Forage plants of Karakalpak Ustyurt (Uzbekistan)

Nodira Rakhimova*, *Khabibullo* Shomurodov, *Tashkhanim* Rakhimova, and *Vasila* Sharipova

Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan, Tashkent, Uzbekistan

Abstract. It has been found that in the territories of the Karakalpak Ustyurt (Uzbekistan), there are at least 497 species belonging to 244 genera and 54 families. The basis of the forage flora of the research area is represented by representatives of the families Amaranthaceae (80 species), Asteraceae (77), Poaceae (58), Brassicaceae (55), Fabaceae (34), Boraginaceae (33), Apiaceae (16), Caryophyllaceae (14), and Polygonaceae (11), characteristic of the flora of the Turan province. The role of herbaceous plants is high in the composition of pasture vegetation - they make up about 60% of the forage plants of the Karakalpak Ustyurt. The analysis of the distribution of forage plants in biotopes shows that the majority of species grow both on the cliffs and on the plateau (274 species). There are 148 species characteristic of the cliffs, and for the plateau of the Ustyurt - half as many - 75. This once again proves that the cliffs, especially the Eastern cliff, is one of the key botanical territories of the Turan Lowland.

1 Introduction

In connection with the extreme environmental conditions resulting from climate change and industrial development in the Karakalpak Ustyurt, including the Eastern Cliff, studying forage plants common in pastures is an urgent task of today. In recent years, as well as directly due to the drying up of the Aral Sea, land degradation and desertification processes have been affecting the state of biodiversity. These processes occur especially intensively in the Aral Sea region, on the Ustyurt plateau, in the Kyzylkum desert, and in the foothills. The main factors for the economic development of the Ustyurt plateau in Uzbekistan are oil and gas activities and infrastructure development (railway and highway). Due to its geological location, the plateau territory is rich in raw materials for the chemical and oil and gas industries. The Ustyurt oil and gas region is the largest in Uzbekistan; about 25 oil and gas fields were discovered here during geological exploration, which have a negative impact on the ecosystems of the region, leading to their disruption. In addition, the Ustyurt plateau is experiencing negative effects from the drying of the Aral Sea, as the absence of a natural thermoregulator locally changes the climate, which has a negative impact on the biodiversity of the region [1-8].

*Corresponding author: rakhimovanodi@mail.ru

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

The flora of Uzbekistan is rich in forage plants. According to preliminary estimates by O.Kh. Khasanov et al. [9], the forage flora of Uzbekistan includes more than 2,500 species. Analyzing the flora of Karakalpakstan, S.E. Erezhepov [10] notes that more than 700 species growing in this territory have food value to varying degrees. In the same years, as a result of studying the vegetation of the Northern Kyzylkum, U. Turemuratov [11] notes that the flora of this region includes no less than 830 species belonging to 322 genera and 78 families. Of these, about 200, according to the author, are forage. Climatic conditions in Karakalpakstan have a positive effect on the development of desert vegetation with various medicinal, tanning, essential oil and especially forage plants. In this regard, natural pastures predominate in Karakalpakstan, accounting for about 90% of the total area, and serving as the main source of fodder, the basis for the development of animal husbandry, especially karakul sheep breeding.

2 Materials and Methods

The study area is the Republic of Karakalpakstan, Kungrad district. The total area of the territory is 7,300,000 hectares. The geographical name of the territory is the Karakalpak part of the Ustyurt plateau (fig 1.).

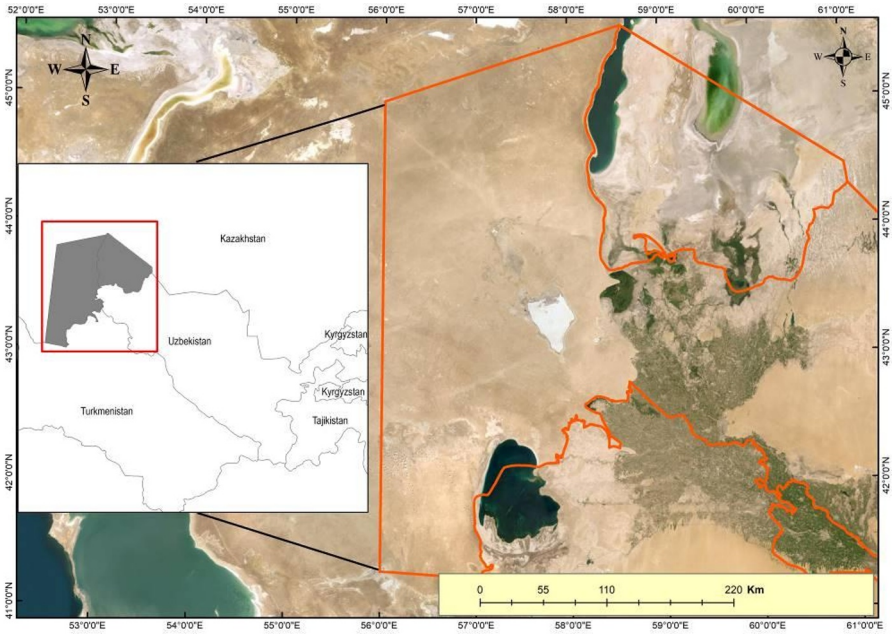


Fig 1. Research area map (Karakalpak Ustyurt).

The objects of the study were wild vascular forage plants of the Karakalpak Ustyurt. Bioecological features and adaptations of plant species to mobile environmental conditions were studied on the basis of existing literature sources [12]. To analyze forage plants according to the biomorphs of Ustyurt, we took as a basis the classification used in the "Key to plants of Central Asia" [13]. When studying pasture vegetation, generally accepted methods of route field geobotanical and floristic research were used, which are widely used in mapping vegetation, studying and monitoring pastures [14]. Projective coverage is determined visually [15]. The Latin names of plant species are given by Plants of the World Online [16].

3 Results and Discussion

3.1 Taxonomic analysis of forage plants of Karakalpak Ustyurt

According to the latest data from D.M. Tazhetdinova [17], the flora of vascular plants of the Karakalpak Ustyurt is estimated at 625 species belonging to 269 genera and 62 families. According to our data, the forage flora of this region consists of no less than 497 species belonging to 244 genera and 54 families. The leading position in the spectrum of forage flora of Ustyurt with more than 10 species is occupied by the *Amaranthaceae* (80 species), *Asteraceae* (77), *Poaceae* (58), *Brassicaceae* (55), *Fabaceae* (34), *Boraginaceae* (33), *Apiaceae* (16), *Caryophyllaceae* (14) and *Polygonaceae* (11). This spectrum practically coincides with the leading families of the forage flora of Kyzylkum [18].

Representatives of these families unite 378 species or 73.1% of the total forage flora of the study area. The predominance of the *Amaranthaceae* family in the vegetation cover of the Karakalpak Ustyurt does not require unnecessary comment, since the Turan lowland is an ecological niche for representatives of this family. This family in the Karakalpak Ustyurt not only predominates in the number of species, but also dominates the vegetation cover. Of the 5 types of pastures identified on the plains (that is, not including cliffs) *(Anabasis salsa, Haloxylon ammodendron, Kalidium caspicum, Halocnemum strobilaceum, Tamarix hispida),* in four the habitat-forming species are representatives of this family.

The second place in terms of species abundance is occupied by the *Asteraceae* family with 77 species. They occupy a special place in the desert pastures of Central Asia. Due to the wide distribution of species of the genus *Artemisia*, desert pastures are the arena for the development of free range animal husbandry in the region. Among the wormwood in Ustyurt, *Artemisia terrae-albae, A. diffusa* and *A. kemrudica* are of particular importance. If *A. terrae-albae* in Ustyurt is one of the background plants, like *Anabasis salsa* and *Salsola arbusculiformis*, and *A. diffusa* increases the yield and quality of pastures on sand, forming a stable community with *Haloxylon ammodendron* and *Caroxylon orientale*. The third species, *Artemisia kemrudica,* forms a disjunctive area in the Karakalpak Ustyurt. *A. kemrudica* is found in the south of Karakalpak Ustyurt, in the area of Shakhbakhty, Kaplankyr and Kulantakyr, where it grows in a community with *Atraphaxis spinosa* on microdepressions of the plateau as part of anabasis-salsa pastures. It is a favorite year-round food for wild ungulates.

The predominance of the following three families *(Poaceae, Brassicaceae, Fabaceae)* in the vegetation cover undoubtedly improves the quality of pastures in the study area. Thanks to their succulent shoots and leaves, the vast majority of species in these families are readily eaten by animals. Representatives of the *Apiaceae family are distinguished by the same qualities.* At the beginning of the vegetation period, species of the genus *Ferula* and *Seseli* are good fodder for small cattle.

The *Polygonaceae* family is represented in the flora of Karakalpak Ustyurt by only 4 genera (*Atraphaxis*, *Calligonum*, *Polygonum*, *Rheum*). *Calligonum* and *Atraphaxis* play an important role in providing food for Ustyurt pastures in the summer-autumn-winter period. Almost all species of these genera are the favorite foods of camels during these seasons. *Rheum tataricum* forms huge thickets in favorable years in the central and northern parts of Ustyurt. Large leaves are readily eaten by all types of animals, especially camels, reducing thirst for water.

Most species of the *Boraginaceae* family in the flora of the Karakalpak Ustyurt are represented by annual species. Their grazing value depends on the meteorological conditions of the year. In wetter years, representatives of the genera *Arnebia, Heterocaryum and* Lappula *form rather high phytomasses* in the composition of anabasis-salsa and wormwoods (Anabasis salsa, Artemisia terrae-albae) and are satisfactorily eaten mainly in

dry form after autumn precipitation. In years with low atmospheric precipitation, they are practically unnoticeable in the vegetation cover.

The spectrum of leading genera is headed by *Astragalus* (16 species), *Salsola* (14), *Artemisia* (14), Stipa (8), *Climacoptera* (8), *Strigosella* (8), *Lepidium* (7), *Acanthophyllum* (7) and *Tamarix, Euphorbia, Zygophyllum, Lappula, Cousinia, Anabasis* and *Atriplex* (6 species each). Despite the dominant role of the genera *Salsola* and *Artemisia* in the forage flora of the saltwort and gypsum deserts, they give way to astralagus in the Ustyurt. Representatives of this genus make up 5.8% of the total flora. The leading position of *Astragalus* in the pasture flora of Ustyurt, due to the large numbers of species growing on the cliffs, once again indicates the close connection of the flora of the eastern cliff with the mountainous Central Asian flora.

3.2 Analysis of forage plants by palatability and life forms

An analysis of the forage plants of the Karakalpak Ustyurt shows that out of 497 species, 120 are readily eaten by animals, 223 are satisfactorily eaten, and 114 are poorly eaten. 28 species that have toxic substances are eaten poorly or unsatisfactorily depending on the season of the year or the phase of development. Analysis of the distribution of readily eaten species (over 4 species) by family is almost similar to that (range of leading families) of the entire forage flora of Ustyurt. The exception is the *Liliaceae* family, which is not included in the list of leading families of Ustyurt in terms of the content of forage plants, with 4 species of readily eaten species. The *Poacea* family leads the list due to the high feeding quality of species of the genus *Anisantha, Aristida, Agropyron, Crypsis, Catabrasella, Cynodon, Elymus, Eremopyrum, Poa, Puccinellia, Stipa, Shismus, Stipagrostis*, etc. (table).

Table 1. Leading families in terms of content of readily eaten species

Name of families	Total number of species	Readily eaten	% of the total number of species
Poaceae Barnhart	61	36	59
Amaranthaceae Juss.	80	23	27.5
Brassicaceae Burnett	55	22	40
Asteraceae Bercht.&J.Presl	75	12	16
Fabaceae Lindl.	34	10	29.4
Liliacea Juss.	7	4	57.1
Boraginaceae Juss.	33	4	12.1

Well-eaten species of the genera *Haloxylon, Salsola, Kochia, Kraschenninnikovia* show that *Amaranthaceae* play a large role in the development of cattle breeding in the pastures of Ustyurt. In the *Brassicaceae* family, the high percentage of readily eaten species can be explained by the species diversity of the genera *Strigosella* and *Lepidium*, both of which are soft-stemmed, readily eaten species. Most species of the *Fabaceae* family are characterized by the same qualities.

Forage plants of the Karakalpak Ustyurt are distributed in separate geographical areas as follows: on the plateau there are 75 species, on the cliff there are 148 species, and the species growing both on the plateau and on the cliff are 274 species. The eastern part of the Ustyurt cliff is a great pasture for free range animal husbandry. This botanical-geographical region of Ustyurt is characterized by a high diversity of vegetation. Unlike other parts of the chinks and the plateau itself, fairly high-quality mesophilic, soft-stemmed plants grow here, such as *Medicago sativa*, *Melilotus albus, M. officinalis, Agropyron frageli, Cynoglossum viridiflorum,* species of the genus *Seseli, Strigosella*, etc. *Medicago sativa and Agropyron frageli* on the Eastern Cliff form communities, which include a sufficient

amount of readily eaten plants of the spring-summer-autumn season. Unfortunately, due to the drying out of the Aral Sea and global climate change, entire communities of these formations are disappearing right before our eyes.

In the pastures of the Karakalpak Ustyurt, annual species dominate - 210 species, of which 52 (25.1% of all annuals) belong to the Amaranthaceae family. The predominance of annual plants is typical for the flora of arid zones of Central Asia. It is known that annual plants, as reactive species in terms of population strategy, successfully spread in depleted territories. They capture the depleted territory earlier compared to representatives of other life forms. Vegetation-free areas, due to various anthropogenic impacts, occupy vast territories in the research area. This contributes to the wide distribution of annual and biennial plants. The share of perennials in the pasture flora of the Karakalpak Ustyurt is 189 species, which is 38.0% of the total number of species. The share of trees and shrubs in Ustyurt is small - 84 species (trees - 4 species, shrubs - 33, dwarfshrubs - 6, subshrubs - 27 and subdwarfshrubs - 14 species).

4 Conclusion

An analysis of the forage plants of the Karakalpak Ustyurt shows that out of 497 species, 120 are readily eaten by animals, 223 are satisfactorily eaten, and 114 are poorly eaten. 28 species that have toxic substances are eaten poorly or unsatisfactorily depending on the season of the year or the phase of development. The rich composition of readily and satisfactorily eaten species indicates the high quality of pastures in the research area. The analysis of the distribution of forage plants in biotopes shows that the majority of species grow both on the cliffs and on the plateau (274 species). There are 148 species characteristic of the cliffs, and for the plateau of the Ustyurt - half as many - 75. This once again proves that the cliffs, especially the Eastern cliff, is one of the key botanical territories of the Turan Lowland. *Medicago sativa* and *Agropyron frageli* on the Eastern Cliff form communities, which include a sufficient amount of readily eaten plants of the spring-summer-autumn season. Considering the low natural yield of pastures in the Republic of Karakalpakstan, for the development of animal husbandry, the priority is to improve pastures with the most valuable forage and highly productive forage plants.

Acknowledgments

The work was carried out within the framework of the State program (PFI-5) “Assessment of the current state of vegetation cover and pasture resources of the Republic of Karakalpakstan.”

References

1. T. Rakhimova, N.K. Rakhimova, Kh.F. Shomurodov, O.S. Abduraimov, Ontogenetic Structure of Rare Species on the Ustyurt Plateau in Uzbekistan. Arid ecosystems. **26/3(84)** (2020)
2. N.K. Rakhimova, T. Rakhimova, B.A. Adilov, Sh.B. Tamambetova, F.I. Polvonov. Current condition of Crambe edentula Fisch. & C.A. Mey. ex Korsh. on the Ustyurt plateau in Uzbekistan. Arid ecosystems. **11**/4 (2021)
3. V.K. Sharipova, T. Rakhimova, N.K. Rakhimova. Ecological state of some pasture differences of Haloxylon ammodendron of Karakalpak Ustyurt (Uzbekistan). E3S Web of Conferences, Yogyakarta, Indonesia, **361** (2022)

4. N.K. Rakhimova, T. Rakhimova, J.S. Sadinov. Current state of Anabasis salsa pasture varieties in Karakalpak Ustyurt (Uzbekistan) due to Aral Sea drying. Plant science today, **9(3)** (2022)
5. N.K. Rakhimova, T. Rakhimova, Kh.F. Shomurodov, V.K. Sharipova. The status of coenopopulations of Xylosalsola chiwensis (Popov) Akhani & Roalson and Scorzonera bungei Krasch. & Lipsch. on the Ustyurt plateau (Uzbekistan). Arid ecosystems, **13/2** (2023)
6. Kh.F. Shomurodov, N.K. Rakhimova, U.Sh. Saitjanova, Z. Zhao. The ecological-phytocenotic characteristics of Halocnemum strobilaceum (Pall.) Bieb. Grasslands on the Ustyurt plateau in Karakalpakstan. Arid ecosystems, **13/4** (2023)
7. N.K. Rakhimova, T. Rakhimova, Kh.F. Shomurodov, B.A. Adilov, V.K. Sharipova, U.Sh. Saitjanova, B.Sh. Khabibullaev, J.S. Sadinov, F.I. Polvonov, A.T. Sultamuratov. Assessment of the current state of rangelands in Karakalpak Ustyurt, Uzbekistan. Biodiversitas, **24/7** (2023)
8. T. Rakhimova, N.K. Rakhimova, V.K. Sharipova, N.K. Rakhimova, E.E. Temirov. Phytocoenotic Distribution of Hulthemia persica (Michx. ex Juss.) Bornm. (Rosaceae) under Different Ecological Conditions in Uzbekistan. Plant sciences today, **11/1** (2024)
9. O.K. Khasanov, T. Rakhimova, T. Khudoyberdiev, H. Shomurodov. Analysis of wild forage resources of Uzbekistan, prospects for their use. Bulletin of the Ferghana State University, **4** (1996)
10. S.E. Erezhepov. Flora of Karakalpakstan and its economic characteristics, use and protection (1978)
11. U.T. Turemuratov. Vegetation cover of the North-Western Kyzylkum (1978)
12. E.P. Korovin. Vegetation of Central Asia and South Kazakhstan. Book 1 (1961)
13. Key to plants of Central Asia (**in 10** volumes) (1968-1993)
14. Methodological guidelines for geobotanical survey of natural fodder lands in Uzbekistan (1980)
15. L.G. Ramensky. Selected works. Problems and methods of studying the vegetation cover (1971)
16. Plants of the World Online (2024), https://powo.science.kew.org/
17. D.M. Tajetdinova. Taxonomical analyzes of the flora of the Ustyurt botanical-geographical district (Uzbekistan). Journal of Biology of Uzbekistan, **5** (2018)
18. Kh.F. Shomurodov. Forage plants of Kyzylkum and prospects for their use. Abstract of Dr. diss. Tashkent (2018)