The effect of grazing intensity on the productivity and floral diversity of natural pastures of the Volgograd Trans-Volga region

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Abstract. Arid pastures, which account for 50-75% of the country's natural fodder lands, are a unique natural territory of the Russian Federation. However, more than a half of the pasture areas, which are concentrated in the Caspian Sea region, are to some extent degraded. In Volgograd Zavolzhie, due to the plowing of virgin lands, overgrazing and irrational use of agricultural land, an outbreak of deflationary desertification occurred in the 70-80s. At present, the region continues to use its land resources unabatedly, which has led to the intensification of degradation and desertification processes on pastures and a decrease in their productivity. Feed-valuable species have disappeared or become rare. Coenotically and floristically full-membership pasture phytocenoses have become incomplete, biologically impoverished communities, so maintaining ecological balance, productive potential of pasture ecosystems and restoration of their biodiversity is a fundamental task for the region.

1. Introduction
The average annual precipitation in Zavolzhie is 280-300 mm. More than 50% of precipitation falls on the warm period of the year. Evaporation rate is more than three times higher than the amount of precipitation, reaching 900-1000 mm. The humidification coefficient is 0.3. The average annual air temperature changes from northeast to southwest. The hottest month is July, for example in Elton and Pallasovka, where the air temperature rises to +45°C and the average monthly temperature is +24.5-25.0°C. The coldest month is January. In Pallasovka, for example, the average monthly temperature is -11.8°C. The amplitude of absolute and maximum temperatures in the year is about 80°C. The number of dry days (relative humidity up to 30%) per summer reaches 64. The average number of days with droughts reaches 80.

From a hydrological point of view, the region is a part of the Caspian Sea region, which is characterized by poor development of the river network and the presence of estuaries and salt lakes. As a rule, river expands with a help of snow. Average annual flow module is less than 1 l/sec with 1 km², chloride type water with salinity of more than 1 g/l.

The Volga region is a part of the light chestnut soil subzone, but its soil cover has brightly individual regional features related to salinity of soil-forming rocks, groundwater, poor drainage of the territory, peculiarities of the western relief, dry climate, xerophyte, low productivity of vegetation cover, anthropogenic degradation of soils [1].

In contrast to other regions of the Volgograd region, the soils of the Zavolzhye region are characterized by high complexity and triple-dimensional structure [2, 3]. The majority of the solonetz
complex components are surface and moderately saline. Even zonal soils may have weak sulfate-chloride and chloride-sulfate salinity in the layer of 0-10 cm. Salinization is mainly chloride and sulfate-chloride from the depth of 0.5-0.7 m. Soda is added to these salts in salts, and strong salinization is noted from a depth of 30-40 cm.

Zonal light chestnut soils, mainly of medium and heavy loamy granulometric composition, occupy an average of 25% of the area. They are confined to micro-slopes, alkaline soils, saline soils, and have a non-wash water regime.

Saline solonetzes are the dominant component of soil complexes (50-60% of the area). They occupy micro-rises covered with low-productivity black wormwood associations (Artemisia pauciflora Weber). A characteristic feature of these soils is the presence of readily soluble salts (chlorides, sulfates) directly under the salt horizon. In the same layer there are calcium sulphates up to 30 t/ha. The water regime of these soils is non-flushing with elements of intra-soil desuctive exodus.

Dark-colored chernozem or meadow-chestnut soils occupy micro-declines (traps) with the most productive herbal-grass vegetation (about 25% of the area). These soils are not saline and are characterized by periodically washing water regime.

2. Materials and methods

The studies were carried out at key sites in various natural biogeocenoses, reflecting the characteristic features of pastures. Two sites are located in the Staropoltavsky district, the rest are in the Pallasovsky district of the Volgograd region. We studied species diversity, general projective coverage, height of some plant species, biological yield in air-dry condition.

3. Results and Discussion

Studies have shown [4-6, 8, 9] that the state of vegetation cover is determined by the intensity of grazing animals on them.

Several stages of pasture degradation reflecting succession with increasing grazing intensity were revealed in steppe biocenoses.

Cereals are present in traps with weak grazing: Needle Grass (Stipa lessingiana) and Crested Hairgrass (Koeleria cristata (L.) Pers.), the Volga fescue (Festuca valesiaca), Stipa sareptana, crested wheat grass (Agropyron pectinatum (M. Bieb.) P. Beauv). Cereals are well developed, the maximum productivity is 330 g/m², the average height of grasses is 25-30 cm, the projective coating is 90%. Shrubs contain almonds (Amygdalus nana L.) and Iberian spirea (Spiraea hypericifolia L.). Average height of the spire is 0.6 m, along the edges of 1.1 m, biomass of annual shoots and leaves is 235 g/m². Spirea sized from 50 to 400 m² are located at a distance of 10-15 m from each other. The Volga fescue grows by ringing spirulas along the edges of the traps, which extends beyond the traps to solonchak solonetzes, which is not observed in other areas. Spirea have a significant impact on soil conditions. For example, due to their snow accumulation capacity, cereals can grow on solonetzes [7, 10].

At moderate grazing, the presence of feather grass and the Volga fescue (Festuca valesiaca) is almost equal in the tracts. The maximum productivity of a feather grass is 150 g/m², the Volga fescue 165 g/m², all vegetation of traps 315 g/m². Average height of plants is 25-30 cm, projection coverage is 80%. Some species have been replaced by others: Austrian wormwood (Artemisia austriaca Jacq), chamomile (Tanacetum achilleifolium), and occasionally silver cobblestone (Potentilla argentea). Sp remained in satisfactory condition in the area.

During intensive grazing there is a replacement of highly nutritious species with low eaten ones, in motley grasses there are a large number of Austrian wormwoods, chamomile, yarrow (Achillea millefolium L.), silver cinquefoils. The spirea have been eradicated. Maximum productivity of grasses in traps of 165-220 g/m², their average height of 20-25 cm, projective coverage of 60-70%.

The overgrazing areas are mostly adjacent to settlements where animals cross the area several times during the same day. Grasses of little use for grazing prevail in the traps: common yarrow, Austrian wormwood, chamomile, annual weeds. The maximum vegetation productivity is 75.8 g/m², the projective coating is 30%, the average height is 15-18 cm. Due to overgrazing and unsustainable use of
land, land degradation processes are most often occurring in such areas, which lead to a decrease in the productivity and environmental sustainability of agro-landscapes. Such pastures need radical improvement in terms of land reclamation urgently.

As in the harsh natural-climatic conditions of the Volgograd Zavolzhye lowlands are the most productive areas of pastures, they are first of all removed from the pasture turnover by excessive load. On a degraded lowland, the productivity of herbs is 80-90 g/m² and phytocenosis consists of an Austrian wormwood. Most of these cavities are currently in a very poor condition and need urgent refinement. It is worth noting that the herbage of large lowlands with moderate grazing is in good condition, it is dominated by feather grass and the Volga fescue. Maximum grass productivity is 370 g/m².

As the grazing intensity increases, the floristic composition of the steppe prices significantly deteriorates. Plants, the number of which is decreasing on pastures (indicator species), serve as a signal of deterioration of the floral composition (in our case it is turf cereals). Overgrazing on meadow-chestnut soils completely disappears turf grasses, here are present in the first level of Austrian wormwood, under it stands a bird's knot-grass (*Polygonum aviculare*) - an indicator of soil compaction. Transient species from cereals to weeds include yarrow, phlomoides tuberosa, chamomile and others.

To visually determine the condition of arid pastures, we used the following indicator species: abundant content of feather grass (60-80%) - good condition; predominance of Tipchak (over 60%), as well as replacement of highly nutritious species with malnourished ones - satisfactory; approval of Austrian wormwood (over 50%) - unsatisfactory; approval of annual weeds (over 50%) - extremely unsatisfactory condition.

As for changes in desert biocoenoses, at low grazing on solonchak solonetzes there are black wormwood and kohia (*Bassia prostrata* (L.)), the maximum productivity of grasses is 180 g/m², the projected coverage of 40%, the average height is 8-10 cm. At moderate grazing, black wormwood prevails in the species composition with a maximum productivity of 130 g/m². The average height of plants is 8-10 cm, projective covering is 20-30%.

Black wormwood also prevails in areas of intensive grassland grazing. The content of the kohia is not very high. There are various species of saltwort: hill (*Salsola collina* Pall.), larch (*Salsola laricina* Pall.). Sandy hornbills (*Ceratocarpus arenarius* L.) predominate on degraded solonetzes. The total biomass of the above-ground part of grasses in such areas ranges from 90 to 122 g/m².

When grazing too much, black wormwood and weeds grow on solonetzes. Kohia is completely missing. Total productivity is 45 g/m². Since cohija is a basic type of solonetze-eaten by sheep, these pastures are not very suitable for exploitation and require urgent reclamation.

Table 1 presents individual characteristics of the surveyed pastures. When analyzing the condition of pastures, it is necessary to take into account the fluctuation variability of the vegetation cover during the vegetation period. The vegetation of meadow-chestnut soils is more sensitive to moisture than the vegetation of saline soils. This is confirmed by the large fluctuations in the productivity of grasses on these soils. At the beginning of vegetation, precipitation significantly increases biomass. Summer precipitation maintains the vitality of the plants, and when abundant, also causes the growth of herbs. At the end of vegetation (August-September), under favorable conditions of hydration, otava begins.

4. Conclusion
The condition of natural pastures in the Volgograd Zavolzhye region depends on the intensity of grazing on them.

The productivity of steppe biocoenoses of large lowland is several times higher than that of desert biocoenoses of solonchak saline soils. The productivity of steppe biocoenoses of large lowlands is several times higher than that of desert biocoenoses of solonchak saline soils. The total productivity of herbs is also reduced (350 to 70 kg/m²).
Table 1. Geobotanical characteristics of pastures

| Type of pastures | Average height, sm | Projective coverage, % | Reserve of phytomass, g/m² |
|------------------|--------------------|------------------------|---------------------------|
| **Steppe ecosystems** |                    |                        |                           |
| Very hard:       |                    |                        |                           |
| herbal camomile  | 14                 | 30                     | 36                        |
| wormweed         | 12                 | 20                     | 31                        |
| wormweed-knot-grass | 15               | 25                     | 70                        |
| wormweed-camomile | 17                | 20                     | 46                        |
| Hard:            |                    |                        |                           |
| camomile-wormweed | 20                | 45                     | 85                        |
| herbal wormweed  | 12                 | 40                     | 73                        |
| camomile         | 14                 | 30                     | 80                        |
| wormweed         | 15                 | 35                     | 47                        |
| **Medium:**      |                    |                        |                           |
| camomile-wormweed | 16                | 60                     | 90                        |
| herbal wormweed  | 17                 | 55                     | 63                        |
| the Volga fescue -wormweed | 11     | 70                     | 85                        |
| **Weak:**        |                    |                        |                           |
| the Volga fescue-feather grass | 38   | 95                     | 370                       |
| The herbal Volga fescue | 32   | 90                     | 310                       |
| **Desert ecosystems** |                |                        |                           |
| Hard:            |                    |                        |                           |
| bluegrass-camomile | 15               | 25                     | 57                        |
| camomile-wormweed | 16                | 30                     | 85                        |
| camomile         | 13                 | 30                     | 45                        |
| wormweed-camomile | 17                | 25                     | 38                        |
| annual camomile  | 14                 | 20                     | 43                        |
| **Medium:**      |                    |                        |                           |
| camomile         | 20                 | 50                     | 140                       |

In saline solonchaks, the floristic composition of plant communities and the proportion of species in them change insignificantly. However, due to overgrazing, the total vegetation productivity decreases (from 180 to 45 g/m²).

In order for pastures to prosper and be highly productive, it is necessary to develop a pasture management system and new technologies for phytomeliorative works, which will facilitate the involvement of existing desertification hotspots in the economy. Phytomelioration of arid pastures and determination of norms of load on them will provide increase of yield of fodder lands and biodiversity by 1.5-2 times, increase of share of high-productive fodder plants in grassland due to application of perspective phytomeliorant plants having high fodder advantages.

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