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## Floristic composition of sand massifs in the western part of the Sub Ural plateau

Currently, on the territory of Kazakhstan, one of the topical issues is the study of the current state of ecosystems. The aim of the study is a biomorphological, geographical and ecological analysis of the sand massifs flora in the western part of the Sub Ural plateau. 137 species of vascular plants belonging to 99 genera and 35 families were registered in the Karagash and Akkum sand massifs. Most of the flora (70; 50.4%) is occupied by species belonging to the *Asteraceae*, *Poaceae*, *Fabaceae* and *Chenopodiaceae* families. The predominant in the flora are rhizomatous species: *Calamagrostis epigeios*, *Carex colchica*, *Helichrysum arenarium*, *Leymus racemosus*, *Scirpoides holoschoenus*, etc. The presence of adventitious species in the flora indicates high anthropogenic pressure, unfavorable growing conditions and habitat disturbance. The predominance of xerophytes is associated with the adaptation of psammophytes and steppe species to growing in arid climates. The chorological analysis showed the predominance of the wide-ranging Eurasian and Ancient Mediterranean species. There is a need to protect meadow and psammophytic mixed-grass-stipa grass and juniper communities. They belong to plant species distribution area of which is currently being intensively reduced, so it is necessary to organize comprehensive measures to protect their growing environment. Information about the species composition of plants, their biological and ecological features, which in the future will become the basis for the organization of monitoring work, are of great practical importance.

**Keywords:** West Kazakhstan region, Sub Ural plateau, sand massif, psammophytes, floristic analysis, vegetation cover, Akkum, Karagash.

### Introduction

The United Nations Convention on combating desertification, adopted in Paris on June 17, 1994, is considered one of the most important international documents aimed at ensuring sustainable development. Currently, the intensification of the desertification process leads to the formation of ecological disaster zones. More than 66% of the territory of the Republic of Kazakhstan is affected by this phenomenon. This process continues from year to year, and in this regard, one of the most urgent issues is the study of ecosystems of sand massifs found in the dry steppe region. In this regard, the Republic of Kazakhstan is carrying out a set of measures aimed at fulfilling the requirements mentioned in this convention [1].

The West Kazakhstan region is located in the north-west of Kazakhstan. The relief of the region is formed by spurs of the Obshii Syrt, the Sub Ural plateau, the Presyrt slope, the Peri-Caspian depression, and the Zhayik river valley [2].

The Sub Ural plateau is characterized by a high denudation step-slope hilly and ridged topography with a height of 250-400 m, divided by the Presyrt slope, which stretches from the northwest to the southeast from the Peri-Caspian depression in the west. There are salt domes, large and small chalk hills and individual chalk outcrop, sand massifs, lakes, salt flats, river valleys, ravines and gullies. In the western part of the Sub Ural plateau there are sandy massifs formed from surface alluvial-delta marine sediments. Their appearance is due to the action of rivers found in the Sub Ural plateau. During the multi-phase transgression and regression of the ancient Caspian Sea, observed in the Pleistocene period, it was formed in the place of the deltas of abundant water rivers flowing into the sea.

The well-known scientist, researcher of desert regions A.G. Gael and his colleagues believe that the formation of these sand massifs was influenced by the alluvial sediments transported due to active erosion processes during the Ice Age [3].

At the edge of the sand massifs, there are small sand dunes, and towards the central part, they change to medium-height sand dunes and rolling sand ridges. Sand dunes vary in height from 2 to 17 meters. They are alternated with large dune depressions, the depth of which is between 1-8 m, and the area reaches 1-2 sq.km in some places.

Currently, due to the rapid development of the processes of desertification and degradation of natural ecosystems, the information about the species composition of plants growing in the sand massifs of the western part of the Sub Ural plateau, their biological and ecological features is of great practical importance.

### *Experimental*

Research work on the flora composition of sand massifs in the western part of the Sub Ural plateau was carried out in 2020-2022.

The purpose of the work: to conduct a comprehensive analysis of the floral composition of sand massifs in the western part of the Sub Ural plateau. In the course of the study, the following tasks were set: to clarify the systematical groups of plants growing in the sand massifs of the western part of the Sub Ural plateau, to analyze the biomorphological, geographical and ecological composition and to justify protection measures.

The Karagash and Akkum sand massifs in the western part of the Sub Ural plateau were taken as the research area. They are located in the eastern part of the West Kazakhstan region, which, according to geobotanical zoning, is included in the Black Sea region – Kazakhstan region of the Eurasian steppe zone [4]. Doctor of biological sciences, professor V.V. Ivanov, who has studied the West Kazakhstan region for many years, refers these sand massifs to the psammophytic southern steppes with feather grasses vegetation [5]. The Karagash sand massif is located between the Buldyrty and Tamdy rivers, and Akkum is located at the confluence of the Kaldygayty and Kuagash rivers (Fig. 1).

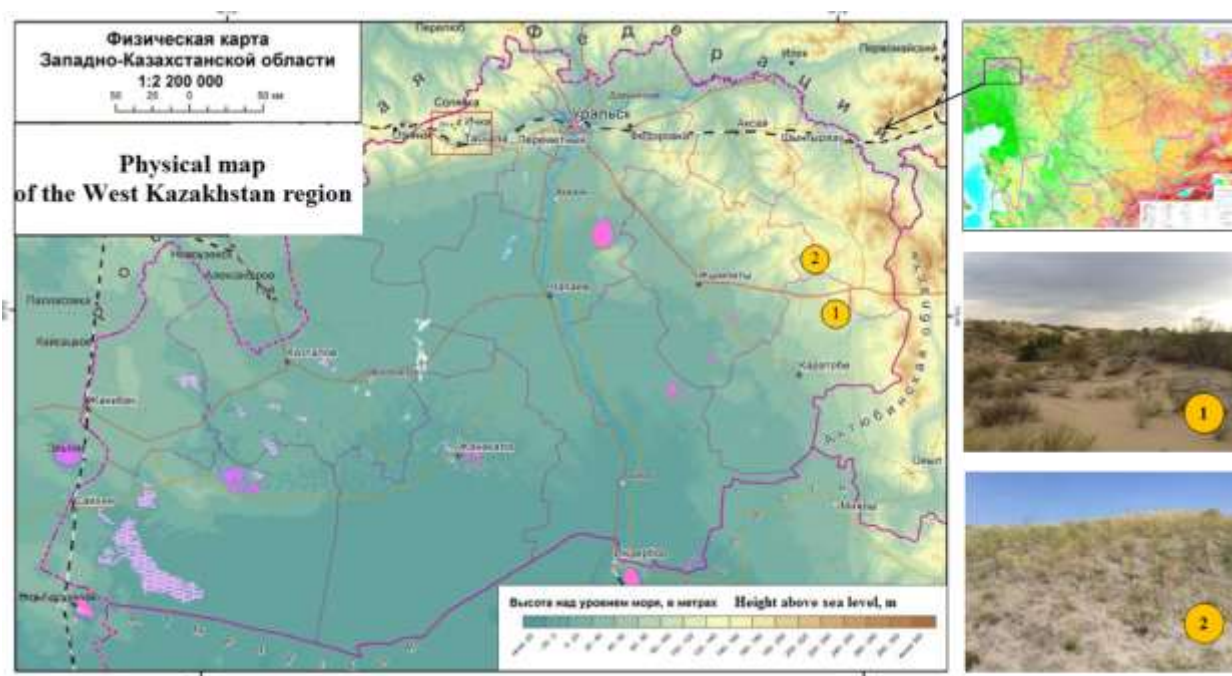


Figure 1. Research area in the West Kazakhstan Region: Point 1 – Akkum sand massif; Point 2 – Karagash sand massif

Geobotanical studies were conducted on a standard area of 100 square meters using existing methods [6]. The floristic composition and projective cover of vascular plants were determined in the test areas. To identify the plants, “Flora of the USSR” (1934-1960) [7], “Flora of Kazakhstan” (1956-1966) [8], “Illustrated determinant of plants of Kazakhstan” (1969-1972) [9], according to V.V. Ivanov “The determinant of the families of the Northern Caspian” (1966-1974) [10] and other handbooks were used. The flora list was clarified according to the literary sources [11] and the data of the Herbarium fund of M. Utemisov West Kazakhstan University (PPIU). Biomorphological analysis was carried out according to Serebryakov [12]. Cenotic groups according to the data of R.V. Kamelin [13], geographical groups according to A.L. Takhtajyan [14] and ecological groups were determined based on the relation of plants to moisture. The names of vascular plants are given taking into account the summary of S.K. Cherepanov [15].

The Jaccard’s coefficient, which indicates the floristic similarity between the sites, is calculated as:

$$K_J = (c / a + b - c) * 100\%$$

with:  $K_J$  = Jaccard's coefficient; a – the number of species in the first site; b – the number of species in the second site; c – the number of common species for these two sites [16].

Microsoft Excel statistical analysis package was used for statistical processing of the received research materials.

### Results and Discussion

Studies of the flora and vegetation of sand massifs in the western part of the Sub Ural plateau were carried out by Shtromberg Ch. (1894), V.M. Savich (1908), I.V. Larin (1929), A.P. Shimanyuk (1941), A.G. Gael et al. (1932, 1949), S.A. Nikitin (1954), V.V. Ivanov (1958), A.Z. Petrenko (1968), A.Yu. Bogdanov (1971), S.K. Ramazanov (2001), T.E. Darbaeva (2002), T.E. Darbaeva et al. (2021), etc.

The Karagash sand massif is located at the high source of the Buldurty river [17]. On an area of 7 thousand hectares, there are moderately high and low sand dunes formed as a result of Aeolian processes. The dominant psammophyte plants of sand dunes include *Artemisia marschalliana* Spreng, *Carex colchica* J. Gay, *Calligonum aphyllum* (Pall.) Gürke, *Helichrysum arenarium* (L.) Moench, *Leymus racemosus* (Lam.) Tzvel., etc. In the inter-sand depressions lying near the groundwater grows *Betula pendula* Roth., *B. pubescens* Ehrh., *Carex colchica* J. Gay, *C. praecox* Schreb., *Populus tremula* L., *Salix caspica* Pall., *S. rosmarinifolia* L., etc. In their shrub tier includes *Frangula alnus* Mill., *Rhamnus cathartica* L., *Rosa cinnamomea* L., etc., and the herbaceous tier consists of mesophilic grasses and mixed-grass. On the slopes and tops of individual sand dunes can be found juniper communities (*Juniperus sabina* L.) (Fig. 2).

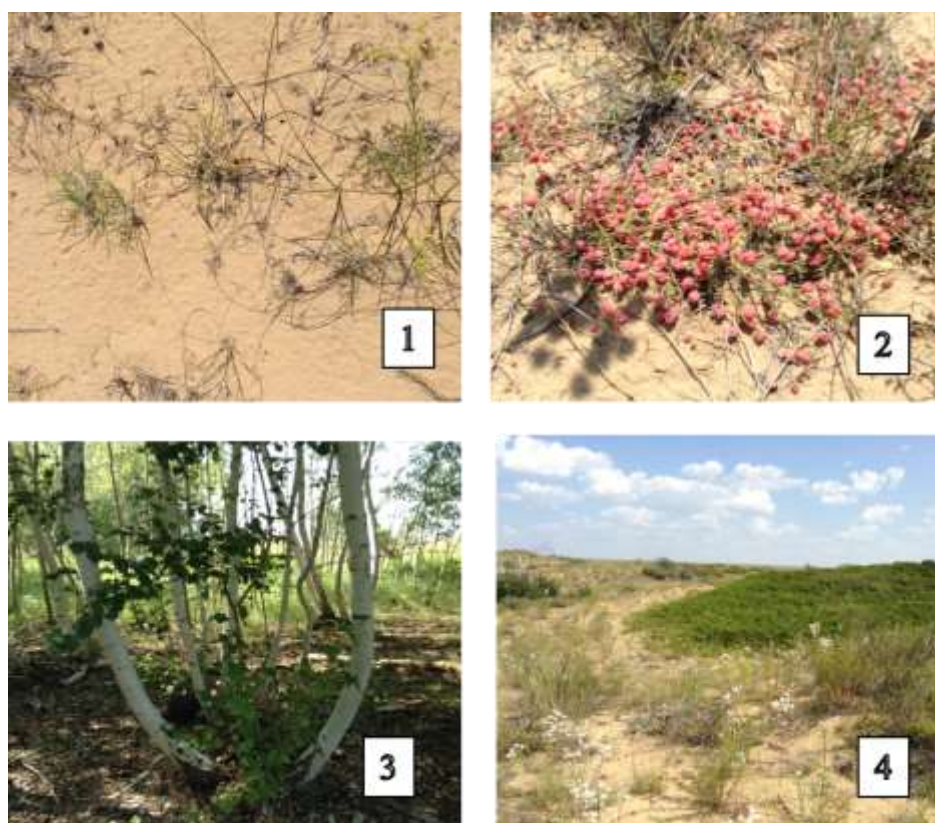


Figure 2. Karagash sand massif: 1 – The sparse psammophilous communities; 2 – Communities with *Ephedra distachya* L.; 3 – Birch-aspen groves; 4 – Communities with *Juniperus sabina* L.

In the central part of the region there are loose sand dunes that are not supported by vegetation. Sandy massifs in the north, north-east and east side gradually change to fescue-feather-grass steppes (*Festuca valesiaca* Gaud. + *Stipa* sp.).

Akkum sand massif is located on the plain terrace of the Kuagash and Kaldygayty rivers with an area of 7.5 thousand hectares. It is believed to have formed in the Quaternary period on the site of the abundant warty river deltas which flowed into the Khvalyn sea. The central part consists of rolling medium-height sand dunes, the Windward slope of which is elongated and flat, and the slope side is steep towards inter-sand de-



pressions in the form of horseshoe or crescent. On the outskirts of sand massifs grow psammophyte plants (*Artemisia marschalliana* Spreng, *Carex colchica* J. Gay, *Calligonum aphyllum* (Pall.) Gürke, *Leymus ramosus*, *Juniperus sabina* L., etc.).

In the areas close to the shores of the Akkum sand massif, tree-shrub plants grow in the hollows between high sand dunes and on their grassy slopes. Groundwater is unmineralized fresh (0.3-0.7 g/l) and is located close to the surface (0.2-1.0 m). The vertical structure of birch communities consists of 3 tiers. The first tree tier is birch (*Betula pendula* Roth., *B. pubescens* Ehrh.), which is considered an edifier, its height is 7-10 m, and its diameter is 15 cm.

The height of the second tier is 1.5-2.1 m., consisting of shrubs: *Calligonum aphyllum* (Pall.) Gürke, *Chamaecytisus ruthenicus* (Fisch. ex Woloszcz.) Klásk, *Salix caspica* Pall., *Spiraea hypericifolia* L. The height of the third grassy tier is 0.2-0.9 m., consists of herbaceous plants (*Asperula danilewskiana* Basiner, *Calamagrostis pseudophragmites* (Haller f.) Koeler, *Carex colchica* J. Gay., etc.). Projective cover reaches 20-40%, saturation of species – 4-5, number of species – 9-11. Hand-planted *Populus alba* L., *P. nigra* L., *Pinus sylvestris* L. can be found in some depressions between dunes (Fig. 3).

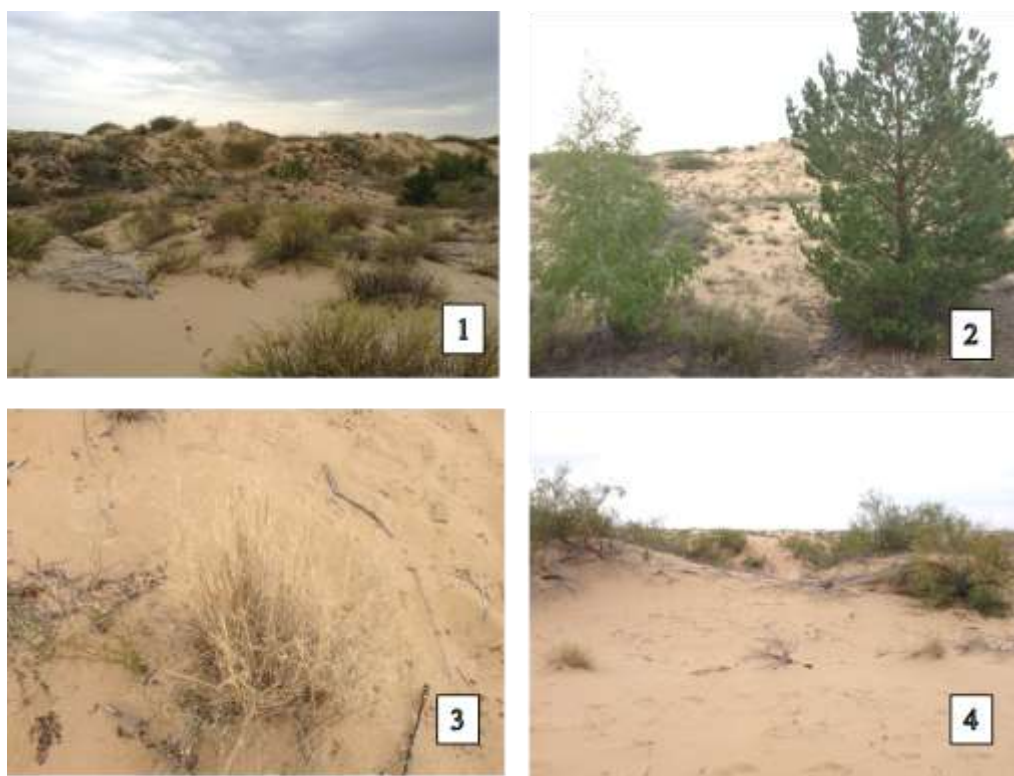


Figure 3. Akkum sand massif: 1 – General view, 2 – Pine plantings in depressions between sandy dunes, 3 – The sparse psammophytic communities, 4 – The willow communities

On the slopes of moderately high sand dunes and ridges, and sometimes even at elevations, there are shrubs (*Salix caspica* Pall., *S. rosmarinifolia* L., *S. daphnoides* Vill., *Chamaecytisus ruthenicus* (Fisch. ex Woloszcz.) Klásk., *Ch. zingeri* (Nenukow ex Litv.) Klask, *Spiraea hypericifolia* L.), semishrubs (*Artemisia marschalliana* Spreng.) and communities of psammophytic herbaceous vegetation (*Achillea micrantha* Willd., *Carex colchica* J. Gay, *Festuca beckeri* (Hack.) Trautv., *Polygonum arenarium* Waldst. et Kit. etc.).

The first tier with a height of 0.8-1.2 m. is overgrown with shrubs; the second tier has a height of 0.4-0.7 m. forms herbaceous plants, and semi-shrubs that can be: *Artemisia marschalliana* Spreng, *Chondrilla ambigua* Fisch. ex Kar. et Kir., *Helichrysum arenarium* (L.) Moench., *Jurinea arachnoidea* Bunge, in the third tier there are low (0.15-0.35 m) herbaceous plants: *Agropyron desertorum* (Fisch. ex Link) Schult., *Festuca beckeri* (Hack.) Trautv., *Poa bulbosa* L. Projective cover in these communities does not exceed 30-50%, the saturation of species is 3-5, the number of species is 11-13.

Towards the central part, on the slopes of sand dunes and ridges, communities with *Calligonum aphyllum* (Pall.) Gürke, are formed. In these communities, 3 tiers are also distinguished. The first tier is dominated by *Calligonum aphyllum* with a height of up to 1.5 m. The second tier is formed by *Agropyron fragile* (Roth)

*P. Candargy*, *Aristida pennata* Trin., *Artemisia marschalliana* Spreng, *Gypsophila paniculata* L., *Leymus racemosus* (Lam.) Tzvel. with a height of 0.4-0.7 m. and 3 tiers are formed by low plants with a height of 0.15-0.3 m: *Anisantha tectorum* (L.) Nevski, *Poa bulbosa* L. Projective cover does not exceed 40-50%, species saturation – 7-9, number of species – 14-18.

Towards the southern part of the massif, monocenosis communities of Juniper (*Juniperus sabina* L.) are observed on the slopes and higher sides of the sand dune.

As a result of the conducted research, it was revealed that 137 species of vascular plants belonging to 99 genera and 35 families grow on the sand massifs of the western part of the Sub Ural plateau. 94 species were recorded in the Karagash sand massif, and 121 species in the Akkum massif (Table 1).

Table 1

#### Taxonomic diversity of the sand massif flora in the western part of the Sub-Ural plateau

Regions	Number of			Average number of		
	species	genera	families	species in family	genera in family	species in genera
West Kazakhstan region	1256	487	117	10.7	4.16	2.57
Sand massifs of the western part of the Sub Ural plateau	137	99	35	3.91	2.83	1.38
Karagash sand massif	94	74	29	3.24	2.55	1.27
Akkum sand massif	121	86	32	3.78	2.69	1.41

This is 10.9 percent of the 1256 species found in the region, according to the scientist O.T. Kolchenko, who studied the vegetation cover of the West Kazakhstan region for many years [2].

A comparative analysis of the species composition of these two arrays was performed by calculating the Jaccard's similarity coefficient,  $K_j = 56.9\%$ . The high coefficient of similarity indicates the similarity of their species composition, that is, it can be concluded that the similarity of environmental conditions plays an important role in the formation of flora.

Among them, the basis of the flora is made up of *Magnoliophyta* (132 species; 96.4%), and the share of *Equisetophyta* (2; 1.4%) and *Pinophyta* plants (3; 2.2%) is insignificant. The *Magnoliopsida* are dominant with 102 species (74.5%). The *Liliopsida* include 30 species (21.9%). The ratio of monocotyledonous and dicotyledonous plants is 1: 3.4.

The taxonomic analysis of the composition of plants found in the region showed the predominance of the *Asteraceae* family, which includes 25 species, representing 18.2% of the plants found in the study area. The dominant families include *Poaceae* (20 species; 14.6%), *Fabaceae* (16; 11.7%), and *Chenopodiaceae* (9; 6.5%). This 4 family makes up half of the species found in the region (50.4%). Most of the dominants that make up the main vegetation cover also belong to this family (*Agropyron fragile* (Roth) P. Candargy, *Aristida pennata* Trin., *Artemisia lerchiana* Web., *A. marschalliana* Spreng, *Leymus racemosus* (Lam.) Tzvel. etc)

The average species richness per family is 3.91. The level of species wealth above the average is 8 families; the total number of them is 94 species (68.6%). The rest of the families are limited to 2-3 species. The 16 families are limited to only 1 species.

The largest genera are *Carex* (5 species), *Astragalus* (4), *Achillea* (4), *Artemisia* (4). Results of the analysis show a small number of large polymorphic genera; most genera are limited to only 2-3 species. 73 genera are limited to only 1 species.

Life forms of plants are considered an integral indicator of their relationship with the environment formed in the course of adaptive evolution. The flora of sand massifs in the western part of the Sub Ural plateau contains 7 species of trees and 17 shrubs. They are often found in inter-sand depressions where fresh groundwater lies close to the surface (Table 2).

**Life forms of the sand massif flora in the western part of the Sub-Ural plateau, according to I.G. Serebryakov's classification**

Life forms	Number of species	Percentage of the total number of species
Tree and woody plants 32 species (23.36%)		
Trees	7	5.11
Shrubs	17	12.41
Semishrubs	4	2.92
Dwarf semishrubs	4	2.92
Perennial (polycarpic) herbaceous plants 80 (58.39%)		
Grassy horsetails	3	2.19
Long-rhizomatous	15	10.95
Rhizomatous	10	7.30
Short-rhizomatous	8	5.84
Tuberiferous-rhizomatous	1	0.73
Taproot	26	18.98
Bulbiferous	2	1.46
Loose-tussock	1	0.73
Dense-tussock	7	5.11
Tussock	4	2.92
Soboliferous	3	2.19
Annual (monocarpic) herbaceous plants 25 (18.25%)		
Biennials	12	8.76
Annuals	13	9.49
Total	137	100

The results of the analysis of the flora composition of the research area showed that the dominant life form is perennial herbs (80 species, 58.39%). Polycarpics are dominated by vegetatively mobile biomorphs (37 species, 27.01%). The vast majority are long rhizomes, as they are well adapted to fixing sand: *Calamagrostis epigeios* (L.) Roth., *C. pseudophragmites* (Haller f.) Koeler., *Carex colchica* J. Gay., *Helichrysum arenarium* (L.) Moench., *Leymus racemosus* (Lam.) Tzvel., *Scirpoides holoschoenus* (L.) Soják., etc. There are 25 species of monocarpics, which make up 18.25 percent of the flora.

Since the degradation processes are quickly observed in sandy areas, on the species composition of plants also has a significant influence. For example, the degraded steppes are mainly dominated by annual plants but the protected steppes contain more perennials [18].

The flora of sandy massifs is characterized by its diversity in its cenotic composition (Table 3).

Table 3

**Cenotic analysis of the sand massif flora in the western part of the Sub-Ural plateau**

Florocenotic element	Number of species	Percentage of the total number of species
Forest 12 species (8.76%)		
Forest	11	8.03
Meadow-forest	1	0.73
Forest-steppe 17 (12.41%)		
Steppe 67 (48.91%)		
Steppe	48	35.04
Desert steppe	7	5.11
Mountain steppe	4	2.92
Meadowsteppe	8	5.84
Desert 8 (5.84%)		
Desert	6	4.38
Steppe desert	1	0.73

Sandydesert	1	0.73
Meadow 23 (16.79%)		
Meadow	18	13.14
Meadow-swamp	1	0.73
Field-Meadow	3	2.19
Forest-meadow	1	0.73
Waterside 3 (2.19%)		
Weed 7 (5.11%)		
Total	137	100

7 major florocenotypes consisting of 16 florocenoelements were distinguished. The dominant florocenotype is the steppe florocenotype, which occupies 48.91% of the flora of the region. It should be noted that the steppe type of vegetation includes communities of xerophilous, for the most part, herbaceous plants [19]. Abundant moisture and proximity of unmineralized groundwater in the depressions between the sand dunes contribute to the increase in the share of meadow florocenotypes (23; 16.79%).

The flora also contains adventive species (weeds) (7; 5.1%), which is associated with high anthropogenic pressure on the region and unfavorable growth environment, and is also an indicator of ecosystem destruction. Deterioration of the habitat leads to the reduction of the range of local natural species, the reduction of nutritious fodder plants, and the increasing effect of poisonous, harmful and poor forage plants adapted to grow in unfavorable conditions [20].

In the composition of the flora, there was a predominance of plants adapted to growth in drought, especially with an increased proportion of intermediate groups – mesoxerophytes and xeromesophytes (Table 4).

Table 4

#### Ecological groups in relation to the humidity of the sand massif flora in the western part of the Sub-Ural plateau

Ecological groups according to humidity	Number of species	Percentage of the total number of species
Mesohygrophytes	3	2.19
Hygromesophytes	2	1.46
Mesophytes	35	25.55
Xeromesophytes	31	22.63
Mesoxerophytes	31	22.63
Xerophytes	35	25.55
<b>Total</b>	137	100

Chorological or geographical analysis shows the physico-geographic features of the region, nature and climate conditions within the range of plants and the nature of migration. The results of the analysis showed that there are 7 major areal types and 13 geoelements (Table 5).

Chorological or geographical analysis shows the physical and geographical features of the region, the climatic conditions of nature and the nature of migration within the range of plant distribution. The results of the analysis showed that 7 large area types and 13 geoelements occur (Table 5).

Table 5

#### Chorological analysis of the sand massif flora in the western part of the Sub-Ural plateau

Name of types of area (geoelements)	Number of species	Percentage of the total number of species
Eurasian areal type 48 species (35.04%)		
Eurasian	34	24.82
Euro-Siberian	13	9.49
East European-Kazakhstan	1	0.73
European areal type 24 (17.52%)		
European	5	3.65
Pontic	19	13.87

Holarctic areal type 11 (8.03%)		
Ancient Mediterranean area type 29 (21.17%)		
Ancient Mediterranean	26	18.98
Asiatic	3	2.19
Mediterranean area type 9 (6.57%)		
Turanian areal type 10 (7.30%)		
Aral-Caspian	6	4.38
Pre-Caspian	2	1.46
Sarmatian	2	1.46
Pluriregional areal type 6 (4.38%)		
Total	137	100

The analysis of the composition of the flora showed a predominance of wide-area Eurasian (48 species, 35.04%) and Ancient Mediterranean (29 species, 21.17%) species. The meeting of Holarctic, European, Eurasian and Turanian species is explained by migration processes.

The vegetation cover of sand massifs fixes loose sands and has a favorable effect on the ecological condition of the adjacent territory. Both sand massifs are surrounded by riverine forests with unique forest and meadow vegetation, denser forests and large lake basins in depressions near large ravines and groundwater. Sand massifs are used in animal husbandry, therefore it is necessary to systematically carry out measures to improve the variety and quality composition of vegetation and maintain ecological stability. Degraded areas are dominated by milkweed communities (*Euphorbia seguieriana* + *Leymus racemosus*).

Both sand massifs are included as geological objects in the list of subsurface areas of special ecological, scientific and cultural value [21]. *Stipa pennata* L. is listed in the “List of Rare and Endangered species of plants and animals of the Republic of Kazakhstan” (2006) [22], and 8 rare and endangered species are listed in the Green Book of the West Kazakhstan region [23]: *Achnatherum splendens* (Trin.) Nevski, *Betula pendula* Roth, *B. pubescens* Ehrh., *Chamaecytisus borysthenicus* (Gruner) Klask., *Ch. zingeri* (Nenukow ex Litv.) Klask., *Helichrysum arenarium* (L.) Moench., *Juniperus sabina* L., *Rhaponticoides kasakorum* (Iljin) M.V. Agab. & Greuter ex C. Shih & L. Martins. They need to status correction by preparation of new issue of the Red data book.

Forest groves, meadows, mixed-grass-stipa grass communities and juniper-grown areas are now rare due to the influence of natural and anthropogenic factors (wildfires, excessive livestock grazing, non-observance of mowing regime, unsystematic collection of medicinal plants, etc.), therefore their protection it is necessary to organize measures. In order to organize effective protection measures for individual plants, their populations and communities, there is a need to comprehensively protect their growing environment first.

“Karagash” and “Akkum” psammophyte massifs should be organized not only as specially protected natural areas at the local level, but also as a complex ecosystem at the republican level with large-scale biosphere significance.

### Conclusions

As a result of the conducted research, it was revealed that 137 species of vascular plants belonging to 99 genera and 35 families grow on the sand massifs of the western part of the Sub Ural plateau.

The flora composition of sand massifs in the western part of the Sub Ural plateau was determined. In the study area, 137 species belonging to 35 families are found. Most of the flora composition (70 species; 50.4%) is occupied by the families *Asteraceae*, *Poaceae*, *Fabaceae* and *Chenopodiaceae*. The results showed that in the flora composition of the study area is dominated by long-rhizomatous species that adapted to fixing sand: *Calamagrostis epigeios* (L.) Roth., *Carex colchica* J. Gay., *Helichrysum arenarium* (L.) Moench, *Leymus racemosus* (Lam.) Tzvel., *Scirpoides holoschoenus* (L.) Soják., etc. The meadow vegetation is dominated in the blowing depressions and in sites with closely located non-mineralized fresh groundwater (23; 16.79%). The flora showed a predominance of xerophytes and intermediate groups (mesoxerophytes and xeromesophytes). Their predominance is associated with the adaptation of psammophytes and steppe species to growing in arid climates. The chorological analysis showed the predominance of the wide-ranging Eurasian (48 species, 35.04%) and Ancient Mediterranean (29 species, 21.17%) species. The pres-



ence of adventitious species in the flora (7; 5.1%) indicates high anthropogenic pressure, unfavorable growing conditions and habitat disturbance. The deterioration of the ecological state of the distribution area affects the communities of rare plants both directly and indirectly. In this regard, it is advisable to organize reference areas of biodiversity or key botanical territories in meadows, and psammophytic mixed-grass-stipa grass and juniper communities. It is necessary to carry out measures to reduce anthropogenic pressure on the ecosystems of this territory, taking into account the biodiversity of plants and the possibilities of their effective use in the economy.

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## Подурал үстіртінің батыс бөлігіндегі құмды массивтердің флоралық құрамы

Бүгінгі күні Қазақстан аумағында экожүйелердің қазіргі жай-күйін зерделеу өзекті мәселелердің бірі. Зерттеудің мақсаты — Подурал үстіртінің батыс бөлігіндегі құмды алқаптардың флорасына биоморфологиялық, географиялық және экологиялық талдау жасау. Аққұм және Қараағаш құмды массивтерінде 99 туыс пен 35 тұқымдасқа жататын түтікті өсімдіктердің 137 түрі тіркелді. Флора құрамының басым бөлігін (70 түр; 50,4%) *Asteraceae*, *Poaceae*, *Fabaceae* және *Chenopodiaceae* тұқымдасына жататын түрлер алады. Талдау нәтижелерінде тамырсабақты түрлер басымдығын көрсетті. Олар: *Calamagrostis epigeios*, *Carex colchica*, *Helichrysum arenarium*, *Leymus racemosus*, *Scirpoides holoschoenus* және т.б. Флора құрамында адвентивті түрлердің кездесуі антропогендік қысымның жоғарылығын, өсу ортасының қолайсыздығын және мекен ету ортасының бұзылғандығын көрсетеді. Ксерофиттердің басымдығы псаммофиттер мен далалық түрлердің құрғақ климат жағдайында өсуге бейімделуімен байланысты. Хорологиялық талдау нәтижелері кең аралды еуразиятық және ежелгі жерортатеңіздік түрлердің басым екендігін көрсетті. Шалғынды және псаммофитті әр түрлі шөпті-селеулі, сондай-ақ арша қауымдастықтарын қорғау қажеттілігі туындайды. Бұл қауымдастықтар қазіргі уақытта таралу аймағы қарқынды түрде азайып бара жатқан өсімдік түрлеріне жатады, сондықтан олардың өсу ортасын тұтас қорғау арқылы кешенді шараларды ұйымдастыру қажет. Өсімдіктердің түрлік құрамы, олардың биологиялық және экологиялық ерекшеліктері туралы мағлұматтардың практикалық маңызы зор, олар болашақта мониторинг жұмыстарын ұйымдастыруға негіз болып саналады.

*Кілт сөздер:* Батыс Қазақстан облысы, Подурал үстірті, құмды массив, псаммофиттер, флоралық талдау, өсімдік жамылғысы, Аққұм, Қараағаш.

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## Флористический состав песчаных массивов западной части Подуральского плато

В настоящее время на территории Казахстана одним из актуальных вопросов является изучение современного состояния экосистем. Целью исследования является биоморфологический, географический и экологический анализ флоры песчаных массивов западной части Подуральского плато. В песчаных массивах Карагач и Аккум зарегистрировано 137 видов сосудистых растений, относящихся к 99 родам и 35 семействам. Большую часть состава флоры (70; 50,4 %) занимают виды, принадлежащие к семействам *Asteraceae*, *Poaceae*, *Fabaceae* и *Chenopodiaceae*. Преобладающими в составе флоры являются корневищные виды: *Calamagrostis epigeios*, *Carex colchica*, *Helichrysum arenarium*, *Leymus racemosus*, *Scirpoides holoschoenus* и др. Наличие адвентивных видов в составе флоры свидетельствует о высоком антропогенном давлении, неблагоприятных условиях произрастания и нарушения среды обитания. Преобладание ксерофитов связано с адаптацией псаммофитов и степных видов к произрастанию в условиях засушливого климата. Результаты хорологического анализа показали преобладание широкоареальных евразийских и древнесредиземноморских видов. Возникает необходимость охраны луговых и псаммофитных разнотравных-ковылных и можжевелевых сообществ. Они относятся к видам растений, ареал распространения которых в настоящее время интенсивно сокращается, поэтому необходимо организовать комплексные меры защиты среды их произрастания. Важное практическое значение имеют сведения о видовом составе растений, об их биологических и экологических особенностях, которые в будущем станут основой для организации мониторинговых работ.

*Ключевые слова:* Западно-Казахстанская область, Подуральское плато, песчаный массив, псаммофиты, флористический анализ, растительный покров, Аккум, Карагач.

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