Features of operation of pastures of the Don basin

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Abstract. The purpose of the research was to identify the productivity of forage lands on the sandy lands of the Don basin and the optimal load on them of farm animals. The objects of research were pasture ecosystems of Ust-Khopersky, Chirsky, Kazansko-Veshensky, Tsimlyansky, Golubinsky, Archedinsko-Ilovlinsky-Don sand massifs. The work is based on the methods of landscape-bioecological research and the study of the development of phytocenoses. The optimal load of farm animals during their grazing is determined, taking into account the feed capacity of pastures and recommendations for the use of forage lands are given. Overgrown sands are the most productive (1.4-3.8 t/ha). Accordingly, they withstand the greatest load of livestock. When grazing cattle, the load on them should not exceed 0.2-0.4 head / ha, when grazing horses – 0.2-0.5 head / ha, when grazing sheep and goats – 1.0-2.9 head / ha. The most vulnerable areas are open and medium-grown sands. When grazing cattle, the load on them should not exceed 0.1-0.2 head / ha, when grazing horses – 0.1-0.4 head / ha, sheep and goats – 0.4-2.1 head / ha.

1 Introduction

The ecological state of the lands of arid territories and the development of negative desertification processes on them mainly depend on the state of natural pastures [1]. The suitability of natural pastures for grazing various types of livestock is determined by the species diversity of the vegetation cover [2-4]. In turn, the peculiarities of vegetation distribution, the species composition of communities and their cenotic structure depend on edaphic, climatic (also microclimatic) and anthropogenic factors [5-7].

Rational use of natural forage lands is one of the main directions of the development of the feed industry, the organization of which is approached differentially. Pastures can successfully perform the functions of permanent reproduction of forage resources, formation of the natural environment and conservation of biodiversity only in a situation when their exploitation is carried out within ecologically acceptable limits [8, 9]. Degradation of pasture ecosystems is accompanied by deterioration of productivity, floristic diversity of lands, their downing, destruction of soil cover, development of wind and water erosion, formation of large arrays of mobile sands, desertification [10, 11]. The negative transformation of pasture ecosystems in large areas leads to the need to eliminate the

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consequences of pasture digression and wind erosion, including through the use of phytomeliorative technologies [12, 13].

2 Materials and methods

Landscape-ecological methods were used in the work to reveal the features of the distribution of landscape zones (respectively, vegetation), as well as to study the development and productivity of plant formations. The aim of the research was to establish the productivity of pasture ecosystems on the sandy lands of the Don basin and to determine the optimal livestock load on them. The objects of research were the pasture ecosystems of the sandy massifs of the Don basin: Ust-Khopersky, Chirsky, Kazansko-Veshensky, Tsimlyansky, Golubinsky, Archedinsko-Ilovlinsko-Donskoy.

The species diversity was revealed taking into account the degree of overgrowth of the sands by the projective cover (PP), when open sands were identified at PP < 30%, medium–grown – at PP 30-50%, overgrown – at PP >50%.

The pasture load of animals (*Z*) during grazing on the sandy massifs of the Don region was determined taking into account their number per 1 ha of forage land for the entire pasture period according to the formula:

$$\boldsymbol{Z = U/P \cdot S},$$

where ***S*** is the need of 1 head in feed, kg/head. per day, ***P*** is the number of days of the pasture period, ***U*** is the pasture yield, t/ha.

3 Results and discussion

The territory of the Don River basin is located between 44 and 54o north latitude and 37 and 45o east longitude. In the meridional direction, the greatest length is 650 km, in the latitudinal direction, the greatest length reaches 160 km.

The basin is located within the forest-steppe, steppe and semi-desert landscape zones, Figure 1. The grass-meadow steppes of the Don basin are divided into northern and southern. The southern meadow steppes are characterized by such sod cereals as *Stipa pennata* L.*, Stipa tirsa* Steven*, Stipa lessingiana* Trin. & Rupr Abundantly found: *Koeleria macrantha* (Ledeb.) Schult.*, Festuca valesiaca* Gaudin*, Poa angustifolia* L.*, Calamagrostis epigeios* (L.) Roth*, Phleum phleoides* (L.) H. Karst.*, Carex humilis* Leyss. and *Carex praecox* Schreb. The northern steppes are characterized by the abundant presence of cereals with loose turf and a small number of long-rooted cereal species. The dominant species are: *Agrostis tenuis* Sibth.*, Phleum phleoides* (L.) H. Karst.*, Koeleria delavignei* Czern. ex Domin*, Bromopsis riparia* (Rehmann) Holub*, Poa angustifolia* L. There is an abundance of cereals with fine turf: *Festuca valesiaca* Gaudin and *Koeleria macrantha* (Ledeb.) Schult. *Stipa pennata* L. is often found. *Stipa tirsa* Steven is more widespread to the south.

Outside the watersheds, steppe areas are located on the slopes of river valleys and gullies. The northern slopes have more moisture-loving and abundant vegetation: *Carex humilis* Leyss.*, Stipa pennata* L.*, Linum flavum* L.*, Polygala sibirica L.* and others. The southern slopes are inhabited by *Stipa sareptana* A.K. Becker, *Stipa capillata* L. and other species peculiar to the southern steppes.

To the south of the forest-steppe zone, sparsely wooded grasslands are common. In their communities, there are no more than 30 species per 1 м^2. A large proportion of the herbage here are: *Festuca valesiaca* Gaudin, *Koeleria macrantha* (Ledeb.) Schult., *Stipa capillata* L., *Stipa pennata* L., *Stipa lessingiana* Trin. & Rupr.

The more humidified area in the west is characterized as grass-tipchak-kovyl steppes. The dominance of the grass-tipchak-kovyl steppes are: *Stipa lessingiana* Trin. & Rupr.,

Stipa ucrainica P.A. Smirn., *Stipa pulcherrima* K. Koch, *Stipa pennata* L., *Stipa zalesskii* Wilensky, *Stipa capillata* L., *Stipa tirsa* Steven.

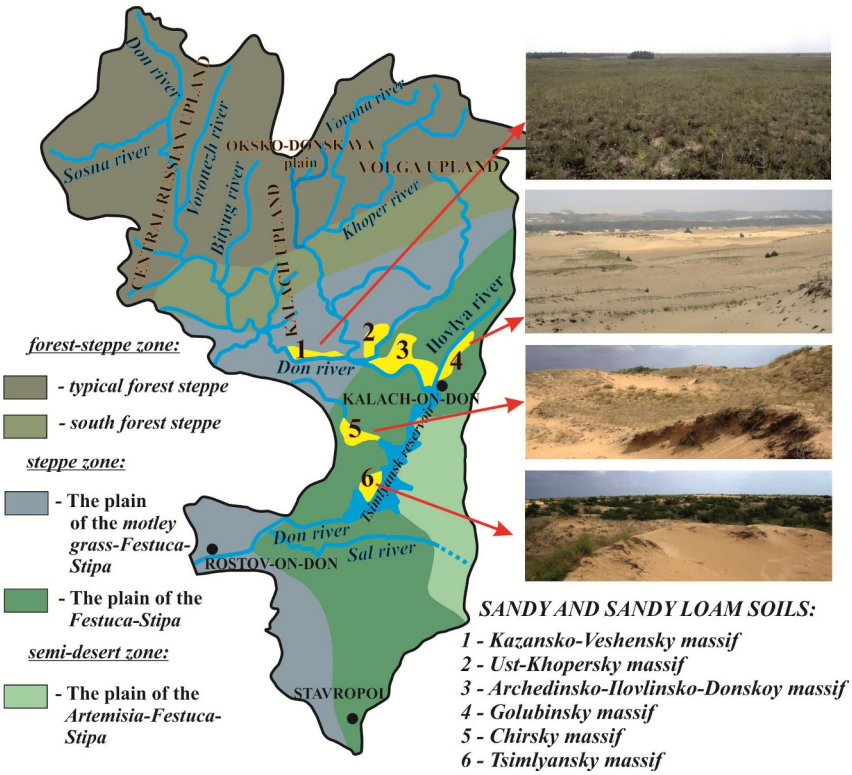

Fig. 1. Landscape zones of the Don basin.

In the east, the area is less humidified. Tipchak-kovyl steps are common here. They are confined to dark chestnut soils, where narrow-leaved cereals predominate in the vegetation cover: *Festuca valesiaca* Gaudin, *Stipa lessingiana* Trin. & Rupr., *Stipa capillata* L., *Stipa ucrainica* P.A. Smirn., *Koeleria delavignei* Czern. ex Domin, *Poa bulbosa* L., *Agropyron pectinatum* (M. Bieb.) P. Beauv. The role of semi-desert plants and species that survive on salt patches is increasing.

A significant part of the river floodplains of the Don basin is covered with meadows, which are flooded annually in high water. The floodplain areas of the Upper Don area dominated by fire meadows with an admixture of *Poa pratensis* L., *Elytrigia repens* (L.) Nevski, *Alopecurus pratensis* L. To the south, species that prefer salt marshes and salt marshes appear in floodplain meadows.

The vegetation cover of the semi-desert zone in the southeast of the basin is complex, sparse and low. Zapadins are distinguished by a richer species diversity. The chestnut soils are dominated by *Artemisia glauca* Pall. ex Willd., *Festuca valesiaca* Gaudin. The subdominants are *Stipa lessingiana* Trin. & Rupr. and *Stipa sareptana* A.K. Becker. Solonets are occupied by halophytes.

The vegetation of the sands is spread over the floodplain terraces of numerous rivers of the Don basin and in other places where sands meet. On mobile sands in interbarkhane depressions with weak sand mobility, the water regime ends annually with a positive balance, which every year leads to the enrichment of deep horizons with moisture. Such areas serve as a source of water for plants. In the dune chains, the conditions of the water

regime and the mobility of the sands hinder the development of vegetation cover, and in the inter-dune depressions. In the depressions between the dunes, the conditions of the water regime are the best.

Mobile sands are usually inhabited by *Chamaecytisus borysthenicus* (Gruner) Klask., *Leymus racemosus* (Lam.) Tzvelev etc. Then such species as *Artemisia arenicola* Krasch. ex Poljakov, *Chamaecytisus ruthenicus* (Fisch. ex Woloszcz.) Klásk. and others. Mobile sands are gradually overgrown and phytocenoses are replenished with such sandy-steppe species as *Festuca beckeri* (Hack.) Trautv., *Anisantha tectorum* (L.) Nevski, *Artemisia austriaca* Jacq. and others. Shrubs (*Genista tinctoria* L., *Chamaecytisus ruthenicu* (Fisch. ex Woloszcz.) Klásk.*s, Chamaecytisus borysthenicus* (Gruner) Klask.) and semi-shrubs (*Thymus pallasianus* Heinr. Braun, *Artemisia austriaca* Jacq., *Artemisia marschalliana* Spreng., etc.) are widely distributed.

Species of the genera *Festuca*, *Koeleria*, *Stipa*, *Carex*, *Artemisia*, *Thymus*, etc. predominate on hilly-hilly loose sands in communities of psammophytic and hemipsammophytic steppes. Their abundance varies depending on the exposure and part of the slope. In places with a large accumulation of moisture, the appearance of *Calamagrostis epigeios* (L.) Roth was noted.

A characteristic feature of the vegetation of the territory is the multi-annual and multi-seasonal changes in phytomass. The most nutritious are spring-summer shrub pasture feeds, which contain up to 11.8 MJ ha/kg of exchange energy, spring annual cereal and perennial cereal feeds (10.5-11.4 MJ ha/kg), spring wormwood feeds (10.2 MJ ha/kg). The least nutritious are winter pasture feeds from annual grasses of the *Poaceae* family (4.2 Mg/kg), Figure 2.

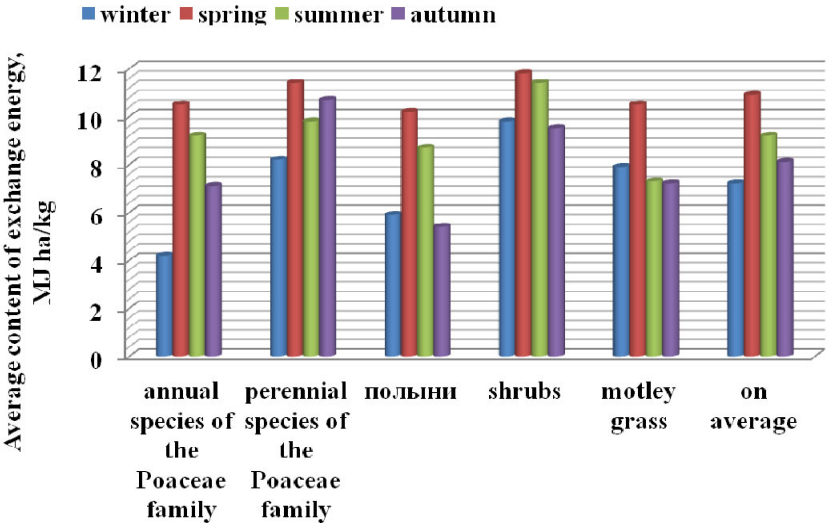

Fig. 2. Average content of exchange energy in pasture feed of the Don basin.

In accordance with the change in productivity, the feed capacity of pastures changes, which leads to the need to regulate the loads on them. But the established practice of using land often ignores the environmentally acceptable norms of their operation, which leads to their destruction. To identify the rationality of the use of forage lands of the Don basin, the optimal load on sandy lands during cattle grazing was determined (taking into account the feed capacity of pastures), Table 1.

It was found that overgrown sands (1.4-3.8 t/ha) are the most productive and durable. The most vulnerable areas are open and medium-grown sands. They should be subjected to the least load. When grazing cattle, the load on them should not exceed 0.1-0.2 head / ha, when grazing horses – 0.1-0.4 head / ha, when grazing sheep and goats – 0.4-2.1 head / ha.

Thus, in the massifs of the Don basin, it is possible to divert sands for moderate regulated grazing with an even distribution of livestock, taking into account the productivity of pastures.

Table 1. Average annual yield of forage lands and optimal load of animals during grazing on sandy lands of the Don basin.

Territories	Productivity (t/ hectare)	Optimal load on forage lands, heads / ha			
		sheep	goats	cattle	horses
Ust-Khopersky sand massif					
I	0.9	0.6	0.7	0.1	0.1
II	2.0	1.4	1.5	0.2	0.3
III	2.4	1.7	1.8	0.2	0.3
Kazansko-Veshensky sand massif					
I	2.3	1.6	1.8	0.2	0.3
II	2.7	1.9	2.1	0.3	0.4
III	3.8	2.6	2.9	0.4	0.5
Chirsky sand massif					
I	0.6	0.4	0.5	0.1	0.1
II	0.9	0.6	0.7	0.1	0.1
III	1.4	1.0	1.1	0.1	0.2
Tsimlyansky sand massif					
I	1.8	1.3	1.4	0.2	0.3
II	1.9	1.3	1.5	0.2	0.3
III	2.1	1.5	1.6	0.2	0.3
Golubinsky sand massif					
I	1.6	1.1	1.2	0.2	0.2
II	1.7	1.2	1.3	0.2	0.2
III	2.2	1.5	1.7	0.2	0.3
Archedinsko-Ilovlinsko-Donskoy sand massif					
I	2.2	1.5	1.7	0.2	0.3
II	2.4	1.7	1.9	0.2	0.3
III	3.1	2.2	2.4	0.3	0.4

Note: I – open sands; II – middle overgrown sands; III – overgrown sands.

With irrational use of sagebrush and sagebrush-grass pastures on sandy lands, grass stands are simplified: first, perennial herbaceous species fall out, then semi-shrubs, annual herbaceous plants from the group of different grasses with low forage qualities and a shortened root system grow. The right combination of modes of use of sandy pastures improves natural herbage, their qualitative composition, enhances the vitality of plants. Systematic grazing helps to improve the species diversity of forage, increase the productivity (and capacity up to 40%) of pastures. When grazing, it should be borne in mind that different types of animals eat the same types of plants differently. For cattle and horses, the preferred feed species are representatives of the *Poaceae*, *Asteraceae* and *Fabaceae* families. However, cattle choose juicy, soft grasses, mesophilic flora, sedges growing in humid conditions. Horses prefer hard steppe cereals. Sheep are good at eating xerophilic plants, species of the *Poaceae*, *Chenopodioideae* and *Fabaceae* families, sedges of dry places.

4 Conclusion

A proper grazing system should ensure their optimal productivity and the output of cheap livestock products per unit of area used with minimal negative impact on the grass stand.

On the sandy massifs in the Don basin, animal husbandry involves moderate grazing. Overgrown sands are the most productive (1.4-3.8 t/ha). Accordingly, they withstand the greatest load of livestock. When grazing cattle (cattle), the load on them should not exceed 0.2-0.4 head / ha, when grazing horses – 0.2-0.5 head / ha, when grazing sheep and goats – 1.0-2.9 head / ha. The most vulnerable areas are open and medium-grown sands. They should be subjected to the least load. When grazing cattle, the load on them should not exceed 0.1-0.2 head / ha, when grazing horses – 0.1-0.4 head / ha, when grazing sheep and goats – 0.4-2.1 head / ha.

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