

# Present State of Pasture Types of the Central Kyzylkum

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## Abstract

The modern state of desert pastures of the Central Kyzylkum has been studied. The pasture territories of the Central Kyzylkum are distributed on sandy soils (14%), salt marshes (6%), gravelly-loamy gray-brown soils (75%) and riparian nature-territorial complexes (5%). The main (75%) areas of pasture are occupied by the gravelly-loamy gray-brown soils which are dominated by species of sagebrushes. There are formed of 8 pasture types depending on the properties of natural complexes. The main type of pasture is sagebrushes (*Mixto artemisieta*), which occupy 60% of the pasture area, and then follow *Peganeta harmala*, *Mixto calligoneta*, *Halocnemeta strobilacei*, *Tamariceta varia*, *Haloxyleta aphylli*, *Convolvuleta hamadae* and Mixshrubs pasture types. The share of fodder plants is high (an average of 83%) in the flora of the study area. According to seasonal grazing, pastures of the Central Kyzylkum can be divided 5 groups: year-round, spring, spring-summer, autumn-winter and unsuitable pastures for grazing. Among them are prevail year-round grazing pastures. The numbers of annual plants and abundance venomous plants in the flora are indicators of pasture degradation in the study area. Annual plants may occupy 55% of composition of plant communities on degraded sites, besides the pasture types which formed under the influence of anthropogenic factors. In Central Kyzylkum newly formed and transformed pasture types occupy 25% of pastures.

## Keywords

Types of Pasture, Venomous Plants, Productivity, Seasonal Use, Degradation Indicators

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## 1. Introduction

Extensive natural desert pastures are main area of development in the Union of Independent States (UIS) coun-

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tries as less labor intensive and more profitable livestock industry. The potential for further development of sheep and camel in desert pastures is of enormous importance.

The total area of desert pastures in the Union of Independent States (UIS) is about 180 million hectares and is used all year round thanks to the presence of natural fodder. The desert region of the UIS is grazing more than 17 million karakul sheep and goats. Natural desert pastures in Turkmenistan are 95% and Kazakhstan—89% of the total agricultural land. This figure is 84% in Uzbekistan and its territory is fully located on the territory of the Kyzylkum desert [1] [2]. In the countries of Central Asia, the Kyzylkum desert provides valuable forage for livestock. The flora Kyzylkum is estimated about 1050 species and the fodder flora consists of no less than 908 species (86%) [3] [4].

At the same time the Central Kyzylkum, located on the territory of the Republic of Uzbekistan, is of great importance to maintain the well-being of a million people in the desert zones and economic development of the county. Production of all types of cattle products is concentrated in this region, but it is an independent geobotany district, where, unfortunately, there are no data on its pastoral response.

One of the quality indicators of the Central Kyzylkum pastures is to spread sagebrush species which is important to maintain quality karakul fur and a healthy livestock [5]. Reducing the proportion of pasture lands of the Central Kyzylkum and sharp increase in the number of farm animals for the last 20 years has taken the negative consequences, especially on the quality of sagebrush pastures [5] [6]. In addition, the cutting forage shrubs, various anthropogenic impacts during the construction of linear structures and geological exploration have their negative impact on the pasture ecosystems of the research area. Unfortunately, to date, the degree of degradation by overgrazing of the vegetation cover of the Central Kyzylkum is 35.7% [2] [7].

This paper presents the current state of pastures of the Central Kyzylkum, the characteristic of pasture types and shows indicators degradation.

## 2. Materials and Methods

Central Kyzylkum includes several remote mountains that cover the northern, southwestern and south-eastern district of Kyzylkum [8] and is located within two administrative regions (Bukhara, Navoi) of Uzbekistan.

In the Central Kyzylkum, the total solar radiation reaches 140 - 160 kcal/cm<sup>2</sup> per year, and the radiation balance is up to 50 - 60 (sometimes up to 70) kcal/cm<sup>2</sup> per year. The duration of sunshine is high, 2500 - 3000 h per year. The sum of temperatures above 10°C is 4000° - 5000° and higher. The average annual temperature is about 16°C, the average temperature in January is 0°C - 10°C. The duration of the growing season is 240 - 260 days. The bulk of the precipitation falls in winter-spring and partly in the autumn period (the maximum is observed from December to April). The annual precipitation is 70 - 125 mm. There is almost no precipitation in the summer [9].

The research was conducted in the largest and most anthropogenic-dynamic territory of the Central Kyzylkum—on the massif of “Kokcha”. It includes remote mountain Kokchatau, massif area—341,521 hectares, of which 89% (304,806 ha) are pasture.

Defining pasture differences was conducted identifying the dominant plant species. Vegetation cover and forage yields were determined among pasture types by transect (10 × 2 m) and mowing areas (1 × 1 m). The degree of plant abundance on the vegetation is determined on the 7-point scale and given by the following notation: 5% - 10%—sol, 10% - 20%—sp<sub>1</sub>, 20% - 40%—sp<sub>2</sub>, 40% - 50%—sp<sub>3</sub>, 50% - 70%—cop<sub>1</sub>, 70% - 80%—cop<sub>2</sub>, 80% - 90%—cop<sub>3</sub> [10].

Pasture types and difference corrected by the explication of vegetation Uzbekistan [11].

The Latin name of the plant species is given by Cherepanov [12], the name of pasture types by Rabotnov [13].

## 3. Results and Discussion

### 3.1. The Pasture Flora and Distribution of Pastures

Fodder flora of Kyzylkum desert consists of 908 species of vascular plants belonging to 345 genera and 68 families. In the fodder flora of Kyzylkum is dominated by annuals (1/2 of all taxa), the share perennials estimated 283 types (31.1%), and tree and shrubs are not more than 166 species (12.7%) [3] [4].

According to our data, in the study area recorded 229 plant species of belonging to 144 genera and 40 families. Of these, 218 species are fodder. The pasture flora is dominated by species of the family *Chenopodiaceae*, *As-*

teraceae, Fabaceae, Brassicaceae, Boraginaceae, Poacea, Ranunculaceae, Lamiaceae, Liliaceae and Caryophyllaceae. The analysis of the distribution of plant species showed that annual species were dominant followed by perennials. Share of trees and shrubs do not exceed of 20.0%.

The pasture territories of the Central Kyzylkum are distributed on sandy soils (14%), salt marshes (6%) and riparian nature-territorial complexes (5%). The main (75%) areas of pasture are occupied the gravelly-loamy gray-brown soils which are dominated by species of sagebrushes (*Artemisia diffusa*, *A. turanica*) (Table 1).

Gray-brown soils wide spread in the southern and central parts of the Kyzylkum. In the Central Kyzylkum gray-brown soils are covered with sand “cloak”, which is a determining factor in the formation of vegetation in this region [8]. 50% - 60% of the soil is consisted of gravel with a length of 7 - 10 mm. The area of salt marshes and riparian forests is low (5% - 6%) and they are considered as a new map-units, which are not registered in the reference map of the study area in 1995 year.

### 3.2. Characteristics of Pasture Types

There are formed of 8 pasture types depending on the properties of natural complexes. The main type of pasture is sagebrushes (*Mixto artemisieta*), which occupy 60% of the pasture area. Then follow *Peganeta harmala* (13%), *Mixto calligoneta* (7%), *Halocnemeta strobilacei* (6%), *Tamariceta varia* (5%), *Haloxyleta aphylli* (5%), *Convolvuleta hamadae* (2%) and Mixshrubs (2%) pasture types (Table 2).

It spread 39 species of *Artemisia* on the territory of Uzbekistan and is mainly participated Northern-Turan species of sagebrushes—*Artemisia diffusa*, *A. turanica* in the formation of the Central Kyzylkum vegetation [5] [14]. Also, in the Central Kyzylkum 60% of the pasture area is refers to a type of *Mixto artemisieta* which dominated by sagebrush species—*Artemisia diffusa*, *A. turanica* (Table 2). The cover vegetation is 54% and rich in species composition (83 plant species). The proportion of forage plants is 85%. The average seasonal yield is 330 kg per hectare. Due to the abundance of different kinds of vital forms and eaten plants, this pasture is considered a year-round pasture for seasonal use. Dominants of the pasture type *Artemisia diffusa*, *Artemisia turanica* are a valuable fodder plants for a sheep, goats and camels. Eaten features of the aboveground annual phytomass are persisted on 80% for all season. In addition, the species composition is rich of following valuable

**Table 1.** The distribution of pastures in different natural-territorial complexes.

Natural-territorial complexes	Area	
	ha	%
Gravelly-loamy gray-brown soils	228,247	75
Sandy soils	42,977	14
Salt marshes	17,940	6
Riparian forests	15,642	5

**Table 2.** Characteristic pasture types of the Central Kyzylkum.

Pasture types	Soil types	Vegetation cover	Annual seasonal yield	The proportion of forage plants	Area
		%	kg	%	km <sup>2</sup>
<i>Mixto artemisieta</i> of them a plant communities on degraded areas	Sandy gray-brown	52	330	85	183,555
		35	130	38	2301
<i>Convolvuleta hamadae</i>	Sandy	55	310	82	6723
<i>Mixto calligoneta</i>	Sandy	45	440	79	21,778
<i>Tamariceta varia</i>	Salt marsh	65	390	87	15,642
Mixshrub	Sandy	45	330	81	6668
<i>Halocnemeta strobilaceae</i>	Salt marsh	15	52	100	17,940
<i>Haloxyleta aphyllai</i> of them a plant communities on degraded areas	Sandy	55	400	82	14,531
		35	110	48	5486
<i>Peganeta harmala</i>	Sandy gray-brown	45	180	71	37,969

fodder ephemera and ephemerides *Carex pachystylis*, *Poa bulbosa*, *Koelpinia linearis*, *Eremopyrum buonapartii*, *Strigosella africana*.

The *Convolvuleta hamadae* pasture type takes 2% of the study area. The vegetation cover is 55%, only 46 species are found. Dominant plants *Convolvulus hamadae* spreads with the abundance of sp<sub>3</sub>. The average seasonal yield is 310 kg per hectare. The proportion of forage plants is 82%. Dominant plants *Convolvulus hamadae* refers to a group of low-eaten plants. However, this pasture type is considered a spring pasture for seasonal use, since the spring is formed 85% of the crop phytomass and this is due to the formation of a large biomass by *Carex physodes*, *Poa bulbosa* and *Astragalus villosissimus*.

Calligonum determines the landscape of sandy desert zone of the Central Kyzylkum. *Mixto calligoneta* pasture type occupies 7.1% of the total pasture area of the research massif (21.778 km<sup>2</sup>). Pasture type is rich in species composition, only 52 species are found, of these shrubs and trees—5, semishrubs—4, perennial grasses—15, annuals—28. The vegetation is rich in such dominant fodder plants as *Calligonum microcarpum* (sp<sub>3</sub>-cop<sub>1</sub>), *Calligonum leucocladum* (sp<sub>3</sub>-cop<sub>1</sub>), *Artemisia diffusa* (sp<sub>2</sub>-sp<sub>3</sub>), *Carex physodes* (sp<sub>1</sub>-sp<sub>3</sub>), *Poa bulbosa* (sp<sub>1</sub>-sp<sub>2</sub>). *Mixto calligoneta* pasture type is the highest in terms of yield, since the seasonal average yield of 440 kg per hectare. The proportion of forage plants is 79%. This pasture is considered optimal for grazing for the whole season, due to the abundance produced above-ground crop mass of dominant plants. One of the features of this pasture type is to inclusion eco-plastic annual halophytes in sand depressions such as *Ceratocarpus utriculosus*, *Girgensohnia oppositiflora*, *Salsola iberica*, *Salsola sclerantha* (sp<sub>1</sub>-sp<sub>3</sub>), which is an indicator of beginning of overgrazing.

Natural and historical formation of the riparian forest tracts in the Kyzylkum are only preserved in the valley of the Amudarya, Syrdarya and Zarafshan. With geological and geographical point of view, formation of riparian forest tracts is due only to those habitats that are dominated by alluvial hydromorphic soils. However, there has been the emergence and expansion of territories riparian forests even the salt marshes at negative human activities in the Central Kyzylkum. Wherein, *Tamariceta varia* pasture type relates to a new natural-territorial complex—riparian forests. In the study area the appearance of the reservoir “Shurkul” and collector lake “Agitma” contributed to the formation of pasture type. It takes of 5% the pasture area and distributes in the salt marshes and hilly sands. The vegetation cover is large—65%. Pasture type formed by riparian forest species *Tamarix hispida*, *T. laxa* (sp<sub>2</sub>-cop<sub>1</sub>). The average seasonal aboveground yield is 390 kg. The proportion of forage plants is 87%. Formation general crop biomass increases on the spring (70%) to the autumn (100%). Eating feature of pasture biomass is 30% in spring, autumn and winter—50% - 60%. In winter *Tamariceta varia* on the floristic composition is the most eaten pasture type by grazing in comparison with other pastures of the Central Kyzylkum.

The Mixshrub pasture type occupies only 2% of the pasture area of the massif. Type is distributed in hilly and plain of sandy soils, vegetation cover is 45%. It formed by a variety of shrubs like *Haloxylon persicum*, *Astragalus villosissimus*, *Convolvulus hamadae*, *Calligonum microcarpum*, *Lycium ruthenicum*, *Ammothamnus lehmannii* (sp<sub>2</sub>-cop<sub>1</sub>). The average seasonal yield is 330 kg per ha. The proportion of forage plants is 81%. This pasture belongs to the group of the unsuitable pastures for grazing. The seasonal change of eating features of plants is not distributed evenly by season, which is considered a cause of unsuitable for grazing. Seasonal eaten of crop biomass does not exceed of 30% - 45%.

The greatest variety of halophyte vegetation is concentrated in the salt-marshes and lake basins in the Kyzylkum. The most widespread saline soils and alkaline lands developed under the influence of groundwater [4] [15]. The *Halocnemeta strobilaceae* pasture type relates to a new natural-territorial complex—salt marshes in the Central Kyzylkum. It is a type of new formed pastures under the influence of anthropogenic factors. In the Central Kyzylkum *Halocnemeta strobilaceae* pasture type formed on the outskirts of the reservoir “Shorkul” and networks of irrigation canals and most of the pasture (88%) are confined to these sites. Violation of the hydrological regime of the soil in flood irrigation systems has led to soil salinization and contributed to the spread of annual halophytes. In pasture type plants unevenly distributed in small “patches”, that is considered to be the cause of low crop yields. The vegetation cover does not exceed 10% - 15% and dominant plant *Halocnemum strobilaceum*—a true halophyte that can accumulate in their tissues than 25% of salts. The species composition of vegetation on the salt marsh is relatively poor—there are only 13 species, of these, 11 species are annuals. The yield is not high, the average seasonal yield of 52 kg per hectare. This pasture is considered the autumn-winter pasture for seasonal use. In the spring and summer the eaten crop biomass is low 10%, in autumn and winter, this figure rises to 50% - 55%.

The *Haloxyleta aphyllai* pasture type is characteristic type of the Central Kyzylkum desert flora. The formation of this type is mostly associated with ancient and modern valleys, with various negative elements of relief—basins, inter-ridge depressions in the sands, where hydrological conditions are favorable for them. Pasture occupies 5% of the total pasture area. Dominant species *Haloxylon aphyllum* spread with the abundance of  $cop_1$ . There are 61 species: trees and shrubs—7, semishrubs—7, perennial grasses—22 and annuals—25. The proportion of forage plants is 82%. The average seasonal yield is of 400 kg per hectare. This pasture is considered the autumn-winter pasture for seasonal use. Eating feature of plants is increase from spring to winter.

In 1964 year I.I. Granitov [8] noted effect of anthropogenic pressure on sagebrushes, despite the broad liability desert environment, sagebrushes can be easily transformed with the overgrazing to plant associations are not specific for this or that region. He indicated the disappearance of the sagebrushes and the appearance of venomous and uneaten plants *Goebelia pachycarpa* and *Peganum harmala* in the Southwestern Kyzylkum. According to our observations, as a result of overgrazing and man-made effects on sagebrush pastures of the Central Kyzylkum are especially formation of *Peganum harmala*—*Peganeta harmala* pasture type. Pasture type formed near the village, the well and paddock, where the soil structure is deteriorating due to the continuous compression of the hooves of farm animals. Pasture type occupies 12% of the total pasture area and only found 48 species, including shrubs—4, semishrubs—1, perennial grasses—15 and annuals—28. The proportion of forage plants is 69%. The yield of pasture type is low-average seasonal yield of only 130 kg per hectare. This pasture is considered the spring-summer pasture for seasonal use. Eating feature of forage plants saved up to 50% - 55% due to the ephemeral and ephemeroïds to the spring-summer season. Reduced share of ephemera and ephemeroïds in autumn-winter seasons is considered to cause a sharp decrease in the degree (35% - 40%) of pasture use.

### 3.3. The Quality and Degradation Indicators of Pastures

The share of fodder plants is high (average of 83%) in the composition of all pasture types, this figure is 43% in the plant communities on degraded areas (Table 2). If estimate the quality of pasture region, 67% of the areas correspond to the share of pastures which using year-round (*Mixto calligoneta* and *Mixto artemisieta* pasture types) and it is typical for the desert pastures of Central Asia (Table 3). Also there is widespread autumn-winter (14%), spring-summer (12%), spring (2%) pastures. Unsuitable pastures which indicated the uneven distribution of seasonal eaten features of forage plants are occupied 2% of the pasture area. 3% of the study area is pastures with varying degrees of degradation. In these areas the abundance of uneaten and poisonous plants is high, the proportion of forage plants and annual seasonal yield are low as prevents rational provision of pasture feed farm animals.

Regular pressure on pastures, often without regard to their potential possibilities, leads to the appearance of uneaten and venomous plants, reduction of certain valuable fodder plants. The prevalence of annual plants is alarming indicator of the increasing anthropogenic pressure on the Kizilkum pasture vegetation. In addition, the increase of the abundance uneaten plants also is an indicator characterizing the degree of pasture degradation in plant communities [3] [16] [17].

According to the analysis of the flora revealed that the number of annual plants and abundance of uneaten, venomous plants are indicators of pasture degradation of the Central Kyzylkum. In particular, the vegetation those share of annual plants higher than 55% are found in plant communities on degraded areas, as well as the new formed and transformed pasture types (Table 4). The high proportion (85%) of annual plants is found in the *Halocnemeta strobilaceae* pasture type. Wherein, the share of annual halophytes is 60%, as indicate of high they

**Table 3.** The distribution of pasture types of seasonal use.

Group of seasonal use	Pasture types	Share %
Year-round pastures	<i>Mixto artemisieta</i> , <i>Mixto calligoneta</i>	67%
Autumn-winter pastures	<i>Tamariceta varia</i> , <i>Halocnemeta strobilaceae</i> , <i>Haloxyleta aphyllai</i>	14%
Spring-summer pastures	<i>Peganeta harmala</i>	12%
Spring pastures	<i>Convolvuleta hamadae</i>	2%
Unsuitable pastures	Mixshrub	2%
<i>Plant communities on degraded areas</i>		3%

**Table 4.** Quantitative indicators of annual and uneaten, venomous plants on pasture types.

Pasture types	Share of annual plants %	Share of uneaten and venomous plants %	Abundance of uneaten and venomous plants
<i>Mixto artemisieta</i>	48	10	<i>Iris songarica</i> —sp <sub>2</sub>
<i>Of them a plant communities on degraded areas</i>	61	9	<i>Nitraria shoberi</i> —cop <sub>1</sub> ; <i>Iris songarica</i> —sp <sub>3</sub> ; <i>Goebelia pachycarpa</i> —sp <sub>2</sub> ; <i>Tortula desertorum</i> —sp <sub>2</sub> .
<i>Convolvuleta hamadae</i>	37	7	<i>Iris songarica</i> —sp <sub>2</sub>
<i>Mixto calligoneta</i>	52	11	<i>Peganum harmala</i> —sp <sub>2</sub> ; <i>Goebelia pachycarpa</i> —sp <sub>2</sub>
<i>Tamariceta varia</i>	67	9	<i>Halimodendron halodendron</i> —sp <sub>3</sub> ; <i>Nitraria shoberi</i> —sp <sub>3</sub> ; <i>Peganum harmala</i> —sp <sub>2</sub> ; <i>Lycium ruthenicum</i> —sp <sub>2</sub> .
Mixshrub	38	9	<i>Goebelia pachycarpa</i> —sp <sub>2</sub> ; <i>Lycium ruthenicum</i> —sp <sub>2</sub>
<i>Halocnemeta strobilaceae</i>	85	-	-
<i>Haloxyleta aphyllai</i>	41	10	<i>Lycium ruthenicum</i> —sp <sub>2</sub> ; <i>Peganum harmala</i> —sp <sub>2</sub> .
<i>Of them a plant communities on degraded areas</i>	58	10	<i>Peganum harmala</i> —sp <sub>3</sub> ; <i>Iris songarica</i> —sp <sub>2</sub> ; <i>Lycium ruthenicum</i> —sp <sub>2</sub> ; <i>Goebelia pachycarpa</i> —sp <sub>3</sub> .
<i>Peganeta harmala</i>	58	13	<i>Peganum harmala</i> —sp <sub>3</sub> -cop <sub>2</sub> ; <i>Goebelia pachycarpa</i> —sp <sub>2</sub> ; <i>Iris songarica</i> —sp <sub>2</sub> ; <i>Ceratosephalus testiculata</i> —sp <sub>2</sub> ; <i>Tortula desertorum</i> —sp <sub>2</sub> ; <i>Lycium ruthenicum</i> —sp <sub>2</sub> .

ruderal diapason [18]. The proportion of annual species is 67% in the *Tamariceta varia* pasture type. The formation of this type occurs on humid-saline soils, in spite of this, of the total annual plants (33 species) the proportion of annual halophytes is only 21%. Other annual plants are mainly related members of the family *Boraginaceae* (12%), *Poaceae* (9%) and *Asteraceae* (9%). Occurrence of representatives of other families that are not specific to saline hydromorphic soils is not yet complete formation of the plant community in the *Tamariceta varia* pasture type.

Share uneaten and venomous plants are 7% - 13% in the composition of the all pasture types of the Central Kyzylkum. However, the abundance of uneaten and venomous plants is high in the degraded areas, as well as in the new formed and transformed pasture types, which covered 40% - 80% (sp<sub>2</sub>-cop<sub>2</sub>) of vegetation. The halophilic flora Kizilkum are found 13 species of venomous plants [3], however, in the vegetation of the halophilic *Halocnemeta strobilaceae* pasture type is not observed venomous plants in the study area. As results of pasture degradation of the Central Kyzylkum, there are widespread following of the venomous and uneaten plants: *Peganum harmala*, *Goebelia pachycarpa*, *Iris songarica*, *Ceratosephalus testiculata*, *Tortula desertorum*, *Lycium ruthenicum*, *Halimodendron halodendron*, *Nitraria shoberi*.

#### 4. Conclusions

The Central Kyzylkum is located in the desert region and its pasture flora is rich in forage plants. The dominance of the territory year-round pastures provides a great opportunity for the development of pasture cattle breeding.

In Central Kyzylkum, it reinforces the negative human impact on the pasture ecosystem. Its negative impact acts on two directions. First, the development of new agricultural lands as a result of human activities is considered to be the cause of the destruction of water-salt balance of the soil and increase the groundwater level. This is beneficial to the formation of new pasture types, which is not specific to the region. Second, around the settlements observed overgrazing and historical formed pastures are transformed pastures which consist of venomous plants. In Central Kyzylkum newly formed and transformed pasture types occupy 25% of pastures. The *Halocnemeta strobilaceae* and *Tamariceta varia* pasture types in the salt marshes are considered as new formed pastures or new map-units, which are not registered in the reference map of the study area in 1995. As a result of overgrazing, there is transformation of sagebrush pastures on pastures that is dominated by venomous plant *Peganum harmala* as an indicator of the watering presence and digression of pasture.

There is a positive side of the newly formed pasture types. The *Tamariceta varia* pasture type, highly productive riparian forests on the hydromorphic saline soils, is important to stabilize ecological condition and preservation of biological diversity of the region. The *Halocnemeta strobilaceae* pasture type in the salt marsh cannot be

considered a low of yield pastures. Cultivation halophyte plants by remediation methods can improve pasture fund territory.

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