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VEGETATION COVER AND SOIL STRUCTUREDNESS OF NATURAL FORAGE LANDS OF TUVA

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Abstract

The researches of vegetation and soil cover have been carried out in three main pasture areas of central tuvan basin of Tuva. Soil cover of studied territory is represented by light loamy chestnut soils. The analysis of vegetation pastures showed that their floral composition consists of 17 families, 31 types and 37 species. The Ak-Khaya area is different from other areas by its more rich vegetation cover of pasture and projective cover to 45-55%. The third area of Bora-Bulak has less floral composition. It consists of potentillaacaulis and fringed sagebrush. Pasture lands soil is more consistent, water raise is stronger, water capacity is low and water conductivity is acceptable on the third area of Bora-Bulak. The consistent ofcoarse sand (0,25-1 mm) is higher in the soil cover of the first area of Sholuk-Khovu and second area of Ak-Khaya in Barun-Khemchik region. This factor influenced to the improvement of water qualities of soil.

Keywords: pasture, vegetation cover, association, granulometric consistent, water qualities.

Introduction

The study of vegetation world (that is difficult material system of our planet) in its all diversity and all famous levels of organization is one of the most important biological ñhallenges. The perception of many aspects of the functioning and development of specific vegetation communities – study of structure, floral consistent, productivity, regularity of area distribution and the combination of communities in one vegetation cover – is the fundamental perception in the field of botany and ecology of vegetation (Dubrovsky, Oorzhak & Namzalov, 2014). For thousands of years, the use of land in Tuva caused by the uniqueness of natural and climatic conditions and the development of pasture cattle breeding (Lysenkov, 1969). At present time cattle breeding is the main traditional branch of the republic's agriculture. The influence of anthropogenic impact on the grass ecosystems (especially on pasturage) leads to different results in different zones. The study of vegetation degradation's regularities makes it possible to determine the period of steppe pasture use, establish methods of regulation of pasture impact, develop activities for pasture reconstruction. All these activities will be the basis for detailed map of steppe pastures with recommendations for their use (Sambuu, 2017).

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One of the factors that reduce the productivity of pastures is unrestricted or unsystematic pasturage of cattle. Most of the pastures of the basin are in the middle or severe lever of disfunction due to unsystematic pasturage. Unrestricted pasturage, first of all, destroys the most valuable forage grass and on the contrary makes stronger the viability and abundance of poorly eaten species (Gasanova & Zagidova, 2017; Chadamba & Nazyn-ool, 2012). During the plant formation in spring animals (that are on unrestricted pasturage) eat the most valuable and green grass. Poorly eaten plants turn to flowering, coarsen and loose nutritional qualities. Studies carried out in the second half of the 20th century by scientists from different countries show that it's possible to take out from 25 to 75% of upper ground vegetation mass in different natural zone productivity of pastures not to be damaged (Shamsutdinov, 2012, Nasiyev, Bekkaliyev & Boranbaeva, 2015; Nasiyev, 2016; Nóbrega *et al.*, 2017). According to the result of excessive anthropogenic impacts, during degradation of natural pastures, intensive destruction of the soil cover, dust storms, an increase of the area of the drift sands. These processes lead to a very fast damage of natural ecosystems, desertification of lands and further expansion of desert areas (Sambuu & Ayunova, 2016; Boner & Tomanova, 2006). It was noted that there were change of floral consistent and productivity, deterioration of agrochemical and agrophysical indicators of pasture cover during intense use of pastures. Excessive poaching and cattle pasturage lead to a distinct compaction of the soil (especially to 5-10 cm of soil layer) and this factor leads to standstill water conditions (Alves Pereira *et al.*, 2010; Magliano *et al.*, 2017; Antoneli *et al.*, 2018). Bleakness and compaction of the soil surface make high emergence of soil erosion emerge (Gasanova *et al.*, 2007; Tubalov, 2017).

The governor's project "Kyshtag for a young family" has been implemented since 2016 (every year more than 100 young families become shepherds). When the number of cattle increases, impact on pasture lands also increases. Therefore, due to increasing anthropogenic pressure the problem of pasture degradation is a topic issue.

The aim of the research is to estimate the interconnection between the vegetation cover and the soil structuredness of the natural forage lands of Tuva.

Methods

The objects of the study are the vegetation communities of steppe pastures of the central tuvan basin of Tuva. The researches were carried out from 2011-2016. The geobotanical research was realisedin a detailed-route method in the pasture lands of western Tuva. During the examination temporary test grounds were laid (with a size of 100m^2) in pastures. The floral consistent of pasture plants has been identified on the test grounds. The study of the structural and aggregate consistent of soil was carried out in layers of 0-20, 20-40 cm. The analysis of the granulometric consistent was carried out on the basis of the State Station of the Agro-chemical Service "Tuvinskaya" with the help of pipette method by N.A. Kachynski. Water conductivity, water capacity of soils, speed and raise of water were determined by the method of N.A. Kachynskion the basis of the research laboratory "Agromonitoring" of TuvSU (Vadyunina & Korchagina, 1986).

Research places, analysis, and results

Forage lands were studied in three main areas of the pastures of the central tuvan basin situated in the steppe zone of the Khemchik and Ulug-Khem basins. The first area is located in Sholuk-Khovu of Barun-Khemchik region,the second area is in Ak-Khaya of Barun-Khemchik region, the third area is in Bora-Bulak village of Dzun-Khemchik region. Most of the territory of pasture steppe of the central Tuvais covered by chestnut soils (Petrov, 1952). The soil cover of the territory is also represented by light loamy chestnut soils.

During the geobotanicalre search we studied cenosis making plants and physical qualities of the soil. Pasture areas were situated in the bioclimatic and economic conditions that are typical for soil-geographical subzones of the western part of the central tuvan basin. Analysis of pasture vegetation (table 1) showed that its floral consistent is represented by 17 families, 31 types and 37 species.

The results below show the laboratory studies of determination the granulometric consistent and water qualities of pastures in the Khemchik basin. The diagram of capillary water's raise in soil samples from three main pasture areas is represented in fig. 1. It was found out that the water raise in soil samples of first and third areas of the upper (0-20 cm) soil layer is less than the lower layer (20-40 cm). The soil sample from the third area of 20-40 cm (the cylinder was 16 cm) was moistened in 20 minutes and the soil sample from the horizon of 0-20 cm was moistened to 12 cm. The soil sample of the first area at the same period of time was moistened to 10 cm (the lower layer of 20-40 cm) and to 4.8 cm (upper layer of 0-20 cm).

Table 2 presents laboratory studies on determination of the whole water capacity in chestnut soils. We can see that the water capacity of first and second areas is 33-36%, water capacity of the third area is lower - 25%. If you look horizontally, the water capacity in the horizon of 0-20 cm is slightly more (25-37%) than the subsurface (20-40 cm) horizon where the water capacity is 23-32%.

The laboratory analysis on the determination of water conductivity showed that the time of the first drop of water filtered through the soil of the arable layer of 0-20 cm was 12-16 minutes; through the subsurface layer was 6-7 minutes. Therefore, more water was filtered through the subsurface layer in the first 20 minutes (table 3). If we compare the time of the first drop of filtered water over the areas, we can observe an increase of the water filtering time (3-4 minutes) in the soil of the third are a than the filtration of water in soil samples of the first and second areas.

Discussion

In very ancient times people watching the plants assimilated way marks in space and time. The plants functioned as a barometer and hygrometer (Viktorov &

Table 1: Floral consistent of research areas of central tuvan basin

No.	Family and type name	Amount of types /species	Fullness of species	% from the whole amount of species
	Poaceae family			
1	Fescue valissian (Festucavalesiaca)	1/1	often	19
2	June grass (Koeleriacristata)	1/1	often	
3	Beetle grass (Cleistogenessguarrosa)	1/1	mosaic	
4	Esparto grass (Stipacapillata)	1/1	fully	
5	Chee grass (Achnatherum splendens)	1/1	mosaic	
6	Fairway crested grass (Agropyrondesertorum)	1/1		
7	Steppe snow grass (Poastepposa)	1/1	absently	
	Cyperaceae family			
8	Sedge pedatiform (Carexpediformis)	1/2	mosaic	5,4
9	Sedge steady (Carexduriuscula)		mosaic	
	Asteraceae family			
10	Fringed sagebrush (Artemisia frigida)	1/2	often	10,8
11	Sagebrush paniculate (Artemisia scoparia)		mosaic, only in long-kept ecosystems	
12	Milk-witch gowan (Taraxacumofficinale)	1/1	isolated	
13	Heteropappus Altai (Heteropappusaltaicus)	1/1	mosaic	
	Fabaceae family			
14	Yellow alfalfa (Medicagofalcate)	1/1	isolated	10,8
15	Trichocarpous locoweed Oxytropiseriocarpa	1/1	rarely	
16	Pygmy pea shrub (Caragana pugmaea)	1/2	mosaic	
17	Bunhe pea shrub (Caraganabungei)		mosaic	
	Rubiacea family			
18	Lady's galioum (Galiumverum)	1/1	rarely	2,7
	Alliaceae family			
19	Dwarf Alp onion (Allium senescens)	1/3	isolated	8,1
20	Blue onion (Allium senescens)		isolated	
21	Alliumanisopodiumonion		isolated	
	Rosacea family			
22	Potentillaacaulis	1/2	often	5,4
23	Potentillabifurca		isolated	
	Goosefoot family			
24	Aristate goosefoot (Chenopodiumaristatum)	1/1	isolated	10,8
25	Sandy ceratocarpus(ceratocarpusarenarius)	1/1		
26	Prostrate cypress (Kochiaetraeus)	1/1	isolated	
27	Nanophytonerinaceum	1/1	mosaic	
	Joint-fir family			
28	One-seededephedra	1/1	mosaic	2,7
	Pink family			
29	Stellariadichotoma	1/1	absently	5,4
30	Multicoloured carnation	1/1	rarely	
	Buttercup family			

Table 1 continued ....

Table 1 continued ....

No.	Family and type name	Amount of types /species	Fullness of species	% from the whole amount of species
31	TurchaninovPasque flower (Pulsatillaturczaninovii)	1/1	absently	2 , 7
	Figwort family			
32	Woolly speedwell (Veronicaincana)	1/1	rarely	2,7
	Limoniaceae family			
33	Sea lavender (Goniolimonspeciosum)	1/1	rarely	2,7
	Iris family			
34	Yellow iris (Irishumilis)	1/1	isolated	2,7
	Zygophyllaceae family			
35	Ground burnut (Tribulusterrestris)	1/1	mosaic	2,7
	Selaginellaceae family			
36	Blood-red selaginella (Selaginella sangunolenta)	1/1	rarely	2,7
	Cannabaceae family			
37	Ruderal hemp (Cannabis sativa)	1/1	mosaic, only in long-kept ecosystems	2,7
	Total	**31/37**		**100**

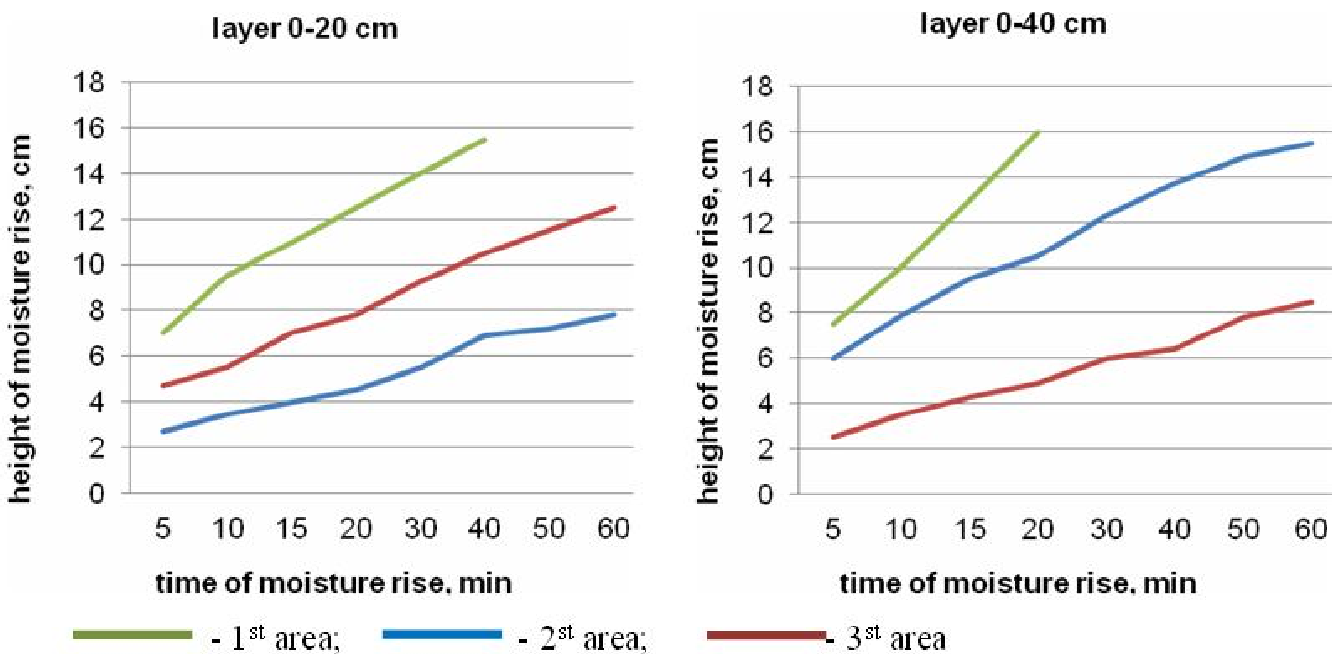

Fig. 1: Capillary water raiseof the pastures of the central tuvan basin

Remezova, 1988). Strong interrelation of plants with living conditions makes it possible not only to judge the needs of plants, but also to make conclusions about the qualities of the environment by the nature of vegetation. This is to say, usage of vegetation as an indicator of conditions. Identification of environment qualities by plants and vegetation covers makes the content of a special branch of botany–phytoindication (or the study of plant indicators).

The indicative value of the vegetation cover is huge because it is easy and accessible to observe. Moreover, it's more sensitive and plastic. According to the expression of the first report on the plant indicators of author Clements F., the plant or vegetation community represents the best measure of the conditions where it grows; it's a kind of "device" that shows the specificality of environment (Viktorov & Remezova, 1988). On the cusp of the 20th and 21st centuries, one of the main anthropogenic factors of Siberia steppe ecosystems was

Table 2: Determination of thewholewater capacity ofchestnut soils

No.	Name of sample	Consistent of agronomically valuablecoarse, %		The whole capillary water capacity of soil, %	Humus consistent, %
		skeleton> 1 mm	Size of 1, 0-0, 25 mm		
1	1st area (0-20 cm)	39,50	39,34	35	2,4
2	1st area (20-40 cm)	59,35	40,64	33	1,7
3	2nd area (0-20 cm)	53,32	30,05	37	2,3
4	2nd area (20-40 cm)	61,44	36,70	33	2,0
5	3rd area (0-20 cm)	60,96	27,57	25	2,3
6	3rd area (20-40 cm)	68,18	34,46	23	1,8

pasture digression as a result of intensive cattle pasturage (Kandalova, 2009). A.A. Gorshkova (1983) was first who paid attention and described in detail the radical change of plant communities and desertification of steppe grass stands under the influence of intensive cattle pasturage. A.A. Gorshkova (1989) also showed main patterns of pasture digression in Siberia. She noted that there is a radical change in the vegetation cover in mesophilic northern steppes of the European part of Russia. The indicators of pasture digression are the transformation of the vegetation cover that goes in a worse way (simplification of structure, decrease of species and productivity, etc.) and xerophytization both from excessive pasture impact and insufficient pasture impact that cause standstill and mesophytization of communities (Gasanova & Zagidova, 2017; Kandalova, 2009).

Table 3: Assessment of water conductivity of chestnut soils

No.	Name of sample	Time of first drop, minutes	Amount of filtered water (1 hour/mL)					
			20 min	30 min	40 min	50 min	60 min	Water conductivity assessment
1	1st area (0-20 cm)	12	6	14	24	48	54	30-70 Satisfactory
2	1st area (20-40 cm)	6	14	26	36	46	56	30-70 Satisfactory
3	2nd area (0-20 cm)	13	6	18	34	46	52	30-70 Satisfactory
4	2nd area (20-40 cm)	7	14	24	34	42	50	30-70 Satisfactory
5	3rd area (0-20 cm)	16	6	22	38	42	46	30-70 Satisfactory
6	3rd area (20-40 cm)	6	18	30	32	38	40	30-70 Satisfactory

Concerning the floral diversity in the consistent of steppe pastures grass stand in three main areas, it was revealed that there is a presence of ephemerals and ephemers (pasque flower, iris). The dominant species are June grass, fescue valissian, fescue and esparto grass. Moreover, sedges also help in formation of vegetation cover. The codominants are fescue, fringed sagebrush and esparto grass. Projective coverage is 50-55%, the middle height of the grass stand is 15-20 cm, the turfness is not so big- 10-15%.

The formation of fringed sagebrush is the most common. Combining with potentillaacaulis and small turf grasses (June grass, beetle grass, fairway crested grass), it becomes prevalent. It's rare to see onions, fathen, sea lavender. The projective coverage is 40-45%, the turfness is weak. The height of the grass stand is 10-15 cm, bushy up to 10% of pygmypea shrub, trails are marked. Pastures are weakly down. The indicator of failure is sedge. Uneatable grasses are potentillaacaulis, sea lavender, wolly speedwell; harmful grass is esparto grass. Harm is limited by ear formation and fruiting time.

The dominants of the third main area are fringed sagebrush, potentillaacaulis, esparto grass and snow grass. There are also cinquef oil, wolly speed well and different types of onions. Projective coverage is 30-35% that is characterized by the presence of areas without any vegetation.

As we can see, according to geobotanical research the vegetation of the three areas is different. The richest vegetation covers are the pastures of places with a projective coverage to 45-55%. Dilute floral consistent is in the third area. There are types of plants that can't to be stumbled easily in this area.

At the same time (with geobotanical description of pastures) there was an attempt to relate the floral consistent with the physical qualities of the soil. The impact of farm animals on pasture ecosystems is manifested not only in excessive harvesting of vegetative parts of plants, but also in compaction of the upper layer of soils especially in spring and autumn when they aren't in a period of physical ripeness (herewith hooves pressure on soil reaches 5-7 kg/cm^2) (Rusanov, 2011). Soil is the natural storage of seeds of many families of grass plants; grasses with a fibrous root system need soils with a low density for their growth and evolution (when inter aggregate and inner aggregate pores are preserved - a necessary condition for the growth of thin root hairs) compared to rod root systems where an increased density of soils isn't considered as a limiting factor; qualitative and quantitative characteristics of the organic matter of soil is important condition for the formation of their physical qualities (Rusanov, 2011).

From an agronomical point of view, the most valuable is the fine-crumpled or granular waterproof structure with aggregate sizes ranging from 0.25 to 10.0 mm. The content of agronomically valuable aggregates is the most important indicator of its condition: the higher their content, the better the soil. In soil with such structure, optimum air and water-physical conditions are created for the development of the root system of plants that helps for intensive development of microbiological activity and mobilization of nutrients (Shein & Goncharov, 2006). The better the structure of the soil, the more resistant soil aggregates to water and mechanical loads, the better the functioning of the soil, the higher and more stable its productivity (Water conductivity of soils, 2018).

Determination of the granulometric consistent of the upper layer of pasture chestnut soils ecosystems of the central tuvan basin (by the content of fractions measuring 0.25-1.0 mm) shows that on the horizon of 0-20 cm their content varies from 27 to 39% (table 2). At the horizon of 20-40 cm, the content of this fraction slightly increases to 34-41%. It shows that this type of soil has the ability to preserve its structural state in the subsoil horizon.

The ñoncrete activity of agrophysical factors related to water is manifested through the water qualities of the soil: water holding, water capacity, water conductivity and water raise (Shein & Goncharov, 2006). Structural consistent influences on the water raise of the soil: the soil with the destroyed, atomized structure has better capillary capacity than the structural soil. Compaction of soil plays a role to water raise: the more the soil is compacted, the more capillary properties appear in it, the higher moisture can rise in it (Water conductivity of soils, 2018). Fig. 1 shows water raise patterns of capillary water in soil samples from three main pasture areas. By the rate of water uptake in the samples, we can said that the soil cover in the third area of the pasture is more compact and unstructured compared to other studying areas.

The amount of moisture capacity of the soil also depends mainly on the granulometric consistent and the amount of humous or organic matters (Rusanov, 2011). The organic matter of the soil participates in adsorption processes in the soil, increases its absorptive capacity and buffering. Low moisture capacity (table 2) indicates a low level of absorptive capacity of the soil due to the destruction of soil aggregates and a decrease in the organic matter content of the soil.

The soil water ability can also indicate good structuredness of the soil. The water capacity of the soil depends directly on the soil porosity and pore size. The higher the porosity and the larger the pores, the water capacity will be better. For grounds and soils (sandy and gravelly, unstructured), water capacity depends almost exclusively on their mechanical consistent and composition since the pore size is determined by the particle size and the density of their packing. Soils of loose constitution has bigger level of water capacity than compacted soils (Shein & Goncharov, 2006). In the experiment, we determined the water capacity of soil samples within a certain time (exactly in 1 hour). The results (table 3) showed that according to the scale of the water capacity of soil, assessment of (by N.A. Kachinski) the water capacity of chestnut soils of the central tuvan basin as arable (0-20 cm) and as subsurface (20-40) cm is satisfactory. The amount of water supplied for 1 hour ranged from 40-56 mm.

Conclusion

The floral consistent of pastures is a biological indicator of the index of the structuredness of soils. The research results show that the soil of pasture lands in Bora-Bulak's third area is the most compacted, water raise is stronger, water capacity is low, water conductivity is satisfactory and floral consistent is more resistant to trampling. In the soil cover in Sholuk-Khovu's first area and Ak-Haiya of Barun- Khemchik region's second area content of sand (0.25-1 mm) is bigger and water qualities appear better. The species consistent of plants in these areas is more diverse with a predominance of grass-fescue-mixed associations. It all adds up to the fact that the pastures in Bora-Bulak of Dzun-Khemchik region are down and degraded.

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