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TAXONOMIC SYNOPSIS OF *SALSOLA* GENUS (MIL PLAIN, AZERBAIJAN)

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ТАКСОНОМИЧЕСКИЙ ОБЗОР РОДА *SALSOLA* (МИЛЬСКАЯ РАВНИНА, АЗЕРБАЙДЖАН)

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Abstract. In article the results of analysis conducted on bioecological features of *Salsola* species which are distributed in desert phytocoenosis of Mil plain of Kur-Aras lowland were given. Materials for research were plant herbaria which collected from researched area, as well as herbarium funds of Baku State University and Institute of Botany Azerbaijan National Academy of Sciences. Morphological study of the flower parts of *Salsola* species was conducted with Carl Zeiss Stereo Discovery V4 stereomicroscope. It was determined that in researched area 10 species (*Salsola australis* R. Br., *S. tragus* L., *S. paulsenii* Litv., *S. soda* L., *S. nitraria* Pall., *S. incanescens* C. A. Mey., *S. dendroides* Pall., *S. ericoides* Bieb., *S. nodulosa* (Moq.) Iljin, *S. foliosa* (L.) Schrad.) of *Salsola* genus are distributed. Their morphology, ecology, systematical position, as well as economic significance were analyzed. It was also found that an anthropogenic impact in this area leads to desertification of landscapes.

Аннотация. Проведен флористический анализ и изучены биоэкологические свойства видов из рода *Salsola*, распространенных в пустынных фитоценозах Мильской равнины Кура-Араксинской низменности. Материалами для исследований послужили растительные гербарии, которые были собраны на исследуемой территории, гербарные фонды Бакинского государственного университета, а также Института ботаники НАН Азербайджана. Морфологическое исследование частей цветка *Salsola* было проведено при помощи модели стереомикроскопа Carl Zeiss Stereo Discovery V4. Определено, что на изученной территории распространено 10 видов (*Salsola australis* R. Br., *S. tragus* L., *S. paulsenii* Litv., *S. soda* L., *S. nitraria* Pall., *S. incanescens* C. A. Mey., *S. dendroides* Pall., *S. ericoides* Bieb., *S. nodulosa* (Moq.) Iljin, *S. foliosa* (L.) Schrad.) рода солянка (*Salsola*). Нами проанализированы морфология, экология, систематическая позиция, а также экономическое значение видов. В результате исследований было выявлено, что антропогенное воздействие на этой территории приводит к десертификации ландшафта.

Keywords: Mil plain, desertification, saltwort, phytocoenosis, desert.

Ключевые слова: Мильская равнина, десертификация, солянка, фитоценоз, пустынной.



Introduction

Kur-Aras lowland that covers 1/3 of Azerbaijan area consists of plains such as Shirvan, Mil, Garabakh, Mugan, and Salyan. Mil plain is situated between 40° to 41°N and 46° to 49°E. The Kur-Aras lowland is the largest lowland in eastern Transcaucasia within Azerbaijan. The climate of Kur-Aras lowland is subtropical, warm, continental. Summer is dry and hot. The average July temperature is +27 °C, sometimes reaching +40 °C. The winter is relatively warm and little snow. The average January temperature is +10 °C. In the mountainous part, summer and winter are cooler. At altitudes from 1000 to 2000 m above sea level, the average July temperature is +14°C; the average January temperature is –6 °C.

During the flora analysis of Mil plain, we defined that 926 plant species belonging to 459 genera and 91 families were distributed in this area. Five families: Poaceae, Asteraceae, Fabaceae, Brassicaceae and Chenopodiaceae contribute 42.51% of the total plant taxa recorded in this study. Poaceae is represented by 59 genera (12.83%) of the total observed plant taxa. Asteraceae carries 54 genera (11.83%), Brassicaceae, Fabaceae and Chenopodiaceae represented by 39, 22 and 21 genera (8.48%, 4.79%, 4.57%) respectively. 15 families are represented by 20 to five genera, contributing (35.12%) of total studied taxa, and 71 families are represented by less than 5 genera, contributing (22.44%) of the total plant genera.

It should be noted that the family Chenopodiaceae Vent. = Amaranthaceae Juss. occupies a significant place, which is distinguished by both in latitude of species and genus spectra. The species of *Salsola* genus are grouped as halophytes, which are also useful for rehabilitation and reclamation of degraded saline lands and saline soils, respectively. *Salsola* genus, a genus of annual semi-dwarf to dwarf shrubs and woody tree species, is widely distributed across the arid and semi-arid areas of the world. Several features like high fodder value, abundant seed production, tolerance to extreme climatic conditions like high temperature and prolonged drought conditions contributed significantly towards its success as a potential forage species in semi-arid to arid environments. Species of this genus are of significant importance.

In Mil plain 10 species of the *Salsola sensu lato* genus are widespread. They are *Salsola australis* R. Br. = *Kali tragus* subsp. *tragus* Scop., *S. tragus* L. = *Kali tragus* subsp. *tragus* Scop., *Salsola paulsenii* Litv. = *Kali paulsenii* (Litv.) Akhiani & Roalson, *S. soda* L., *S. nitraria* Pall. = *Nitrosalsola nitraria* (Pall.) Tzvelev, *S. incanescens* C. A. Mey. = *Nitrosalsola incanescens* (C. A. Mey.) Theodorova, *S. dendroides* Pall. = *Nitrosalsola dendroides* (Pall.) Theodorova, *S. ericoides* Bieb. = *Nitrosalsola ericoides* (M. Bieb.) Theodorova, *S. nodulosa* (Moq.) Iljin = *Caroxylon nodulosum* Moq., *S. foliosa* (L.) Schrad. From these species *S. nitraria* Pall. and *S. nodulosa* (Moq.) Iljin are Caucasian endemics [1].

For the rational use of desert pastures, it is necessary to have a complete understanding of the phytocoenosis of individual species [2]. Representatives of the Chenopodiaceae family make up the bulk of the plant mass that is involved in the addition of the vegetation cover of the study area [3–5]. We were faced with the goal of studying and analyzing the systematic position, bioecological features, life forms, geographic types of range of the species of the Chenopodiaceae family in the flora of saltwort deserts of the Kur-Aras lowland.

Materials and research methods

We evaluated all currently recognized species of *Salsola* genus distributed in Mil steppe. Our study is based firstly on field observations from throughout the distributional range of the genus (Figure), with field trips to researched area in different times of year. Materials for research were plant herbaria which collected from researched area, as well as herbarium funds of Baku State

University and Institute of Botany of Azerbaijan NAS. Contemporary-morphological study of the flower parts of *Salsola* species was conducted with stereomicroscope — Carl Zeiss Stereo Discovery V4. Distribution, habitat and phenology were based on literature revision, herbarium specimens, cultivated material and fieldwork observations. For species with published category of threat, original classification was evaluated taking into account new information on collections or habitat. Analysis was performed according to IUCN Red List guidelines [6].

On the basis of the analysis, the geobotanical features and the systematic position of the representatives of the saltwort desert were studied. The names of the plants are given according to the “Flora of Azerbaijan” [7], taking into account additions and changes that are available in the latest report on vascular plants [8], as well as [9].

Results and its discussion

In Azerbaijan, saltwort deserts as a type of vegetation have been studied by scientists since the 1930s, despite the history of research for many years, but the results of the analysis were not complete, local [10–13]. Partial studies did not provide complete information and a complete picture of the saltwort vegetation of desert phytocoenosis. The results of geobotanical research complement and broaden the understanding of the current state of saltwort vegetation in the Republic of Azerbaijan. The obtained patterns of the population structure of saltwort phytocoenosis can serve as a basis for structural dynamics of desert phytocoenosis of Azerbaijan.

In the present time, due to anthropogenic influences, the vegetation cover of the desert has deteriorated significantly. As a result of pasture digression, agriculture reduces the territory of natural pastures.

The obtained data will allow settling the pasture turnover, establish the terms of use of saltwort pastures and their degree of bleeding, as well as clarify some theoretical issues related to biological ecosystems as a whole, as well as ways of rational use of saltwort deserts.

Salsola tragus L. is an annual, erect, xerohalophytic herb. It is highly branched and rounded in form, growing from 30 cm to 1 m in height and from 30 cm to 1.5 m in diameter. The awl-shaped, spiny-tipped leaves bear small, inconspicuous flowers in the leaf axils. The small, winged seed, retained in the leaf axils until after plant death, contains no endosperm tissue, but is instead comprised of a spirally-coiled, complete embryo already containing some chlorophyll. The root system consists of a taproot, reaching 1 m or more in depth, and extensive lateral roots. Under crowded conditions, roots are shallow. *Salsola tragus* L. was categorized as Vulnerable — VU D2 according to The Red Book of Azerbaijan Republic [13]. Changes at the level of Caspian Sea, improving infrastructure are considered as limiting factors. *Salsola tragus* L. thistle can provide forage for cattle, horses, and sheep. The nutritional value of this forage is considered fair when young and is higher once the plant has dried. It is a high source of vitamin A and phosphorous [14]. It is most palatable in spring when young or in winter when the dead spines are softened by moisture. In some locations, it is viewed as security for livestock when more palatable options are not available (Figure).

Salsola soda L. is a halophyte, an annual plant. It is xerophyte. The geographical type – Mediterranean–Iran–Turan, type of range — Ancient Mediterranean. Has bare, straight from the base of the stems, splayed — branched, usually directed obliquely up, height (5) 40–80 (100) cm. Stem leaves are fleshy, thick, semi-cylindrical, linear, 10–25 mm long and 2–3 mm wide, widened at the base, on the tip with bristles. The bracts leaves are reduced, triangular, much longer than the bracts (up to 3 times), almost horizontally deflected. Flowers solitary, in a spicate inflorescence. Perianth almost to the base 5 separate, cupped, lobes ovoid, jagged at the top, membranous, with

fruits greatly enlarged, on the back with a small tubercular-like protrusion or transverse crest like keel. Wrist buds in the form of transverse tubercles or triangular appendages. Fruits are large, swollen. Anthers with almost no appendages. Stigma is longer than a column. Seeds 3–4 mm long, mostly horizontal or almost oblique. The plant grows from March to November. Flowering in July, fruiting in September. Saltwort fodder grows in lowlands, in salt marshes and saline places. One of the most common saltwort, especially in the eastern and south eastern part of the Kur-Aras lowland. Mostly forms significant thickets. In the fall and winter is considered good food for camels. Serves as a source for artisanal soda (Figure).

Salsola ericoides Bieb. is one of the halophytes of typical plants of saltwort deserts of Azerbaijan. It is xerophyte. The geographical type — East Transcaucasia, type of range — desert.

Spreading-branched shrub, up to 1 m. Stems in the lower part of the woody, covered with light grey bark. Young shoots are thickly pubescent, later becoming bare, grey-blue. In autumn, the whole plant is almost black. The leaves are numerous, alternate, sessile, fleshy, cylindrical, dull, naked. The wings of the fruit attached at the middle of the perianth segments or higher, semi-circular, reddish-brown. Perianth with wings about 5–7 mm in diameter. Anthers with point appendage. The stigmas are short, flat, equal to a very short column or one and a half times longer than it. Flowering in May, fruiting in the month of October. Heather bream is common from lowlands to the lower mountain belt. It grows on saline and saline-grey and brown soils. Forms clean and mixed desert groups on the winter pastures of Azerbaijan. In the fall and at the beginning of winter, they are satisfactorily eaten by cattle in winter pastures. It also serves as a source for artisanal soda (Figure).

Salsola dendroides Pall. 50–70 cm in height. Stem is ligneous, more branched. Length of leaves are 2–5 mm. Vegetation is in April–May, flowering and semination in October–November. *S. dendroides* Pall. is the main fodder plant of pastures, is eaten as feed plant by livestock in winter season. Prilipko noted that leaves and young branches of *Salsola* is eaten by sheep in January after frost [12]. *Salsola* is the dominant species of *Artemisieto–Salsoletum* formation at the winter pastures of region. As a subshrub plant *S. dendroides* Pall. is formed at grey–brown soils and is considered indicator of ground water (Figure).

Salsola nodulosa (Moq.) Iljin 30–40 cm in height. Irregularly branched, stem is covered with light grey bark. Young branches are small and hairy. Leaves are arranged in alternate direction and are 5 mm in length. Reproduction is with seeds. Its vegetation begins in June–July, flowering in July–August and semination in October–November. *S. nodulosa* (Moq.) Iljin is distributed at winter pastures and slopes, as well as saline grey-brown and saltish soils. It is halophyte undershrub. *S. nodulosa* (Moq.) Iljin is dominated at desert and semidesert phytocoenosis, as well as at *Artemisetum–Salsoletum* formations. As with *Artemisia fragrans* Willd., *S. nodulosa* (Moq.) Iljin is considered as the main fodder plant of winter pastures at this formation. Eatable amount of every *Salsola* shrub contain about 50–120 g. *S. nodulosa* (Moq.) Iljin is a Caucasian endemic [15].

Salsola nitraria Pall. is an annual plant. 20–60 cm in height, from the base widespread branched, below side is more or less hairy, above side is naked. Leaves arrange in alternate direction, till 10 mm in length, semi-swollen, blunt, almost threadlike. Bracteate leaves are narrow, acute, naked. Wings are semicircular, yellowish or pink, together with perianth 5–7 mm in diameter. Anthers are long with dotted appendage. Stigma is shorter than style or almost in equal length with it. *Salsola nitraria* Pall. is a Caucasian endemic [13, 15].

Salsola paulsenii Litv. is annual herb, 10–80 (100) cm, glabrous or sparsely papillose-hispid. Stem profusely branched from the base, erect, rarely ascending or prostrate, branches straight or arcuate, often almost perpendicular to the stem. Leaves alternate, filiform or linear. Flowers solitary,

or rarely 2 or 3 in axils of bracts or reduced upper leaves. Perianth segments glabrous, with long-acuminate spinose apex, at maturity forming a slender columnar beak above the wings, prominently winged. Fruiting perianth 7–10 mm in diameter [16].

Conclusion

For the first time critically have been reviewed and specified the species content of *Salsola* genus in Mil plain. It was determined that in researched area 10 species (*Salsola australis* R. Br., *S. tragus* L., *S. paulsenii* Litv., *S. soda* L., *S. nitraria* Pall., *S. incanescens* C. A. Mey., *S. dendroides* Pall., *S. ericoides* Bieb., *S. nodulosa* (Moq.) Iljin, *S. foliosa* (L.) Schrad.) of *Salsola* genus are distributed.

These studies provide an opportunity to study for a full-fledged population structure of saltwort phytocoenosis. As a result of research and analysis, changes, degeneration, reduction of the range of species, pollution as a result of the human factor in the desert phytocoenosis of the Kur-Aras lowland, and in particular of the saltwort vegetation, were found. Strong anthropogenic influence in the area leads to desertification and degradation of landscapes.

Along with the use of phytocoenosis, rational consumption of natural resources, it is necessary to ensure their gentle consumption, preserve the reserves of the arid zone and therefore prevent further desertification, and further expand the search methods to combat such a pressing problem as part of monitoring the conservation of desert vegetation of Azerbaijan.

On the basis of the data collected and the analysis of the morphological and bioecological, plants of deserts phytocoenosis are vulnerable to extinction. Some species are threatened with extinction as a result of active human activities.



Salsola tragus L.



Salsola soda L.



Salsola ericoides Bieb.



Salsola australis R. Br.



Salsola dendroides Pall.

Figure. Some species of *Salsola* genus distributed in Mil plain.

Species of the saltwort (*Salsola*) genus: *Salsola soda* L., *Salsola ericoides* Bieb. serves as fodder lands of winter pastures of the Kur-Aras lowland. It is recommended that a research approach be used, as well as analysis results that maximize the sustainability of the conservation, renewal of vegetation and flora in the region. The above data can also serve as a basis for further study of the structural dynamics of the desert phytocoenosis of Azerbaijan. The resulting numerous new identifications of *Salsola* collections in the Mil steppe and other herbaria would become a reliable reference for scientists and other professionals interested in these plant species.

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