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ABOVEGROUND PHYTOMASS AND PRODUCTION IN THE SHRUB LAYER OF THE CHESTNUT (*CASTANEA SATIVA* MILL.) COMMUNITIES IN THE BELASITSA MOUNTAIN

Violeta Dimitrova [1], Marjana Lubenova [2], Svetla Bratanova – Doncheva[1]

[1]CentralLaboratory of General Ecology – Bulgarian Academy of Sciences 2 Gagarin Street, 1113 Sofia, Bulgaria
[2]University of Sofia, Faculty of Biology,Department of Ecology 8 Dragan Tzankov Blvd, 1164 Sofia, Bulgaria
****Corresponding author: Sv. Bratanova – Doncheva, e-mal: svbratan@ecolab.bas.bg***

ABSTRACT. The aboveground phytomass and production of the shrub layer of three representative for the chestnut formation experimental plots in the region of Belasitsa mountain was investigated. A comparative analysis between data for century old seed stands and young sprout stands with different sylvicultural management was made.

KEY WORDS. chestnut (*Castanea sativa* Mill.), shrub layer, phytomass, annual production

INTRODUCTION

A tendency towards worsening of the status of the chestnut stands in Bulgaria manifested by drying-up, defoliation, development of semi-parasites, diseases and pests has been observed in the last years. This was the reason for initializing investigations of the structure and the functioning chestnut communities aimed at revealing of the main factors responsible for their state (Bratanova – Doncheva, Mihailov, 1995; Bratanova – Doncheva at al., 2002; Lyubenova at al. 2002; Batanova – Doncheva, 2003 and others.).

Bioproductivity is one of the basic indicators for assessment of the functioning of the communities. The existing information in the literature indicated that when the forest community productivity was studied the main attention was paid to the tree layer.. Quite few are the data for the shrub layers. Studies in Bulgaria were carried

out by Lyubenova and Bondev (1999) for linden – turkey oak forests; Lyubenova and Bondev (1998), Bondev and Nikolov (1983) and Meshinev and Nikolov (1986) in the oak forests. Different authors have studied the bioproductivity and phytomass of the shrub layer in different forests, i.e. Cutini (2000), Rapp (1995), Gallardo et al. (2000), Santa Regina et al. (2000), who stresses to litter fall, the content of a litter and nutrient cycles; Chen Xia – Lin investigated the stores of phytomass of the main shrub species in mountain Taue, China; Melanholin (2002) examined the application of the phytomass of the shrub and the herb layer as indicator for the purpose of monitoring; Griazkin (2003) assessed the potential stores of phytomass in the forests in the region of St. Petersburg.

The aim of the present investigation is to establish the phytomass stores and to give quantitative assessment of the productivity of the shrub layer in chestnut communities as an indicator of the state of the chestnut forests.

MATERIAL AND METHODS

1. Object of the investigation

The object of the investigation is a chestnut formation on the north slopes of Belasitsa. It occupies an area of 1460 ha and is situated at about 250 –900 m above sea level. The chestnut forests belong to the native vegetation of the country. They are mesophytic in character and the optimum of development of the species lies within the hornbean belt. Its communities usually border on those of the beech wood belt.

The experimental plots are set in different in forests of different age with different sylvicultural management having been taken up in them: century old seed forest without any sylvicultural actions (plot 2) and young coppice where sylviculture actions with different intensity were undertaken (plot1, plot3). Their full characteristics are given in Table 1.

Table 1. Characteristics of the experimental plots.

Characteristics	**Plot I**	**Plot II**	**Plot III**
Area	0,25 ha	0,20 ha	0,20 ha
Elevation	750	650	500
Slope	17°	28°	23°
Exposure	NE	E	NW
Part of slope	top	lower	top
Soil	Cambisols, CMx	Cambisols, CMx	Cambisols, CM
Composition of the tree layer, site index	Chestnut 10 2 subfloors, site index II	Chestnut 9, beech 1 3 subfloors, site index IV-V	Chestnut 10 2 subfloors, site index I
Origin	Artificial	Natural	artificial
Age	45 г	180 г	45 г
Canopy	0.7	0.8	0.5
Association	*Castanetum – Mixoherbosum*	*Castanetum – Mixoherbosum*	*Castanetum – Mixoherbosum*
Sylvicultural action	Cuttings 30 years ago.; sanitary felling	without	Cuttings 30 years ago.; selective felling 15 years ago.

The experimental plots for studying the structure and function were s-up in the ass.*Castanetum – Mixoherbosum* because it is the most widely distributed association in the chestnut formation.

The plant species and in the three phytocoenoses formed 3 floors. The tree layer had complex form, with edificator *Castanea sativa* Mill. and *Quercus dalechampii* Ten. (plot 2); *Tilia plathyphyllos* Scop., *Ulmus minor* Mill. (plot1) and *Fagus sylvatica* L. (plot 2) were met singly. The canopy varies between 0,7, 0,8 и 0,5 accordingly for 1, 2 и 3 plots. In 1 and 3 plots the tree floor was formed from two subfloors, in plot 2 – by three and the participation of the *Carpinus orientalis* L. and *Carpinus betulus* Lam. was increased.

There were not a dominant in the shrub floor. The participation of the regrowth of *Castanea sativa Mill.* is more significant – average (3,1,III). *Cornus mas* L., *Corylus avellana* L., *Crataegus monogyna* Jacg., *Rosa canina* L.and *Rubus caesius* L. are meet singly in all plots.

The herb floors are with mosaic structure and coverage10 – 40% (plots 2 and 3) and 10 – 20% (plot1). The group of mixoherbosa is prevailing in all plots. The species *Dactylis glomerata* L. and *Melica uniflora* Retz are prevailing from the grass species, from the ferns – *Pteridium aquilinum* (L.)Kuhn. The species as *Genista ovata* W.K. и *Lathyrus laxiflorus* (Desf.)O.Kuntze (+,1, I) are typical for all plots from the legume species, from mixoherbosa – *Primula acaulis* (L.) L. и *Viola odorata* (1,2,II) (Lyubenova at. al., 2003).

2. Methods

Samples were taken in October 2003, a single time. The length and diameters of all branches of all shrubs from each species were measured on the plots. The average model branch from each degree of thickness (between 2 cm) for every species was chosen. It was separated on fractions: leaves, twigs, branches and they were weighted in fresh and absolute dry weight. The material was dried 48 h at temperature 102 C°. The production and phytomass stores in the shrub floor were calculated by method of Rodin (1968).

RESULTS AND DISCUSSION

The shrub floor is represented by 8 species of understory and 13 species of regrowth. The average quality phytomass in the shrub floor is 560 kg/ha, which is smaller than cited 4, 5 t/ha by Bazilevich (1986) about broad – leaved forests.

The phytomass was almost equally distributed between the uderstory (265 kg/ha) and regrowth (296 kg/ha). The average values for the three plots showed that *Castanea sativa* Mill. had the main participation – 236 kg/ha, i.e 42 % in formation of the phytomass store, followed by *Corylus avellana* L.- 220 kg/ha, i.e 39 %. The participation of the other species varied from 0,01 % (Sorbus aucuparia L.) to 5 % (*Carpinus orientalis* L.).

There was a smaller number of species in the old forests (plot 2) which however have ensured bigger phytomass. These forests had more significant stores of phytomass (plot 2 –782 kg/ha) compared with the young coppice (plot 1 – 352 kg/ha) – Table 2. It was established that in the young forests with more intensive sylviculture actions the phytomass was higher – 546,332 kg/ha because the cutting of the shrubs presents an opportunity for the chestnut sprout, which are prevailing, to develop more quickly.

In the young coppice (plot1 and plot 3) the phytomass of the understory was prevailing. In the old forest (plot 2) – phytomass of the regrowth is prevailing which means that when the forest is managed there are better conditions for its regeneration. In the young coppice where sylviculture actions were taken, the cutting of the shrubs and the reduced canopy had lead to more stonger development of the chestnut. The stores of phytomass of the species there were 66 – 80 %, while in the old forests it they were 1%. In the old forests the chestnut was displaced by *Corylus avellana* L. (83%) because it is more light-liking species.

The percent participation of the different fractions of phytomass in the shrub floor is showed in Fig.1 The highest accumulation of phytomass was in the branches – average 54 %, in twigs it was 17% and in leaves – 26 %. In all plots the ratio between the fractions was preserved.

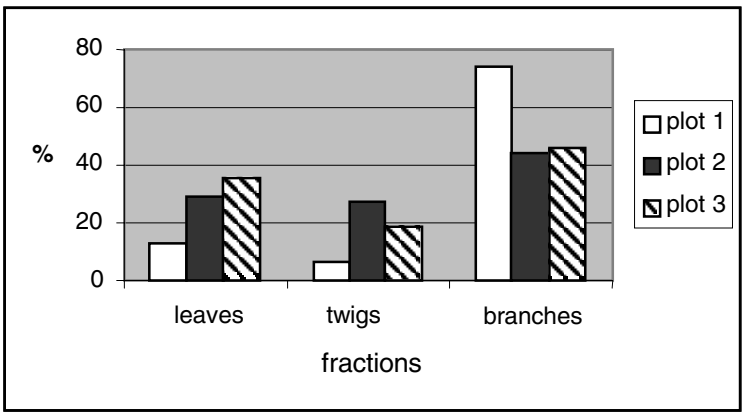

Fig.1. *Percent participation of the different fractions phytomass in the shrub floor of the chestnut coenosis.*

Table. 2. The reserves of phytomass in the shrub floor of the chestnut coenosis (kg/ha, a.d.w ;%)

Species	plot I					plot II					plot III				
	leaves	twigs	Branches	Total	%	leaves	twigs	Branches	Total	%	leaves	twigs	Branches	Total	%
arpinus orientalis L.	1.165	0.596	4.435	**6.196**	**1,8**	11.922	10.488	35.030	**57.439**	**7,3**	9.191	5.793	11.516	**26.503**	**4,9**
ornus mas L.	0.462	0.397	4.095	**4.953**	**1,4**	1.752	1.533	2.275	**5.56**	**0,7**	0.820	1.394	5.724	**7.937**	**1,5**
oronilla emerus L.											0.056	0.126	0.620	**0.802**	**0,1**
orylus avellana L.	1.949	0.808	3.377	**6.134**	**1,7**	200.379	190.956	261,586	**652,921**	**83,5**	0.336	0.141	0.928	**1.405**	**0,3**
rataegus monogina cg.	0.292	0.387	1.316	**1.995**	**0,6**						0.471	0.663	2.164	**3.299**	**0,6**
aburnum anagrioides edic.	3.164	2.280	4.997	**10.441**	**3,0**										
osa canina L.	0.565	0.789	6.178	**7.532**	**2,1**						0.673	0.463	1.820	**2.956**	**0,54**
rbus aucuparia L.											0.024	0.041	0.086	**0.150**	**0,03**
otal understory				**37,251**	**10,6**				**715,92**	**91,54**				**43,052**	**7,68**
cer campestre L.	0.351	0.061	1.494	**1.906**	**0,5**	0.190	0.192	0.969	**1.353**	**0,2**	0.013	0.004	0.048	**0.065**	**0,01**
cer platanoides L.	0.048	0.013	0.314	**0.375**	**0,1**										
cer pseudoplatanus	0.024	0.005	0.063	**0.092**	**0,03**						0.063	0.038	0.429	**0.679**	**0,1**
arpinus betulus Lam.	0.493	0.233	2.189	**2.915**	**0,8**	4.125	3.381	15.146	**22.652**	**2,9**	5.460	4.849	9.281	**19.592**	**3,6**
astanea sativa Mill.	20.051	10.490	206.398	**236.939**	**67,4**	0.677	0.568	8.678	**9.923**	**1,3**	169.265	84.762	207.693	**461.719**	**84,5**
agus sylvatica L.	0.303	0.165	0.928	**1.396**	**0,4**										
axinus åxcelsior L.						0.413	0.614	2.080	**3.107**	**0,4**					
axinus ornus L.	4.784	0.804	15.999	**21.587**	**6,1**	1,345	0,600	3.137	**5.082**	**0,6**	0.013	0.003	0.066	**0.083**	**0,02**
unus avium L.	0.737	0.185	4.038	**4,960**	**1,4**	3.568	2,081	5.930	**11.579**	**1,5**	5.904	4.133	8.879	**18.915**	**3,5**
unus cerassifera hrrh.	1.008	1.654	7.122	**9.784**	**2,8**										
obinia pseudoacacia	6.210	1.690	16.468	**24.368**	**6,9**										
orbus torminalis .)Cr.	0.652	0.162	1.334	**2.148**	**0,6**	0.720	0.416	1.021	**2.142**	**0,3**					
lia platiphylos Scop.	1.509	1.233	5.224	**7.966**	**2,3**	1.650	1.909	6.773	**10.332**	**1,3**	0.267	0.187	1.172	**2.227**	**0,4**
otal regrowth				**314,436**	**89,4**				**66,170**	**8,46**				**503,28**	**92,12**
otal	**43,77**	**21,952**	**258,97**	**351,687**	**100**	**226,74**	**212,738**	**342,625**	**782,09**	**100**	**192,556**	**102,597**	**250,426**	**546,332**	**100**

The average annual production of phytomass in the shrub floor was 303 kg/ha, as the participation of the understory /53 %/ prevaied insignificantly. This of the regrowth /47 %/ - Table 3. The most productive species was *Corylus avellana* L./45 %/, followed by *Castanea sativa* Mill. /37%/. From the other species the participation of *Carpinus orientalis* L. was bigger while the remaining species had a small share /between 2% and 0,01 %/.

The production in the old forests was highest (472 kg/ha in plot 2) and the participation of the regrowth was significantly less than that of the understory. In the young forests the production was between 109, 528 kg/ha for the stand where a sylviculture actions have been taken a longer time ago /plot 1/ and 326, 73 kg/ha for the forests with less intensive sylviculture actions /plot 3/. The regrowth was prevailing in them - Tabl.3.

It is impossible to make any conclusions about the productivity of the chestnut communities as a whole and also about their functioning on this stage because according to the scale of Bazilevich and Rodin /1971/ data on productivity of the tree floor must be also available. The results of this investigation will be used for further characterization and structural differenciation of the phytocoenosis.

Table. 3. Annual production in the shrub floors of the chestnut coenosis (kg/ha/y)

Species	***I***		***II***		***III***		***Average***
understory	***kg/ha***	***%***	***kg/ha***	***%***	***kg/ha***	***%***	***kg/ha***
Carpinus orientalis L.	2.318	2,1	26,882	5,7	17,154	5,2	16,777
Cornus mas L.	1,371	1,3	3,618	0,8	3,358	1,02	2,782
Coronilla emerus L.					0,389	0,1	0,130
Corylus avellana L.	3,540	3,2	410,089	86,8	0,641	0,2	138,09
Crataegus monogina Jacg.	0,880	0,8			1,759	0,5	0,880
Laburnum anagrioides Medic.	6,059	5,5					2,020
Rosa canina L.	2,591	2,4			1,503	0,5	1,365
Sorbus aucuparia L.					0,086	0,03	0,029
Total understory	**16,759**		**440,589**		**24,890**		
regrowth	***kg/ha***	***%***	***kg/ha***	***%***	***kg/ha***	***%***	***kg/ha***
Acer campestre L.	0,661	0,6	0,577	0,1	0,033	0,01	0,424
Acer platanoides L.	0,167	0,2					0,056
Acer pseudoplatanus L.	0,045	0,04			0,358	0,1	0,134
Carpinus betulus Lam.	1,091	1	9,753	2	11,552	3,5	7,465
Castanea sativa Mill.	55,260	50,4	3,415	0,7	276,867	84,7	111,847
Fagus sylvatica L.	0,678	0,6					0,226
Fraxinus excelsior L.			1,678	0,4			0,559
Fraxinus ornus L.	7,644	6,9	2,730	0,6	0,039	0,01	3,471
Prunus avium L.	1,729	1,6	6,955	1,5	12,279	3,8	6,988
Prunus cerassifera Ehrrh.	4,442	4					1,481
Robinia pseudoacacia L.	16,134	14,7					5,378
Sorbus torminalis (L.)Cr.	1,225	1,1	1,355	0,3			0,860
Tilia platiphylos Scop.	3,693	3,4	5,393	1,1	0,708	0,2	3,265
Total regrowth	**92,769**		**31,856**		**301,836**		**442,154**
Total	**109,528**	**100**	**472,445**	**100**	**326,73**	**100**	**302,901**

Because of a lack of such investigations in chestnut forest both in Bulgaria and in others countries the obtained data for the reserves of phytomass were compared with data for the shrub layer in other types deciduous forests. For the linde –turkey oak forests in northeast Bulgaria the reserves of phytomass is 5,177 t/ha /Lyubenova and Bondev,1999/, for the forests of *Quercus daleshampii – Carpinus orientalis* 3 t/ha was calculated /Meshinev and Nikolov, 1986/. The figures obtained by us are significantly lower. This could be explained by the different species composition of the shrub layer and the different number and size of the species.

CONCLUSION

It is clear from the comparison of the data for the three experimental plots, that in the old forests, where sylvicultural actions were not undertaken, the shrub species prevailed, the regeneration of the forest was more difficult and the production of the regrowth was the lowest.

In conclusion we can say that the sylvicultural actions which have been taken in the young forests have contributed for improving of their status. This was especially true for the ratio regrowth – understory which was regulated in advantage of the regrowth. This presented the opportunity for development mainly of the chestnut. This is a prerequisition of preservation of the composition of the forests in the future the same.

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