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Some Notes on the Key Botanical Territories of Ustyurt (Uzbekistan) and the Influence of Oil and Gas Industries on Them

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Abstract

The paper presents data on the modern state of some important botanical territories of the Ustyurt plateau. Materials on the effect of dust rising from the main highway of the oil and gas sector on the vegetation cover of the adjacent areas studied are considered. The results of the analysis showed that the vitality of dominants and rare species along the road and closer to it is low, the projective coverage does not exceed 8%. Starting from 100 to 200 m, the vitality of the dominants improves. With a distance of 500 m from the roads, the species composition increases, the projective coverage reaches 12%. The evaluation of the vitality of dominant and/or endemic species, the comparison of the projective cover and the species diversity of the pilot site with the control plot, and also the method of weighing the annual shoots of dominant and/or rare species with all vegetative and generative elements in a comparative aspect give reliable results in determining the degree Anthropogenic impact on the vegetation cover of Ustyurt. Inclusion of dominants the restoration of vegetation by phytoremediation of the study area gives promising results.

Keywords

Ustyurt Plateau, Oil and Gas Sector, Vegetation Cover, Impact of Dust Particles

1. Introduction

The Ustyurt Plateau is one of the ancient and unique regions of Eurasia. This boundless clay desert, isolated from the lower regions of the region by high cliffs

(plateaus), occupying the northern part of the Aral-Caspian watershed. The plateau is almost completely bounded by chinks. In the east, the Ustyurt chink is formed by the former western shore of the Aral Sea. In the south, it breaks off to the Kunya-Darya ancient alluvial plain and the Uzboi valley, in the west—to the valley Karynyaryk and to the sands of the North Caspian Sea Karakum, and in the north—to the Caspian lowland. The administrative territory of the plateau includes the borders of Uzbekistan, Turkmenistan and Kazakhstan and covers an area of 200 thousand km^2 [1].

The Karakalpak part of Ustyurt (Uzbekistan) occupies more than 7.2 million hectares and is a vast biome, promising for livestock development [2].

It should be noted that Ustyurt, in turn, is recognized as a world-wide territory—it belongs to the global ecoregion—the Central Asian desert. This ecoregion is part of 200 global networks (Global-200), which in 1998 was included in the world ranking of regions with the most outstanding biological characteristics of terrestrial, freshwater and marine ecosystems of the Earth [3].

In recent years, critical environmental conditions have been observed in Ustyurt, related to the drying up of the Aral Sea on one side, and, on the other hand, to the development of the oil and gas sector that adversely affect biodiversity in general. Currently, Uzbekistan, represented by the National Holding Company "Uzbekneftegaz" together with the Russian companies "Lukoil" and "Gazprom", is starting to develop large deposits of natural gas on the Ustyurt Plateau [4]. Especially, exploratory drilling for gas production will inevitably lead to a partial loss of suitable habitats of the Red Book plants, degradation of soil and vegetation cover at the sites of drilling wells and construction of gas pipelines. In connection with this, the further intensification of the activities of the oil and gas industry in the Ustyurt region can be predicted to significantly increase the extent and extent of the degradation of the plant world.

This paper presents data on the floral composition and influence of man-made factors on individual elements of the flora of two important botanical territories of Ustyurt—the "Asaka-audan" depression, "Askha-Mazar" and "Kyrkzyz".

2. Materials and Methods

The Ustyurt Plateau is located in the western part of the country between the Aral Sea and the Caspian Sea. The Uzbek part of the plateau is called Karakalpak Ustyurt and it belongs to Kungrad district of semi-autonomous republic of Karakalpakstan. Kungrad city is the center of the district and located outside of the plateau. The study area is located in the southern part of Karakalpak Ustyurt which includes two major geographic objects—Assake-Audan and Sarykamysh Lake [1].

The average annual temperature is about 12˚C; the absolute maximum and minimum are +42 and –40˚C, respectively [5]. The average annual precipitation in the southern part is 90 mm [2]. There is no river in this part of Ustyurt and there are several anthropogenic small lakes which are fed from self-emission

artesian wells (e.g. Shakhpakhty area). Temporary lakes appear in depressions during high-water years [6].

During the expeditions organized in 2011-2014 within the framework of the UNDP/GEF project "Integrated principles of biodiversity conservation in the oil and gas sector of Uzbekistan" we studied the influence of various factors related to the oil and gas industry on the plant world of Ustyurt. In total, 14 points were studied (**Figure 1**).

Defining plant community was conducted identifying the dominant plant species. Vegetation cover and biomass were determined among plant community 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%—sp1, 20 - 40—sp2, 40% - 50%—sp3, 50 - 70—cop1, 70% - 80%—cop2, 80% - 90%—cop3 [7].

In the description of plant communities (ecological condition, species composition, abundance), the scale of P. Drude [7] was used. The structure of coenopopulations of edificators and rare species was revealed according to generally accepted methods [8] [9]. The determination of the types of coenopopulation is carried out by the classification Uranova [10]. The Latin name of the plant species is given by Cherepanov [11].

3. Results and Discussion

3.1. Flora and Vegetation of Pilot Sites

According to E.P. Korovin and AI. Granitov [12], in the floristic composition of the Karakalpak part of Ustyurt there are 165 species belonging to 102 genera that are part of 26 families. Dalnee, Allaniyazov, Sarybaev) 1983) showed that 406 wild plant species belonging to 208 families and 46 families grow in this region. In Ustyurt, mainly psymophilous, gypsophilic, halophilic and ephemeral vegetation are widely spread [2].

During the expedition to the 14 key pilot sites in Ustyurt, organized in 2011-2014, 95 species of vascular plants belonging to 61 genera and 25 families were recorded.

Below is the data on the flora and vegetation of the base sites—"Asaka-audan" depression, "Askha-Mazar" and "Kyrkzyz", where our research was more concentrated.

"Asaka-audan" ("Shahpakhty" area) (No.3) is a hollow located in the south of Karakalpak Ustyurt [2]. This area is characterized by the presence of small sand and saline massifs on the depression, gypsum soils on the plain and variegated hills. To identify this territory as one of the key botanical territories of Ustyurt was the original plant communities, characteristic for the variegated type of vegetation. The uniqueness of this area, from a botanical point of view, is explained by the fact that there is a young coenopopulation of the Red Book species *Euphorbia sclerocyathium* (**Figure 2**). In addition, 5 coenotic populations of

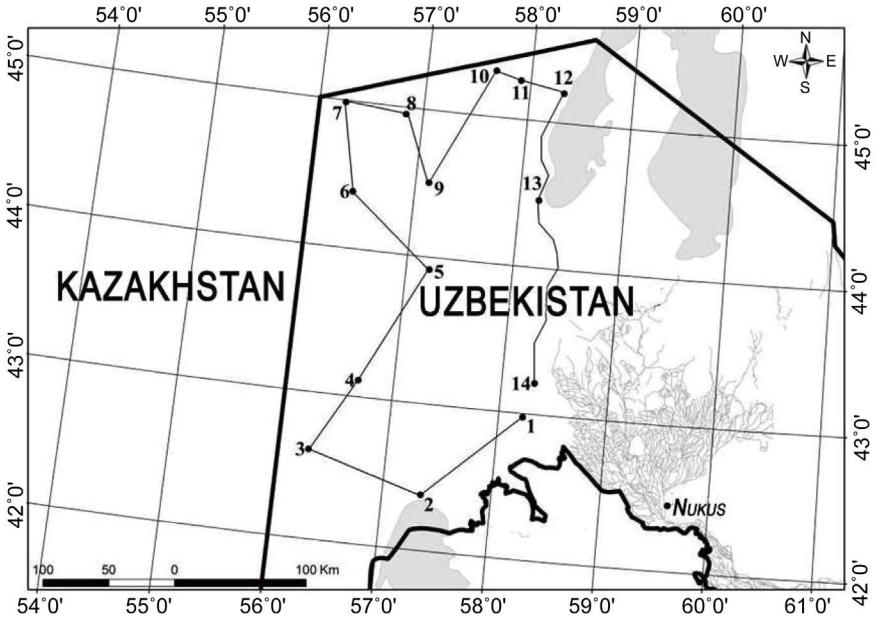

Figure 1. The location of Ustyurt plateau (left). The expedition route organized to Karakalpakistan part of Ustyurt (right): 1—Askha-Mazar, 2—surroundings of the Sarykamysh lake, 3—Asake-audan, 4—Karabaur, 5—sandy area of Kartbaykum, 6—Lysaya, 7—Jarynkuduk, 8—Churuk, 9—Beleuli, 10—Bayterek, 11—Almambet, 12—Aktumsuk, 13—Kasarma, 14—Kyrkkyz.

Figure 2. *Euphorbia sclerocyathium* in the "Shahpakhty" area (left). A new road passing through the center of the population of *Euphorbia sclerocyathium* (right).

Malacocarpus crithmifoliuis found in the Red Data Book of Uzbekistan were found in this area. Another important botanical element of this territory is the relict species of Ustyurt *Salsola arbusculiformus*, which is found in the area of research with small spots. This category includes *Astragalus ammodendron*, *Caragana grandiflora* and shrubs of the family *Fabacea* (Polygonaceae) *Calligonum junceum* described at the beginning of the last century from the shores of the Caspian Sea.

In the course of expeditions from all this territory 66 species of vascular plants belonging to 51 genera and 21 families were recorded. The studied plant communities mainly consist of shrubs and semishrubs (Table 1).

Table 1. Plant communities in the registration area of "Asaka-audan" depression—"Shahpakhty" area.

Registration area, No.	1	2	3	4
Coordinates	N42˚36.611' E56˚16.970'	N42˚36.769' E056˚17.190'	N42˚36.557' E056˚16.880'	N 42˚36.962' E 056˚17.140'
The size of the plot, m^2	10	10	10	10
Plant community	*Calligonum junceum+ Haloxylon aphyllum*	*Caragana grandiflora + Salsola orientalis, S. arbuscula + Artemisia terrae-albae*	*Artemisia diffusa + Haloxylon aphyllum*	*Salsola orientalis + S.arbuscula + Artemisia diffusa*
Projective coverage, %	9.0	20.0	7.0	17.0
Area occupied, %: *trees*	6.0	0.0	1.0	1.0
shrubs	2.0	10.0	1.0	5.0
semishrubs	-	3.0	3.0	10.0
mixgrasses	1.0	7.0	2.0	4.0
Height, sm: *trees*	5.0	-	70 - 80	82.0
shrubs	30 - 45	10 - 70	40 - 50	40 - 70
semishrubs	-	10 - 20	20 - 30	10 - 45
grassy tier	5 - 20	10 - 25	5 - 15	10 - 40

The vegetative community is *Calligonum junceum* + *Haloxylon aphyllum* (N42˚36.611' E56˚16.970'). The botanical composition of this community consists of 9 plant species. Of these, trees are 1, shrubs and semishrubs—3 and herbaceous plants of 5 species. The total projective coverage is 10.0%. The road passes through the center of the described site. Heavy trucks have significantly influenced the ontogenetic state of *Euphorbia sclerocyathium*. Two individuals of *Haloxylon aphyllum* and the same number of *Calligonum junceum*were recorded in the described area. Both species are in a depressed state. The height of individuals of the first species does not exceed 1.5 m, the annual growth is 1-4 cm, the lower branches dry. The height of *Calligonum* does not exceed 50-60 cm, about 70% of shoots are dried up. The annual growth of shoots is up to 3 cm. Plants were in the fruiting phase. Based on the above indicators, the vitality of *Haloxylon* is estimated as low, and *Calligonum* is average. The number of *Euphorbia sclerocyathium* is 10 pcs. Of these, 60.0% are generative and 40.0% virginal. The length of shoots of virginal does not exceed 30 cm, and generative reaches 30 cm. Extinct plants have not been observed. The ontogenetic structure is not full-term, there are no old individuals. Vitality of individuals is average.

This area is dominated by shrubs from different families (N42˚36.769' E056˚17.190'): a large proportion in the projective cover belongs to the *Artemisia terrae-albae*. Along with wormwood there are also *Caragana grandiflora, Salsola orientalis, S. arbuscula, Convolvulus fruticosus, Atraphaxis spinosa*. The site was laid on the southern exposure of the chink. The terrain is uneven, crossed. Soil is gypsiferous, solonchakous. The species composition of this community is quite rich and consists of 14 plant species. The total projective

coverage is 20.0%. On the totality of a number of indicators (age composition of individuals, biometric indices, and ratio of vegetative shoots to generative, share of dried shoots), the vitality of the community dominant –*Artemisia terrae-albae* is estimated as average.

The site was laid on the southern exposure of the chink (N 42˚36.557'E 056˚16.880'). The terrain is uneven, crossed. Soil is gypsiferous, solonchakous. Projective grass cover 7.0%. The center of the registration area is the road. On this *Artemisia diffusa* + *Haloxylon aphyllum* association there are 9 species of vascular plants, one of which is the Red Book species—*Euphorbia sclerocyathium*. There are 20 of them here. Of these, 2 are in the Virginal age, 8 are young generative, 7 are middle-aged generative and 3 old generative plants. 5 individuals of *E. sclerocyathium* in this coenopopulation are in a depressed state.

The site was laid at the very top of the slope on gypsum-bearing soils. Herbaceous plants predominate in the plant cover, although in the general projective cover the role of shrubby plants is great. The botanical composition of this unit is relatively rich and it consists of 17 species. Number of trees-shrubplants 7, and herbaceous 10. As in the previous site, there is no anthropogenic influence on the vegetation cover here. The dominant vegetation cover is *Artemisia diffusa* and *Salsola arbuscula*. The number of specimens of the first species is 33, and in the second—6. Projective coverage of the first species is 8.0%, the second is – 3.0. According to the totality of signs, the vitality of *Artemisia diffusa* is assessed as low, and *Salsola arbuscula* is average.

Due to its location, the surroundings of the settlement "Kyrkzyz" (No.14) (along the Eastern Chink) and its adjacent territory are also important floristic areas. The Ustyurt gas and chemical complex "Surgil" is located on this territory.

Here, the only endemic of Ustyurt is *Allium ravenii* (**Figure 3**), a species rare for the flora of Uzbekistan—*Allium delicatulum* and *Lagochilus acutilobus*, rare for the flora of Ustyurt *Crataegus korolkowii* and *Rosa majalis.* In addition, as a result of processing herbarium materials collected during the expeditions, the flora of Uzbekistan from this region was supplemented by two species –*Centaurea apiculata* Ledeb. and *Jurinea schischkiniana* Iljin. In 5 - 6 km to the

Figure 3. *Allium ravenii* in the "Kirkzyz" area.

north of the Ustyurt gas chemical complex, built on the territory of the settlement "Kyrkzyz", the only cenopopulation of *Malacocarpus crithmifoliuis* found by us was found and evaluated (Figure 4). As shown by biennial studies, this coenopopulation of *M. crithmifoliuis* is younger and more progressive than the cenopopulations, which grows on the western chink.

The survey site was selected in the vicinity of the village of "Kyrkzyz", where a gas processing plant is being built. In order to study the influence of construction works on the environment, in particular on the vegetation cover, this year a number of registration sites were laid down, where the species composition of the site was noted, the projective coverage of the grass stand, the vitality of the dominant and rare species.

In general, 49 species of vascular plants belonging to 45 genera and 20 families were recorded in the "Kirkzyz" area. In this region are mainly 4 type of plant communities (Table 2).

Figure 4. *Malacocarpus crithmifoliuis* and its flowers, fruits and annual shoots (left). The only coenopopulation of *Malacocarpus crithmifoliuis* in the "Kyrkzyz".

Table 2. Plant communities in the registration area of "Kirkzyz" area.

Registration area, №	13	14	15	16
Coordinates	N 43˚13. 467' E 058˚17.917'	N 43˚12.577' E 058˚18.111'	N 43˚12. 365' E 058˚17.989'	N 43˚12.719' E 058˚17.712'
The size of the plot, m^2	10	10	10	10
Plant community	*Anabasis salsa*	*Salsola orientalis* + *Anabasis salsa*	*Salsola orientalis* + *Artemisia terrae-albae*	*Anabasis aphylla*
Projective coverage,%	13.0	21.0	16.0	12.0
Area occupied, %: *trees*	-	-	-	-
shrubs	2.0	-	3.0	-
semishrubs	10.0	21.0	12.0	11.0
mixgrasses	1.0	-	1.0	1.0
Height, sm: *trees*	-	-	-	-
shrubs	30 - 40	-	40 - 60	-
semishrubs	15 - 35	15 - 40	25 - 40	10 - 15
grassy tier	10 - 35	25 - 35	10 - 35	7 - 15

It should be noted that the growth and development of plants is slowed down. In all the surveyed sites, young individuals of both dominant and participating plants were not noted. Annual growth in shrubby plants is 1 - 12 cm, depending on the species. The lowest indices in this respect were observed in biyurgun, comparatively high in *Lycium ruthenicum* and *Salsola orientalis*. In general, the vitality of the dominants in the current year in the vast majority of cases is estimated as low, in some cases as average. Last year, the vitality of most of the dominants was marked as high. For a number of indicators, a similar estimate was given to the rare species *Malacocarpus crithmifolius*. This year, this species has a lot of dry shoots, annual growth is much lower, the number of flowering individuals is also less compared to last year. Accordingly, the vitality of *Malacocarpus crithmifolius* individuals is estimated as average.

Analysis of the species composition of communities based on the data obtained during the period 2013-2014 showed that the number of registered species in the surveyed communities in the current year is less. This is especially pronounced in ephemerals. If last year 11 types of ephemera were registered here, this year their number did not exceed two. All these negative indicators for 2014 (the life condition of dominant and rare species and species diversity), in our opinion, are not related to the negative impact of plant construction on the natural vegetation cover, they are most likely associated with a significantly low temperature of this year in the winter-spring period of the study area.

3.2. Influence of Dusty Roads on the State of Vegetation

During the expeditions, materials were collected on the effect of dust rising from the main highway, on the vegetation cover of the adjacent study area. In the 1980s Alanyazov and Sarybayev [2] indicated completely degraded vegetation of territories destroyed by a man near wells drilled in the "Shahpakhty" hollow ("Asaka-audan" hollow).The results showed that the anthropogenic pressure on the vegetation cover in the "Shahpakhty" continues and becomes more progressive. Especially, around old wells in most cases the plots are not leveled, various technical wastes are not cleaned, the number of roads increases year by year. On the territory of old abandoned wells, on old and now unused roads for the restoration of natural vegetation from the gas companies, no measures are applied. At the same time, numerous roads that lead to the "Shahpakhty" Gas Field is great damage to the natural vegetation cover. The area of the seized lands of one motor road from the main thoroughfare "Kungrad-Zhaslyk" to the "Shahpakhty" Gas Field is no less than 50 hectares.

In 2013, we examined the influence of dusty roads on the growth and development of dominant species and species diversity in the "Shakhpakhty" area. As analysis of collected materials showed, the negative effect of dust particles on vegetation along the road is much higher. The action of dust particles particularly negatively reflects the species diversity and abundance of the territory, the states of ontogeny and intensive formation, and the formation of shoots of plants (**Figure 5**). The survey showed that, as far as distance from the roads, the

Figure 5. Dust lifting from main roads in the "Shakhpakhty" area.

vitality of the dominant species improves, the species composition increases. On gypsum soils, heavy in texture, near the "Shahpakhty" area, *Anabasis salsa* is widely spread. The results of the analysis showed that in the "Shakhpakhty" area, where the road is still heavily used, the vitality of the dominants along the road and closer to it is low. At *Anabasis salsa* and *Salsola orientalis* it is low in a radius of 50 m. Projective coverage does not exceed 8%. Starting from 100 to 200 m, the vitality of the dominants improves and it is estimated as average in *Anabasis salsa* and *Haloxylon aphyllum*. With a distance of 500 m from the roads, the species composition increases, the projective coverage reaches 12% and the vitality of the *Salsola orientalis* is estimated as high. Results have shown that the roads passing through the *Anabasis salsa*, it is grow slowly, since the mechanical composition of soils considerably limits the spread of ephemerals and other herbaceous plants. In the region, the unregulated passage through the steppe of wheeled and caterpillar transport causes a different intensity of disturbance of the soil and vegetation cover mechanically (from compaction to complete destruction), and also through soil contamination (fuel spills, sedimentation of salts of heavy metals), which accordingly cause the transformation of natural ecosystems.

Similar results were obtained in the highway on the region of the "Asha-Mazar" (No.1) leading to the "Shahpakhty" Gas Field. At the same time, 4.3 dry specimens of *Anabasis salsa* were counted closer to the road on an average of 5 m^2. The annual growth of shoots did not exceed 0.5 - 3 cm. 2 km to the west of the road, the vitality of *Anabasis salsa* is higher, there are no dried individuals, the annual growth is 3 - 11 cm. Closer to the road, the species composition of plants did not exceed 5 - 6 species (*Anabasis salsa, A. brachiata, Salsola orientalis, Eremopyrum orientale, Ceratocarpus utriculosus, Artemisia diffusa*), as the distance from the road (2 km) it increased to 9 and in the plant cover, except for the above listed species, *Tamarix sp, Haloxylon aphyllum, Caparis spinosa, Psammogeton setifolium appeared.*

We noted that unlike the "Asha-Mazar" and "Asake-Audan" in the "Kirkkyz" (No. 14) area, the impact on the natural ecosystem is much lower. In this area,

during the construction of the Ustyurt gas chemical complex, technical waste is collected in a pre-designated area. Dumps, after leveling, are piled on top with a more fertile soil and seedlings of *Haloxylon aphyllum*are planted in an ordinary way.

These data repeatedly confirm the increased influence of anthropogenic pressure on vegetation conditions in the territory of Ustyurt. If we take into account the expansion of oil and gas activity in Ustyurt in the future, it immediately requires establishing methods in practice to determine the impact factors and their degrees that affect the state of vegetation in Ustyurt.

3.3. Methods for Determining the Impact of the Oil and Gas Sector on Vegetation

Various methods can be used to determine the degree of anthropogenic impact on vegetation cover. In the course of the study on the effect of oil and gas activity on the vegetation of the Ustyurt Plateau, we tested more than 10 of methods that reliably determine the degree of anthropogenic pressure. The results showed that methods for determining the plant's vital state, the state of plant stand and the state of plant biomass, provide reliable results on the impact of the anthropogenic factor, especially the influence of the oil and gas sector on vegetation (Table 3).

Table 3. Methods for determining the maximum effect on vegetation.

Individual characteristics	Indicators		Degree of anthropogenic impacts
	Control	Experiment	
	I Vital states		
1. Vitality of dominants	high	high	absent
	high	middle	minimal
	high/middle	low	minimal
	middle	middle	absent
	low	low	absent
2. Vitality of rare and endangered species, endemics	high	middle/low	maximum
	middle	low	maximum
	in other cases, there is no effect		
	II State of the herbage		
3. Projective cover	$K_{n\,(\%)}$	$1.5 < K_{n\,(\%)}$	middle/low
		$2 - 3 < K_{n\,(\%)}$	maximum
	in other cases, there is no effect		
4. Species diversity of communities	$K_s = n_i$	$1.5 < K_s = n_i$	middle/low
		$2 - 3 < K_s = n_i$	maximum
	III Biomass states		
5. The mass of annual shoots (together with all vegetative and generative organs)	$K = n_s \cdot m_s$ (gram)	$1.5 < K_{n\cdot m}$	middle/low
		$2 - 3 < K_{n\cdot m}$	maximum

In this case, the most reliable data can be obtained as a result of identifying the vital state of the dominant and/or rare and endemic species of the study area. When assessing the vitality of species, a number of indicators are taken into account, however, in most cases, the focus is on the fullness of ontogeny (v—virginal plants, g1—young generative groups, g2—middle-aged generative, g3—old generative, g3—old generative shortened development cycle, se—senile plants), levels of vitality (I, II), height of bush (cm), length of skeletal shoots (cm), length of annual shoots (cm), percentage of annual vegetative shoots from perennial (%). The totality of all these indicators establishes the vitality of individuals. The low vitality of dominants and endemics in the experimental area, in comparison with the control one, indicates the maximum effect on the vegetation cover (Table 1). However, this approach requires the participation of a more qualified specialist and a certain time for processing the data.

Another method for determining the maximum impact on vegetation is to determine the projected coverage of the grass stand (n = %) and the species diversity of the communities. In this case, the projective covering of the grass stand is determined visually, in% (n = %). This, in our opinion, more practical approach is based on a comparative evaluation of the projective coverage of the control and pilot site. In the case of a projective covering of the natural grass stand of the experimental site, it is two or more times less than the control plot ($2 - 3 < K_{n(\%)}$), the degree of anthropogenic impact on vegetation is estimated as maximum. It should be noted that in determining the projected coverage of the grass stand, the share of secondary sparse communities on the Ustyurt plateau, for example, where the annual halophytes dominate, is not taken into account. In addition, during the determination of the projective cover of the grass stand, the state of species diversity ($S = n_i$) is taken into account in parallel. When the species diversity of the test plot shows two or more times less species (n_i) than the control ($2 - 3 < K_s = n_i$), then one can conclude about the maximum impact of anthropogenic load on vegetation.

One of the convenient ways to identify the effect on vegetation is to determine the average mass (m_s) of annual shoots of dominant species (n_s) in the comparative aspect ($n_s \cdot m_s$). To determine the extent of the effects on the natural vegetation cover, this method does not require a botanist. In the presence of modern electronic equipment, nature conservationists or other organizations interested in biodiversity conservation can determine the mass of annual shoots, and thereby reveal the degree of impact on vegetation. In the event that the average mass of dominants in the experimental area is two or more times lower in comparison with control ones ($2 - 3 < K_{n \cdot m}$), then the degree of impact can be estimated as maximum.

3.4. Proposals on the Composition of Species for Action Plans for Biodiversity Conservation of Ustyurt Plateau

When compiling a list of recommended for the restoration of vegetation species, first of all, the species composition of the natural vegetation cover of the area

where phytoremediation measures will be implemented was taken into account.

The basis of the vegetation cover of the area is formed by *Anabasis salsa* and *Haloxylon aphyllum*, and "Kirkkyz"—*Anabasis salsa*, where in economically significant species of plants recommended for phytoremediation are found in varying degrees of abundance. The list of species recommended for phytoremediation and their characteristics is given in Table 4.

During the expedition with the leadership of the Ustyurt gas-chemical complex, an agreement was reached on restoring the vegetation around the plant with an area of 50 hectares. The scheme of the allotted site for restoration is attached.

4. Conclusions

On the basis of many years of research, the "Shahpakhty" area can be described as one of the key botanical territories of Ustyurt. Specific plant communities, characteristic of the variegated type of vegetation, are recorded here.

The eastern chink, next to which is the Ustyurt gas chemical complex (Surgil)—settlement "Kyrkzyz", is also an important floristic region. Here the only endemic of Ustyurt—*Allium ravenii,* a species rare for the flora of Uzbekistan—*Allium delicatulum* and *Lagochilus acutilobus*, rare for the flora of Ustyurt *Crataegus korolkowii* are grows. Thanks to an expedition organized with the financial support of this project, the flora of Uzbekistan from this region was supplemented by two species—*Centaurea a*piculata Ledeb. and *Jurinea schischkiniana* Iljin.

The conducted research confirms the strengthening of anthropogenic action on the Ustyurt plateau for the future. In addition, with the desiccation of the Aral Sea, Ustyurt's climate locally changes, that this is progressing the destruction of the region's biological diversity. Of the main anthropogenic types of pressure is the oil and gas industry. The negative scope of the activities of this industry is so great that even when transporting oil and gas raw materials with the help of cars, dust pickers negatively affect the state of the vegetation cover, which

Table 4. Perspective dominates for phytoremediation.

Type	Local name of plants	Vital forms	Seed material	Economic characteristics
Haloxilon aphyllum	black saxaul	tree	saplings and seeds	fodder plant
Artemisia terrae-albae	jusan	semishrubs	seeds	fodder plant
Salsola orientalis	keireuk	semishrubs	seeds	fodder plant
Ceratoides ewersmanniana	teresken	semishrubs	seeds	fodder plant
Halothamnus subaphylla	chogon	semishrubs	seeds	fodder plant
Alhagi persarum	yantak	perennial herbaceous	seeds	fodder and medicinal plant
Capparis spinosa	cavil	perennial herbaceous	seeds	food, medicinal plant
Euphorbia sclerociathum	-	perennial herbaceous	seeds	poisonous plant, Red Book species

worsens the ontogeny's fullness, morphometric parameters, the process of vegetative shoots formation, and the projective covering of the grass stand.

The determination of the vital state, the condition of the grass stand and the biomass provide reliable information about the state of vulnerability of the Ustyurt vegetation cover to the negative effect of oil and gas activity. In this case, the degree of anthropogenic impact on vegetation can be determined in three ways. The first method is the most academic, *i.e.* it is based on an assessment of the vitality of the dominant and/or endemic species of the study area. Another most convenient way to determine the effect on vegetation in the field is to compare the projective cover (PC) and the species diversity of the pilot site with the control plot. In the absence of a specialist, the influence on vegetation can be determined by weighing the annual shoots of dominant and/or rare species with all vegetative and generative elements in a comparative aspect.

Priority for the restoration of the negative impact of the oil and gas sector of Ustyurt is phytoremediation measures. In this case, *Haloxylon aphyllum, Artemisia terrae-albae, Salsola orientalis, Alhagi persarum, Capparis spinosa, Euphorbia sclerociathum, Ceratoides ewersmanniana, Halothamnus subaphylla, Agropyron fragile* are promising species when replenishing the natural vegetation cover.

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