



Biological resources of natural forage grassland of the cretaceous south of the European Russia

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Abstract

Problems of climatic changes and questions of the use of the natural resources for creation of a food security system are discussed. It demands an involvement in the agrarian production of the cretaceous South of the European part of Russia of local vegetable biological resources and of use for this potential of natural forage grasslands of the territory. The main objective of the made researches was assessment of territorial confinedness of economic and valuable plant species and also a status and productivity of a natural forage grassland within agrolandscapes of the cretaceous South of the European Russia (the territory of the Belgorod region). Biological and vegetable resources of the natural forage grasslands of the East part of the Belgorod region in a subband of the southern forest-steppe were studied. Field geobotanical inspections of large arrays of ravine and frame complexes and meadows, of the most perspective for the organization of haymaking and pasturable economy, were realized in 2012-2018. Research stations are located in Alexeyevsky district of the Belgorod region (tab time – 2002). The climate of the studied territory is moderately continental with a big annual amplitude of temperatures, a rather soft winter with a frequent thaw and snowfalls; with the solar and long summer; moderate unstable moistening with dominance of summer rainfall. It is established that in the steppe calciphilous communities long-term herbs prevail, and bushes and trees play the subordinated role. At decrease in degree of a pasture, intensity of mowing and recreational loading. The share of wood and shrubby vegetation increases. The overground phytomass of natural forage grasslands increases in process of remoteness from settlements and decreases in economic loading. The biggest value for the livestock production has communities with dominance of *Bromopsis inermis*, mixed herbs and the content of bean herbs of 15-25%. The received data about productivity and biological capacity of natural forage grasslands, allows to plan their share in the haying and pasturable line during cultivation of cattle. The overground phytomass of communities slightly changed by years of a research. Communities with dominance of *Bromopsis inermis* and mixed herbs – on 50-68 g/m² are higher than the others, have the largest phytoweight. The main phytomass of hay crops consists by the types having high growth rate: *Bromopsis inermis*, *Diplotaxis cretacea*, *Festuca orundinacea*, *Lotus corniculatus*, *Matthiola fragrans*, *Medicago falcata*. Perspective forage grasslands are located in the lower slope clots. Distribution of the types by the economic value showed that cereals make 10.8-47.2%, beans – 15.1-25.1% on weight of an absolute dry material. The correlation between productivity of the overground phytomass of communities and a projective covering ($r=0.736$) is discovered. The use of the studied territories as forage grasslands will allow to use rationally an arable land and to reduce the price of livestock production in the Belgorod region for 15-20%.

Keywords: biological resources, carbonate soils, natural forage grasslands, productivity of communities, economic and valuable plant species, cereal herbs, bean herbs

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INTRODUCTION

Scientists actively discuss problems of climatic changes and questions of use of natural resources for creation of a system of food security of their states (Alexandrov 2014, Reu et al. 2014, Roberts and Hamann 2012, Roshydromet 2014).

The cretaceous South of the European Russia geographically is the southern part of Central Russian Upland. The territory of the region, especially Belgorod

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region, is characterized by a high compartmentalization, development of erosion forms of a relief, wide circulation of carbonate soils (Lisetskii et al. 2011, Smirnova et al. 2007, Valkov et al. 2008).

The region has a high agricultural familiarity. The livestock production actively develops. It demands the involvement in agrarian production of a local vegetable biological resources and use for this purpose of the natural forage grasslands of beams and natural boundaries. The meadow and steppe phytocenosis demand careful accounting of floristic structure, studying of vegetable communities depending on an environment, features of an entomofauna (Degtyar and Cherniavskikh 2004, 2006, Kukharuk et al. 2017, Tkach et al. 2014, Toropova et al. 2016).

The needs of studying of a distribution in the nature of wild relatives of cultural plants, food and medical plants is noticed (Dzyubenko 2013, Kulikov et al. 2013, Zohary et al. 2012).

Researchers consider the cretaceous South of Central Russian Upland as a secondary anthropogenic microgen center – the territory in which, due to specific soil climatic conditions, there are processes of shaping at the cultural plants and their wild relatives growing in ravine and frame complexes with cretaceous exposures. Genetic resources of wild relatives of cultural plants as an initial material for the selection of ecologically steady sorts of long-term bean and cereal herbs are studied (Dumacheva et al. 2015a, 2015b, 2017).

The main objective of the made researches was assessment of territorial confinedness of economic and valuable plant species and also a status and productivity of a natural forage grassland within agrolandscapes of the cretaceous South of the European Russia.

MATERIALS AND METHODS

Studying of the biological vegetable resources of natural forage grasslands was carried out in the east part of the Belgorod region in a subband of the southern forest-steppe. The field inspections of the large arrays of ravine and frame complexes and meadows, of the most perspective for the organization of haymaking and pasturable economy, were realized in 2012-2018.

There are selected steppe communities with weak anthropogenic loading and high share of rare and endemic plant species for studying. Research stations are located in Alexeyevsky district of the Belgorod region (tab time – 2002) [7.8]. The soil – carbonate chernozem with the chalk exits. The climate of the studied territory is moderately continental with a big annual amplitude of temperatures, a rather soft winter with a frequent thaw and snowfalls; with the solar and long summer; moderate unstable moistening with dominance of summer rainfall. The duration of sunshine is about 1800 hours, the size of a solar radiation on average is about 4000 Mdzh.sq.m. Period duration with the average daily

air temperature above 0 °C is 225-240 days, and with the temperature over 10 °C – 150-158 days. An average annual amount of precipitation is 545 mm. An average summer temperature is +20.0 °C. An average winter temperature is -7.5 °C. Duration of the frostless season – 155 days. The sum of the air temperatures from steady t° C to higher than 10 degrees is 2700. The average depth of frost penetration in the soil in the winter is 600 mm.

Platforms for geobotanical researches put in places with the most typical vegetable cover. To determine the specific structure of vegetable communities within the sites, the descriptions on transects of 500 were applied. On transects there are allocated stationary platforms of 100 sq.m. Estimated the general projective covering of vascular plants and selected vegetable samples. Determined the area of grounds, species composition, the character of plants, efficiency and biological capacity of haymakings and pastures (g/m² of the absolutely dry material), quality of herbage according to the accepted methodics (Baritskaya and Chepinog 2014, Notov et al. 2013).

RESULTS AND DISCUSSION

The studied natural forage grasslands on landscape and climatic conditions are typical for the cretaceous South of the European part of Russia. The general specific variety and efficiency of the studied communities are given in the **Table 1**.

Specific features of cretaceous substrate cause the growth of plant species and communities, complementary to chalk exits. The territory of stations is to a greater or lesser extent cut strongly up by ravines. The climatic conditions and geographical arrangements of the stations considerably explain a ratio of ecological groups: mesophytes make from 37.5% of species in a station of «Varvarovka» up to 50.3% on «The Melovaya mountain» and 62.1% of views of territories of a hospital of «Bolshoy gill». The big part of mesophyte species is concentrated on northern and western slopes and also in decreases in a relief.

The flora of the area «Melovaya mountain» is presented by the main types of steppe groups, differing with prepotent types. Steppes with prevalence of *Thymus cretaceus* grow on underdeveloped the crushed stony soils of chernozem type and occupy 25% of the total area. Have a high projective covering – 70-75%. The prepotent type of *Thymus cretaceus*. Steppes with prevalence of *Carex humilis* occupy up to 15% of the area. The community with dominants of *Matthiola fragrans* and *Thymus cretaceus* (15%) is associated with the bared cretaceous substrates. Such communities have a low projective covering – 15-30%. Calciphilous and petrophytous steppes with prevalence of *Salvia nutans*, *Elytrigia repens* is 40%. 5% of the total area fall to the share of community with prevalence of

Table 1. Characteristic of the studied natural forage grasslands

Area number	Area name	Area square, ha	Species total number	Community productivity, g/m ² of an absolutely dry material	Average productivity, g/m ² of an absolutely dry material
1	Melovaya mountain	60	175	360.5-463.1	396.6
2	Varvarovka	600	194	200.7-855.3	321.1
3	Olshanskiy gill	3200	205	428.8-1120.0	652.2
4	Bolshoy gill	1100	163	471.5-752.9	574.2
5	Beam to the south of v.Batluki	280	172	458.0-602.1	568.9
6	Dushevoy gill	720	175	429.2-751.2	525.7
7	Borodkin gill	2000	166	384.5 – 586.7	482.6
8	Natural boundary Krasnaya vershina	360	164	475.2 -635.2	482.6

Table 1. Characteristic of natural pasturable communities

№	Area name	Share from the total number of species, %					
		Perennial herbaceous plant	Annual species	Biennial species	Shrubs, subshrubs	Tree vegetation	Noxious plants for live stock
1	Melovaya mountain	75.40	6.86	9.71	8.00	0.03	5.00
2	Varvarovka	68.04	14.00	6.77	5.00	6.19	3.00
3	Olshanskiy gill	74.20	7.10	9.85	3.60	-	5.00
4	Bolshoy gill	79.47	9.52	5.96	1.60	3.45	4.20
5	Beam to the south of v.Batluki	78.20	8.33	8.51	4.50	0.46	3.60
6	Dushevoy gill	81.60	5.70	10.34	2.34	0.02	8.10
7	Borodkin gill	75.60	6.29	10.60	6.64	0.87	9.00
8	Natural boundary Krasnaya vershina	71.20	11.22	7.42	9.84	0.32	5.30

Artemisia hololeuca. These communities are located on naked cretaceous slopes with a low projective covering (10-30%) and often form monodominant thickets. The biggest number of species presented by families: *Asteraceae*, *Fabaceae*, *Lamiaceae*, *Poaceae*. Only on borders of associations other types are their part.

Studying of communities of a station of «Varvarovka» showed that the community with the prevailing type of *Bromus inermis* occupies up to 30% of the total area. Community with dominants of *S. nutans*, *Medicago falcata* and *Festuca cretacea* is up to 5%. With prevalence of *Stipa pennata* (45%), *Astragalus albicaulis* and *F. valesiaca* is 15%; *A. hololeuca* and *Festuca valesiaca* is 5%.

Dominants of communities of a beam Olshanskiy gill are *Stipa pennata*, *Poa pratensis* and *Poa angustifolia*, *Salvia sylvestris ssp. tesquicola*, *Bromus inermis*. On the small area of a beam (5%) the dominants in communities are *M. Falcata*.

In the majority of the studied territories of Alexeyevsky district prevail formations of *Bromopsideta inermis*, *Stipeta pennatae*, *Chamaecytisuseta austriacusae*.

The biggest number of species presented families: *Asteraceae*, *Fabaceae*, *Poaceae*, *Lamiaceae*, *Scrophulariaceae*. Other families have a small number of species.

From the accompanying species on the territory of the studied stations prevail: *Salvia nutans*, *Salvia verticillata*, *Salvia pratensis*, *Calamagrostis epigeios*, *Onobrychis arenaria*, *Elytrigia repens*, *Elytrigia intermedia*, *Linaria vulgaris*, *Poa pratensis*, *Trifolium alpestre*, *Trifolium alpestre*, *Vicia cracca*, *Bromus arvensis*, *Melilotus officinalis*, *Medicago. falcata*, *Securigera varia*, *Fragaria viridis*, *Lathyrus pratensis*,

Genista tinctoria, *Stipa capillata*, *Orobus pratensis*, *Leucanthemum vulgare*.

The overground phytomass of communities has slightly changed by years of a research. Communities with prevalence of *Bromopsis inermis* have the largest phytomass and miscellaneous herbs - 50-68 g of sq.m is higher than the others.

The main phytomass of hay crops consists by the types having high growth rate: *Bromopsis inermis*, *Diplotaxis cretacea*, *Festuca orundinacea*, *Lotus corniculatus*, *Matthiola fragrans*, *Medicago falcata*. Perspective forage grasslands are located in the lower slope areas. Distribution of species on economic value showed that cereals make 10.8-47.2%, bean – 15.1-25.1% on weight of an absolutely dry material. The correlation between the efficiency of a overground phytomass of communities and a projective covering ($r=0.736$) is established.

The analysis of the flora showed that in the studied territories long-lived grassy plants (**Table 2**) prevail.

From 68.04 to 81.6% of the total number of species fall to the share of grassy plants. The most numerous group of plants are long-term herbs of 79.47%.

Subshrubs are widespread in the top and middle part of slopes of beams: *Chamaecytisus austriacus*, *Chamaecytisus ruthenicus*, *Genista tinctoria*, *Caragana frutex*, *Prunus spinosa*, *Amygdalus nana*, *Rosa canina*, *Rosa villosa*, *Cerasus fruticosa*. Low shrubs and semi-low shrubs are not characteristic of such types of communities. Trees: *Malus sylvestris*, *Pyrus pyraeaster var. rossica*, *Elaeagnus commutata* on slopes of a beam meet seldom, sporadically.

In the territory of stations, harmful and poisonous plants for cattle are revealed: *Carduus acanthoides*, *Onopordum acanthium*, *Echinops ruthenicus*,

Chelidonium majus, *Vincetoxicum hirundinaria*, *Saponaria officinalis*, *Echium vulgare*, *Chamaecytisus ruthenicus*, *Symphytum officinale*, *Delphinium consolida*, etc. However their quantity in the general specific variety does not exceed 3.0-9.0%.

CONCLUSIONS

In the steppe calciphilous communities prevail the long-term herbs, and shrubs and trees play the subordinated role. At decrease in degree of a pasture, intensity of mowing and recreational charging the share of wood and shrubby vegetation increases.

The overground phytomass of the calciphilous communities increases in process of remoteness from settlements and decrease in economic loading. The biggest value for livestock production have communities with the prevalence of top grasses, mixed herbs and the content of bean plants not less than 15-25%.

The obtained data on efficiency and biological capacity of natural forage grasslands allow to plan their share in the haying and pasturable conveyor at cultivation of cattle. It will allow to use rationally an arable land and to reduce the price of production of meat in the Belgorod region approximately for 15-20%.

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