

## Conference Paper

# Halophytes of Tersko-kumsk Lowland Area, Their Protection and Rational Use

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## Abstract

Article provides a brief analytical review of studies of halophilic flora species of Tersko-Kumsk lowland area. The most important representatives are indicated, the adaptive properties of different halophyte groups are considered. Their resource value is noted (fodder, medicinal, melliferous, tannic, etc.). In the systematic aspect, the halophilic flora exhibits Mediterranean features, dicotyledons dominate in it, club-moss and horsetails are completely absent, ferns are minimally present. In the edaphic relation, most species of halophytes are obligate, confined to one type of substrate, and the vast majority of halophytes are confined to the steppe belt, the subalpine belt, the belt of upland xerophytes and the alpine belt are in descending order, least of all halophytes in the forest belt, individual species live in subnival belt. The question of the protection of solonchak vegetation and solonchak steppes as a peculiar ecosystems, with a distinctive landscape and original flora containing a highly specialized ecological group of plants, which testifies to the relationship of the nature of plants with the environment. Halophilic cenoses can serve as indicators of the soil, chemical composition and depth of groundwater.

**Keywords:** Tersko-Kumsk lowland, halophytes, main groups, characteristic types, distribution, resource value, protection, rational use.

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## 1. Introduction

The flora study of Tersko-Kumsk lowland from different points of view was done by S.G. Gmelin, F. Marshall-Bibershtein, Kh. Steven, C.A. Meyer [1--5] and later researchers [6--10].

On the territory of the Tersko-Kumsk lowland, against the general background of semi-desert and desert, there is vegetation of steppes, sands, solonchaks, and meadows and in some places mesophytes. Lowland vegetation is rather uniform, scrubby, sparse and does not form a continuous cover. The overwhelming majority of plants in

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the summer ceases to develop, burns out, and the lowland acquires a uniform yellowish-gray color. Only in spring and autumn, due to less high temperatures and high humidity, the surface is covered with a green cover of plants. Ephemera and ephemeroids are widely represented, among which *Poa bulbosa* L. stands out with its bright green color. However, the general background of the area is created by wormwood, especially the Tauride (*Artemisia taurica* Willd.), various saltwort (*Salsola crassa* Bieb., *S. dendroides* Pall., *S. laricina* Pall.) and others.

The nature of the vegetation distribution of the Tersko-Kumsk lowland, depending on the differences in vegetation, natural areas that contrast with each other are clearly distinguished, claiming the rank of individual botanical and geographical areas: Nogai desert-steppe, Kumsko-Caspian solonchak-desert, the Terek Delta with azonal flood-plained meadows, shrubs, forests and fluxes.

## 2. Methods and Materials

The research object is the flora of Tersko-Kumsk lowland area. The material for writing the article was the herbarium collections gathered in the course of expeditionary research by members of the Academy of Sciences of the Chechen Republic. A total of about 500 herbarium leaves of plants were collected, determined and mounted. In addition, herbarium specimens from CI RAS and ChGPU funds, collected in the study area in different years, were processed.

Taxonomic identification of the collected plants was carried out according to the 3 volumes of "Flora of the North Caucasus" by A.I. Galushko [11] and "Determinant of Caucasian plants" by A.A. Grossgeim [12]. The definition correctness was checked by comparison with morphological description of "Flora of the USSR" [13] and "Flora of the Caucasus" by A.A. Grossgeim [14], and for species not included in these reports - according to the diagnoses in the original sources. In addition to these publications, a summary of S.K. Cherepanov was used to clarify the types [15].

## 3. Results

The composition and structure of plant communities are determined by the specific environmental conditions prevailing in the course of historical development of Tersko-Kumsk lowland area, which is quite rich in various plant habitats. There are broadleaved forests, saline, sandy, clayey areas, fragments of steppes and semi-deserts, wetlands and weedy habitats. The differences between these types of habitats relate to many

parameters of the environment, ranging from moisture to the physical and chemical characteristics of the soil. Within the study area, we include the following typical habitats: sandy desert, sea shores, solonchaks, clay and sandy semi-deserts, steppes, river banks and coastal meadows, fluxes and marshes, freshwater bodies, forests, arable lands, weedy places.

Halophytes, representing a highly specialized ecological group, indicate a relationship between the nature of plants and the environment, and their cenoses are indicators of the soil, chemical composition and depth of groundwater [16--18].

Halophytes are plants that can tolerate or withstand soil salinity. Depending on the excess of salt solutions in the soil, they are divided into *halophytes* and *glycophytes*.

The great Russian scientist A.A. Shakhov [19] gives the following ecological and biological formulation of the concept "halophyte": "Halophytes are plants of saline habitats that are adapted to the high content of solonchak salts in the soil, due to hereditary properties that have arisen in the process of historical development and are formed in individual development".

According to A.A. Shakhov [19], the adaptation of plants to the conditions of salinization is carried out through salt accumulation, salt excretion and salt resistance. According to these characteristics, halophytes are divided into three ecological and physiological groups: *salt-accumulating*, *salt-releasing* and *salt-impermeable*.

*Salt-accumulating* halophytes (euhalophytes) are plants that grow well and develop normally only when there is a required amount of chlorides and sulfates, which they accumulate in large quantities in their bodies and because of their hereditary needs for soil salinization. This group of halophytes is characterized by a salt effect (*Salicornia europaea* L., *Suaeda confusa* (L.) Pall., *Su. altissima* (L.) Pall., *Salsola soda* L., *Spergularia maritima* (L.) C. Presl, *S. marina* (L.) Griseb., *Bassia sedoides* (Pall.) Freitag & G. Kadereit and etc.).

*Salt-releasing* halophytes (crinohalophytes) are plants with a lower hereditary need for salts. Possessing the ability to absorb a lot of salts, they can release some of the salts, "filtering" them through themselves on the surface of their organs. These include: *Limonium meyeri* (Pall. ex Willd.) Stank., *L. caspium* (Willd.) Gams, *Aeluropus littoralis* (Gouan) Parl., *Crypsis alopecuroides* (Piller & Mitterp.) Schrad., *Psylliostachys spicata* (Willd.) Nevski, *Tamarix gracilis* Willd., *T. ramosissima* Ledeb. and etc.

*Salt-impermeable* (saltproof) halophytes are plants with a low hereditary need for salts. They develop well without salinization and they have very limited plasma saline impenetrability on saline soils, owing to this, protect themselves from excess salt. This group of halophytes includes: *Plantago maritima* L., *Tripolium pannonicum* (Jacq.)

Dobroc., *Artemisia taurica* Willd., *A. maritima* L., *Juncus gerardii* Loisel., *Carex distans* L., *Leymus racemosus* (Lam.) Tzvelev., *Puccinellia poecilantha* (K. Koch.) Gross, *P. distans* (Jacq.) Parl. and etc.

In contrast to salt-accumulating, salt-releasing and salt-impermeable, the halophytes do not have a clearly pronounced salt effect.

At last, there is another group of highly salt-resistant halophytes (*Juncus gerardii* Loisel., *J. maritimus* Lam. и др.), in which salt removal occurs by dropping parts of plants. Older leaves with a high salt substance dry up and are dropped, and meanwhile growing young ones are capable of absorbing salt. This is characteristic of such halophilic rosette plants as *Plantago maritima* L., *Triglochin maritimum* L., *Aster tripolium* L. and etc. Absolutely the same function is performed by the utricular (bubble-shaped) hairs of the epidermis of some species of *Atriplex* and *Halimione*. They accumulate salts in the cell sap, and soon die off and are replaced by new ones.

Communities with halophytic vegetation are used extremely insufficiently, only 15--20 % of these lands are involved in agricultural use. At the same time, the natural phytocenoses of solonchaks are raw materials source for forage plants (*Festuca orientalis* (Hack.) V. Krecz. & Bobr., *Elytrigia elongata* (Host) Nevski, *Puccinellia gigantea*, *Melilotus officinalis*, *Galega orientalis*, *Trifolium fragiferum*, *Medicago lupulina*, *Lotus tenuis* and etc.), medical (*Artemisia taurica*, contains lactones tauricin, tauremizin, essential oil; *Melilotus officinalis*, *M. dentatus*, *M. albus* -- coumarins, glycosides, carotene; *Limonium meyeri* -- tannins; *Gypsophila trichotoma* -- saponins; *Iris halophila* -- glycosides, vitamin "C", essential oil; *Salsola soda*, *S. tragus* -- alkaloids of salsolin and salsolidine, etc.), melliferous (*Goniolimon tataricum*, *Limonium caspium*, *L. meyeri*, *Grambe steveniana*, *Tamarix gracilis*, *Melilotus officinalis*, *Galega orientalis*, *Glycyrrhiza glabra* and etc.), phytomeliorative (*Tamarix gracilis*, *T. ramosissima*, *T. laxa*, *Leymus sabulosus*, *Galega orientalis*, *Gypsophila trichotoma*, *Melilotus officinalis* and etc.), wood-pulp and paper (*Phragmites australis*, *Elytrigia elongata*, *Bolboschoenus maritimus*, *Scirpus litoralis*) and a number of other useful plants [20] (Gubanov, and etc., 1976).

Separate halophytes (*Elytrigia elongata*, *E. repens*) serve as valuable plant breeding material [21--26]. Allocation of a part of saline lands as reserves should not contradict the possibility of their practical use. Usually, the use of saline lands is accompanied by the implementation of such activities as drainage, washing, irrigation, application of mineral and organic fertilizers and others that are associated with a direct impact on the soil. There is another way to develop and increase the productivity of saline lands -- the widespread cultivation of halophyte plants on them, which form the natural cover of solonchaks, salt marshes and solods.

Here, in a broad sense, experiments can be made to create multi-tiered pastures, to increase the biological productivity of phytocenosis by introducing plant species in their composition, having a relatively high yield of vegetative mass and the ability to adapt to the conditions of salinization. The most promising in this respect are primarily wild-growing salt-resistant cereals: *Puccinellia gigantea*, *P. distans*, *P. poecilantha*, *P. dolicholepis* and their interspecific hybrids *Puccinellia gigantea* x *P. poecilantha*, *P. gigantea* x *P. distans*. *Festuca orientalis*, *Elytrigia elongata*, *Cynodon dactylon*, *Alopecurus arundinaceus* and etc. Adding to them such a cultivated plant as Slavic alfalfa local, very salt-resistant variety, will significantly improve the quality of grass stand. *Melilotus albus*, *M. officinalis*, *M. dentatus*. *Galega orientalis* and etc. can be used among wild salt-resistant representatives in this regard -- herbs with rather valuable fodder values, resistant to overwetting of solonchak and saline places. In the wild, their yield reaches 15--20 centners/ha of hay; sweet clovers are especially good for silage, as they contain a lot of digestible protein.

The communities of euhalophytes are used as poor quality pastures, their forage value increases with the presence of cereals in them. At the same time, the clean thickets of *Salicornia europaea* and *Salsola soda* are good year-round fattening feeds for cattle, horses and sheep. Community productivity reaches 30 centners/ha of green mass. A promising species, giving a large green biomass (up to 70 centners/ha), but requiring a detailed study of the biochemical composition, is sea rocket (*Cakile euxina*) -- psammohalophyte dominating in the vegetation cover of saline sandy places [24].

Over moistened saline lands should be subjected to partial drainage, and their vegetation cover -- to mowing. Such agrotechnical methods allow achieving good development, seeding and high yield of many salt-resistant cereals, especially saltmarsh-grass, which have a high substance of digestible protein [26]. The economic value of saltmarsh-grass is much higher than euhalophytes. Saltmarsh-grasses give early nutritious food, rich in minerals; the height of the grass stand reaches 80--85 cm, the yield is up to 10 centners/ha of hay. In a number of areas of the Tersko-Kumsk lowland areas, saltmarsh-grass communities are successfully used for hay harvesting in the saline massifs. Mowing and grazing of communities is advisable to carry out until the end of their flowering, when the productivity and palatability of the saltmarsh-grasses, due to their low lignification, are the highest [26--30].

Wheat grass (46,0 centner/ha of green mass), shoreweed saltmarsh-grasses (27,0 centner/ha), gonimic saltmarsh-grasses (18,0 centner/ha) and other communities giving early nutritious food, rich in mineral substances, are valuable.

Solonchak vegetation and solonchak steppes are decreasing every year. It is necessary to take measures to preserve them as a kind of ecosystem that characterizes the distinctive landscape of certain regions of the North Caucasus. The preservation of solonchak vegetation has an important cognitive significance because halophytes representing a highly specialized ecological group indicate a relationship between the nature of plants and the environment, and their cenoses are indicators of soil, chemical composition and depth of groundwater [17].

The optimal use of saline land resources requires a comparison of costs and the resulting products. In certain areas of the Tersko-Kumsk lowland, it would be rational to use saline land and solonchak vegetation than to meliorate introduce them into crop rotation, and then maintain productivity at the expense of high costs and effort. On saline lands, the creation of multi-tiered pastures consisting of halophilic shrubs would be an economically viable and promising step (*Halocnemum strobilaceum*, *Aellina glauca*, *Tamarix gracilis*, *T. laxa*, *T. ramosissima*, *T. meyeri*, *Nitrarla schoberi*), semi-shrubs (*Camphorosma monspeliacum*, *Kochia prostrata*, *Halimione verrucifera*, *Frankenia hirsuta*, *Artemisia tschernieviana*, *A. procera*), as well as perennial and annual grasses. The multi-layered location of aboveground and underground organs, on the one hand, will enhance bio-productivity and, on the other, improve the resistance of plant communities of saline lands [26--30].

There are agrocenoses occupied by rice culture, in connection with which the soil salinity is progressing and becoming irreversible on the territory of Tersko-Kumsk lowland. There are areas of natural solonchak and saline vegetation that are strongly reduced under the influence of man and under the influence of overgrazing, transforming into low productive groups.

Today, extremely rare species in the halophilic cover of the saline lands of the North Caucasus are *Puccinellia fominii*, *P. sclerodes*, *Iris halophila*, *Frankenia hirsuta* and some others; endangered communities are from *Halocnemum strobilaceum*, *Elytrigia elongata*, *Triglochin maritima*.

We offer to add some rare and endangered species of flora families of the studied territory to the Red Book of the North Caucasus: *Poaceae* -- *Puccinellia fominii* Bilyk., *P. sclerodes* V. Kxecz., *P. dolicholepis* V. Krecz., *Elytrigia elongata* (Host.) Nevski; *Frankeniaceae* -- *Frankenia hirsuta* L.; *Iridaceae* -- *Iris halophila* Pall.; *Chenopodiaceae* -- *Halocnemum strobilaceum* (Pall.) Bieb.; *Papaveraceae* -- *Glaucium flavum* Crantz; *Juncaginaceae* -- *Triglochin maritimum* L.

## 4. Conclusion

There is a need to create custom territories for the protection of virgin solonchak vegetation in the vicinity of Kissyk Lake and Steppe Pearl Lake, represented by unique areas of solonchak steppes.

It is currently impossible to find ways of economically reasonable management without ecological ways, which determine the state of the biosphere of Earth as a whole. A well-considered, environmentally justified intervention in the historically established ecosystem of solonchaks will allow on the one hand, preserving an interesting phenomenon of nature, and on the other, involving wasted saline lands of the North Caucasus in the economic circulation. The task of the near future is to create highly productive forage agrocenoses on saline lands. The latter is impossible without preserving and comprehensively studying the halophilic flora, its communities, taking into account the ecological, physiological and anatomical features of the species forming it.

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