

**ISCKMC 2022****International Scientific Congress «KNOWLEDGE, MAN AND CIVILIZATION»****ECOLOGICAL OPTIMIZATION OF PASTURE LAND USE ON  
TERRITORY OF REPUBLIC OF KALMYKIA**

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**Abstract**

One of the most urgent environmental problems is the desertification of the planet in new regions, expansion of existing deserts and deepening of desertification itself on the whole planet. As scientists says, the center of desertification in the Caspian region is the Black Lands. The Black Lands are the main base for pasture cattle breeding in the Caspian region. In the late 1980s, 99.9% of the total area of the Black Lands was affected by desertification. A gradual exclusion or elimination of the traditionally established animal husbandry in the region, and the replacement of horse, camel and coarse-wool sheep breeding by the cultivation of fine-fleeced sheep breeds contributed to significant deterioration of the ecological situation in the Black Lands. The increased number of animals and their qualitative change, as well as the transfer of animal husbandry to the industrial basis, necessitated the study and rational use of natural pastures and new fodder.

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## 1. Introduction

At present, one of the urgent environmental problems is desertification. In the Russian Federation, it affected the North-Western Caspian and the infamous Black Lands region. The scale, pace and consequences of desertification here have approached those in the countries of the Sahel belt. Desertification of the Black Lands is due to natural and mainly anthropogenic causes (overgrazing, steppe fires, plowing pastures). Exceeding the grazing capacity of the Black Lands by 2–3 fold led to a severe herbage deterioration, the replacement of indigenous plant species with ephemera inedible for livestock, and pasture degradation. The area of degraded pasture lands currently exceeds 2.5 million hectares (Figure 01). Features of the spread of agro-ecological disaster in the Black Lands are manifested in two forms of desertification – salinization and soil deflation.

In the Republic of Kalmykia, a lot of efforts have been made to restore the vegetation of natural pastures of the Black Lands and ensure the rational use of natural forage resources. As part of the General Scheme for Combating Desertification and the National Program for Combating Desertification in the Republic of Kalmykia, the avalanche-like course of desertification was decelerated on the area of about 1 million hectares and more than 300 thousand hectares of pastures were restored. These positive results were achieved by optimizing the number of grazing animals and by phytomeliorative reconstruction of pastures (Dzhabrueva & Sangadzhieva, 2007; Mukabenova, 2007).

A 3–3.5 fold increase in livestock (primarily cattle and sheep) and development of peasant farms posed a threat of re-desertification. This explains the choice of the object, purpose and objectives of this study.



**Figure 1.** Massifs of open sands

## 2. Problem Statement

The Black Lands are the main base for pasture cattle breeding in the Caspian region. In the late 1980s, 99.9 % of the total area of the Black Lands was affected by desertification. According to the *General Scheme for Combating Desertification in the Black Lands and Kizlyar Pastures* (1986), all lands of the administrative districts of the Black Lands on the territory of Kalmykia were ranked according to the desertification degree:

- a) not affected by desertification – 2.2 thousand ha (0.1%);
- b) slight desertification – 149.0 thousand ha (5.2%);
- c) moderate desertification – 679.2 thousand ha (23.6%);
- d) heavy desertification – 424.9 thousand ha (14.8%);
- e) severe desertification – 1618.3 thousand ha (56.3%).

Pasture degradation has intensified since the Kalmyks began to build wells in dunes and use sandy pastures not only in winter but also in summer. The increased number of fine-fleeced sheep facilitated degradation and contributed to the rapid pasture destruction.

The history of development of animal husbandry in Kalmykia shows that deterioration of the Black Land pastures is largely due to the disappearance of camel and horse breeding, the elimination of Kalmyk fat-tailed sheep breeds, and the transition to monoculture – fine-wool sheep breeding.

### 3. Research Questions

The object of the study is desert pastures on the territory of the Black Lands in the Republic of Kalmykia. This is the largest massif of natural fodder resources and a livestock breeding base for breeding sheep, camels, horses, and cattle. However, since the beginning of the 70s of the last century, the processes of digression and deflation began due to overgrazing and overloading with livestock. For a comprehensive assessment of pasture agroecosystems, a geobotanical assessment of farms located in the most droughty and fragile eastern zone of the Republic of Kalmykia. These are the northern (SPK PZ "Erdnievsky" of the Yustinsky district) and southern (SPK PZ "Pervomaisky" of the Chernozemelsky district) parts – black lands, where new massifs of open sands were added to the previously existing massifs of open sands, and their total area in some years increased by 40–50 thousand hectares (Mukabenova, 2006).

Dynamics of the number of grazing livestock and pasture loads in the Black Lands. Pasture digression and land deflation on the territory of desert pastures. The response of plant communities to long-term overgrazing is pasture digression, when the order of loss of plant species adapted to joint growth is as follows: feather grass – fescue – wheatgrass – sagebrush – bluegrass. The final stages of pasture digression in different areas are virtually similar, which confirms the mechanism of pasture-digression convergence.

Ecological factors affecting the growth and development of desert wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult.) and Siberian wheatgrass (*Agropyron fragile* (Roth) P. Candargy) used as phytomeliorants. Overloading of pastures at the first and second stages of digression resulted in the vacation of ecological niches of fescue (*Festuca valesiaca* Gaud.) and wheatgrass. The following factors significantly affect the growth, development and productivity of crops of desert wheatgrass and Siberian wheatgrass used as phytomeliorants: terms, sowing rate, sowing methods. Desert wheatgrass should be used to restore and optimize the productive qualities of phytocenoses of degraded pastures on brown light loamy soils, and Siberian wheatgrass should be used on brown sandy loamy soils.

#### **4. Purpose of the Study**

The purpose of the study is to assess the processes of pasture-digressive convergence of pasture vegetation in the Black Lands region under the impact of overgrazing and to identify the features of its restoration by phytomelioration.

#### **5. Research Methods**

Geobotanical studies were carried out according to the generally accepted methodology specified in the third volume of Field Geobotany (Poniatovskaya, 1964). Vegetation on the area of 100 m<sup>2</sup> was described. The phenological state was noted according to the scale proposed by Alekhin (Borisova, 1974). The age composition of edicator cenopopulations was studied according to the method by Rabotnov (1983). The elements of seed productivity of plants were determined according to the method by Rabotnov (1983). Life forms were determined by the method of overwintering and by ecological and morphological features (Serebryakov, 1952).

Phenological observations of the growth and development of sown perennials were carried out according to the method by Beidman (1974) and Schultz (1981). The following phases were observed: the beginning of spring regrowth (new shoots and leaves), full spring tillering, stooling (booting), budding (panication), flowering, mowing maturity, cessation of vegetation (Kerley, 1992; Zonn, 1994).

At present, the method of agrostepes is the most widely recognized and effective phytomelioration methods. The method of agrostepes enables real and quick (two or three years) reproduction of the destroyed multi-species herbaceous vegetation, where it is vital, and economically and ecologically feasible (Brown, 1995; Margalef, 1997).

#### **6. Findings**

The study revealed digression series of vegetation changes in pasture lands that occur under the impact of pasture overloads, and free ecological niches in pasture phytocenoses formed as a result of overgrazing. The most important environmental factors affecting the growth and development of desert wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult.) and Siberian wheatgrass (*Agropyron fragile* (Roth) P. Candargy) used as phytomeliorants were investigated, and the phytomeliorative efficiency of desert wheatgrass and Siberian wheatgrass was evaluated in the conditions of the Black Lands.

#### **7. Conclusion**

For the first time for the region of the Black Lands, the comparative phytomeliorative efficiency of desert wheatgrass and Siberian wheatgrass for restoration of pasture ecosystems was studied. Quantitative relationships were determined between the parameters that form the resistance of phytocenoses to pasture use and the biological productivity of herbage. It was revealed that the main factors that contribute to desertification of the Black Lands are pasture digression and deflation. Overgrazing leads to the loss of certain grass species. Deflation is facilitated by dense footpaths, abundance of failures, and cattle passes near barns, wells, and irrigation canals. The number of degression series depends on the vegetation cover

formed (layer density and species replacement). When cereal and absinthic-cereal types of pastures predominate on sandy and sandy soils, the digression series includes 5 stages of vegetation changes. When the soil types are not numerous, the digression series includes 4 stages. The final stage of pasture digression implies the following: grasses and wormwoods are replaced by annual ephemerals and ephemeroids (ceratocarum, bulbous bluegrass, weedy herbs) as digression progresses, that is, pasture-digressive convergence of vegetation occurs. As a result, the ecological niches of valuable fodder plants – fescue and wheatgrass – are vacated. A radical improvement of pastures should be performed through introduction of species lost from herbage. One of the promising crops with phytomeliorative properties are desert wheatgrass and Siberian wheatgrass, which can be used to improve the ecological and reclamation state of degraded pastures. In the study, the technologies have been developed for pastures sown with desert wheatgrass on brown light loamy alkaline soils and Siberian wheatgrass on brown sandy loamy soils, which allow for herbage yield of 5.3–8.2 t/ha and 4.7–6.9 t/ha, respectively..

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