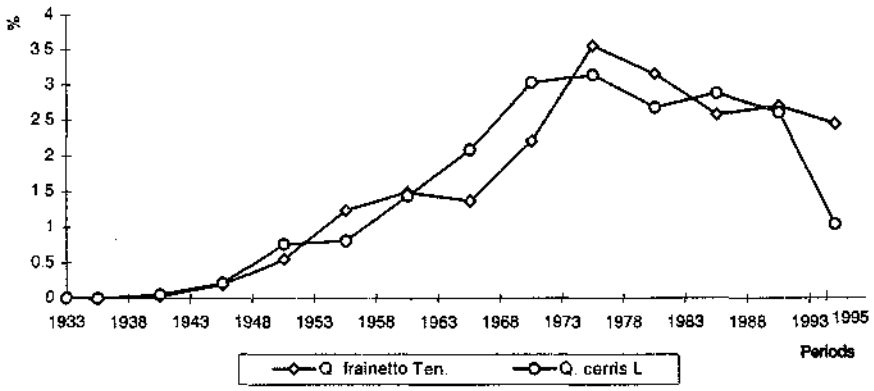

Fig 6 Average annual wood accumulation (%)
Сл. 6 Просечна годишна акумулација на дрвесина (%)

CONCLUSIONS

1. The calculated phytomass reserves are lower than the average for similar xerothermal forest phytocoenoses which were studied in five regions of our country and are close to those established for a 43 years old forest from the Zemen mountain and for a 53 years old forest from the West Balkans (Льобенова 1995), which grow respectively on Hromic luvisols (vertic) and pianosols In three cases mentioned the phytoceonoses are situated on hills with varying slopes, the soils are shallow and the anthropogenic activity is strongly expressed.

2. The structure of the phytomass in fractions and layers shows an unstable condition of the forest phytocoenose: presence of a great amount of dry mass - 27.4% and low contribution of the fractions of one-year old and perennial branches (respectively 0.5% and 9%) in the tree phytomass; prevalence of the fraction of perennial organs in the bush layer phytomass and that of *Carpinus orientalis Mill.* (98%) and a significant contribution of the undergrowth of *Fraxinus ornus L.* -1%; prevalence of the sprouts (54.4%), mostly of tree species (51.8%), and most of all of *C, orientalis Mill,* and *F. ornus L,,* as well as this of grass species (17.9%) and sedges in the phytomass of the herb layer.

3. The plant community under study has a lower annual production (13.5 $t \cdot ha^{-1}$ abs dry phytomass and 8 $t \cdot ha^{-1}$ oxygen) than the average of similar communities in our country and it refers to the average productive communities at 6-th force (Базилевич and Родин 1971).

4. The established net assimilation (0.005 $g \cdot dm^{-2}$ per day) is lower than that cited for deciduous trees.

5. The average annual growth has decreased from 3.5% to 2.4% for the last period, i.e. the forest has reached its functional maximum in wood accumulation.

The structural and functional parameters of the forest phytocoenose under study show that successive changes are under way in the community, leading to its further xerophyting The present condition of the vegetation component is unstable and does not reflect the potentialities of the habitation.

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ИСТРАЖУВАЊА НА НЕКОИ СТРУКТУРЕНИ И ФУНКЦИОНАЛНИ ПАРАМЕТРИ НА ДАБОВА ШУМА ОД СЕВЕРОИСТОЧНИТЕ РОДОПИ

Маријана ЉУБЕНОВА

Катедра по екологија и заштита на животната средина, Универзитет во Софија, Биолошки факултет, Бул. Д. Цанков, 8-1421, Софија

РЕЗИМЕ

Во разгледуваната фитоценоза (просечна старост од 57 години, покровност 0.8, 0.9; висина 13.5 m; дијаметар на стеблата 15.7 cm) со *Quercus frainetto Ten,* како едификатор беа проучувани нејзините структурни и функционални параметри. Фитоценозата се наоѓа во близина на градот Харманли, Хасковски регион и го покрива горниот дел од ридот на 300 м.н.в., со падина од 6°, северна-северозападна експозиција.

Почвата е хромичен лувисол. Во однос на климата, регионот припаѓа кон јужниот бугарски климатски потрегион со медитеранско климатско влијание - средна годишна температура од 12°C и среден годишен талог од 567 mm.

Особеностите на одделните структурни параметри: сигнификантна количина на сува маса (27,4%, помал процент едногодишни и постарите гранки (0.5% и 9% соодветно) во катот на дрвја на фитоценозата (181,03 $t \cdot ha^{-1}$); висок процент на трајни органи (96%) во фитомасата на катот на грмушки (12,6 $t \cdot ha^{1}$) и застапеност на групата тревести видови иципераци (17,0% и 12,6% соодветно) во фитомасата на катотна приземнатавегетација (1,28 $t \cdot ha^{-1}$); преовладување на фитомаса на *Carpinus orientalis Mill,* и *Fraxinus L.* во подлесокот (98% и 1% соодветно) и доминација на изданоците на дрвенестите видови (главно од двата спомнати видови) во фитомасата на приземниот кат. Особеностите на одделните функционални параметри: пониски вредности на резервите на фитомаса (194,4 $t \cdot ha^{-1}$), годишна продукција (13,5 $t \cdot ha^{-1}$), нето асимилација (0,005 $g \cdot dm^{-2}$ на ден), средно годишен пораст на дрвесина, кое е помало за 1% од максимумот, споредено со други слични фитоценози, покажува дека промени на сукцесија што се одвиваат во заедницата, а водат кон натамошно зголемување на ксерофитноста. Моменталната состојба на растителната компонента е нестабилна и не го покажува потенцијалот на биотопот.