

Biological features of *Nitraria sibirica* Pall. and the structure of its coenopopulation (the Republic of Khakasia)

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Abstract. The life form of *Nitraria sibirica* Pall. and the structure of its coenopopulation has been studied in natural conditions. Laboratory germination of seeds was investigated. Individuals build the life form of a hypogeogenic-geoxyle vegetative-mobile shrub. It is found that the coenopopulation is normal incomplete, the ontogenetic spectrum is of a centered type. The germination of seeds does not exceed 6 %.

1 Introduction

Nitraria (Niterbush) – *Nitraria sibirica* Pall. (family Nitrariaceae Lindl.) is a sprawling and branched halophyte with grayish-white bark. This shrub is listed in the regional Red Books of Russia [1-5]. In the Republic of Khakasia it belongs to the status 3 (rare species with a narrow ecological coincidence) [2]. *N. sibirica* belongs to an ancient genus that arose in the deserts of the Upper Cretaceous period on the territory of the ancient Mediterranean. It is a relict of the xerophilic Paleogene flora with the Central Asian type of area [6]. It is found in intermountain basins on salt licks, salt marshes and in the steppes where *Elymus paboanus* and *Achnaterum* grow [7]. Due to its biological and ecological features, the plant is promising and can be used to reduce the soil salinization, to enrich it with organic substances [8], to strengthen sand deposits in protective afforestation, banks, to reclaim man-made landscapes. That is why it is of particular importance to study the population characteristics of this rare species. It will allow us to prognose its growth on the territory of the republic. Information about such studies in Khakasia is extremely limited [9]. The aim of the work is to study the biological features of *N. sibirica* and the structure of its coenopopulation in Khakasia.

2 Material and methods

The coenopopulation (CP) of *N. sibirica* was studied in the steppe Koibalskaya (the Republic of Khakasia) on the territory of the natural reserve «Tract Tryokhozyorki» in 2020 (N – 53°18'46.8"; EO – 91°28'23.5"). The geobotanical description was performed according to the common method [10]. The life form of *N. sibirica* was determined on

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individuals of a mature generative state with the help of the ecological and morphological classification of life forms by I. G. Serebryakov [11]. The description of the shoots was based on the ideas of M. T. Mazurenko and A. P. Khokhryakov [12]. Ontogenesis was studied by the use of the concept of its discrete description [13, 14]. The ontogenetic structure of the CP was performed according to common methods [13, 15-16]. «Curtina» was taken as a counting unit. (Curtina – it is a formation consisting of a primary bush (or primary shoot) and partial bushes (or partial shoots) that have developed from the apical buds of specialized sprouting shoots and are connected by these shoots with each other and with the primary bush (or primary shoot)). The ontogenetic spectra of the CP were built in compliance of representations of L. B. Zaugolnova [17]. The type of coenopopulation was determined in accordance with the classification «delta-omega» by L. A. Zhivotovsky [18]. The peculiarities of the seed germination were studied by the method of N. I. Maisuradze [19].

3 Results and discussion

The research work was carried out on the south-western lakeside in a mixed grass-grain saline steppe. The total projective cover (OPP) of the herbage was 90-95 %, the projective cover of the species was 9-12 %. The dominant species were *Achnatherum splendens* (Trin.) Nevski, *Hordeum brevisubulatum* (Trin.) Link., *Puccinellia tenuiflora* (Griseb.) Scribn. et Merr., *P. macranthera* V. Krecz., *Galatella macrosciadia* Gand., *Saussurea daurica* Adam., *Salicornia europaea* L. They were constantly accompanied by *Artemisia nitrosa* Web. ex Stechm., *Limonium gmelinii* (Willd.) O. Kuntze, *Suaeda corniculata* (C. A. Mey.) Bunge, *Atriplex fera* (L.) Bunge, *A. patens* (Litv.) Grub. *Asparagus pallassii* Miscz., *Hordeum sibiricum* Roshev were met singly. In the studied plant community *N. sibirica* did not form dense thickets, it was located contagiously, on sites, which were open from *A. splendens*.

N. sibirica is a hypogeogenic-geoxylic vegetative-mobile shrub with underground branching of axes and with the formation of thick and durable underground lignified axes. Its leaves are oblong-obovate, fasciculated per 2-4 pieces. Its fruit is a drupe (or stone fruit) of spherical shape, with dark blue juice. The pyrenes are 3-5 mm long. Each mature generative individual of *N. sibirica* is a unit («curtina») which consists of a primary bush (30-90 cm high) and several partial formations (bushy, flowering and non-flowering). The underground part of the primary bush is a xylopodium with a diameter of more than 8 cm and xylorhizomes. Xylorhizomes are extending from the xylopodium and are usually 60-200 cm long. There can be 70-80 xylorhizomes; 10-12 pieces of them are powerful with a diameter of 0.7-1.9 cm. They are formed from the dormant buds of the xylopodial part of the primary bush. Removing in different directions evenly xylorhizomes capture an area with a diameter of up to 2-3 meters. It strengthens the function of vegetative overgrowth. The adventitious roots extend from the xylorhizomes. The aboveground part of the primary bush is represented by 15-133 main skeletal axes of the I (first) order and shoots of formation of the II (second) order branching from the skeletal axes in turns. On the shoots of formation other shoots of branching of the III-IV orders (less often of the V order) develop. From 1 to 72 shoots of formation (50-60 cm high) and from 13 to 160 shoots of branching (20-30 cm high) can develop on one main skeletal axis. The shoots of the branching of the III-IV orders have generative organs. There are from 4 to 60 generative shoots with small, white flowers in corymbose dichasia. Shoots of the II order (less often of the III order) die off from the distal end; their number can exceed 100 pcs. After the death of the oldest xylorhizomes' sections the connection between the partial formations is lost and a clone is formed.

The ontogenesis of *N. sibirica* is complete, it passes through 10 ontogenetic states (4 periods). The particulation occurs in a subsenile ontogenetic state. The reproduction of individuals is mainly vegetative.

The studied CP is normal, that is, it is capable of self-maintenance by the seminal or the vegetative pathways, or by both together. The studied CP is incomplete, due to the fact that it lacks seedlings and individuals in the juvenile, immature, virginal and senile ontogenetic states. The CP is characterized by a centered ontogenetic spectrum with an absolute maximum on mature generative individuals (61.5 %), while a high percentage of individuals in the old generative ontogenetic state remains (23.1 %). The shares of young generative and subsenile individuals are about 7.69 %.

The maintenance of the CP occurs due to the vegetative reproduction, life duration and the stability of individuals of the mature generative ontogenetic state. Seed renewal is weak and occurs periodically. Seeds ripen, but the seedlings are often absent. One of the reasons for this is probably the growth of the species on the territory which is flooded in the spring and autumn periods.

The CP is aging according to the classification «delta-omega» by L. A. Zhivotovsky (2001). The efficiency index is 0.88, the age index is 0.56.

The obtained data on the ontogenetic structure of the coenopopulation of *N. sibirica* CP are partially consistent with the results of other researchers working on the Trans-Baikal Territory, in the area near the Western Issyk-Kul Region and in the Republic of Khakasia [9, 20, 21].

Seeds were germinated in the laboratory after 8 months of rest. The pretreatment was carried out during 21 days at a temperature of 10°C because of seed hardness. The seeds were germinated in Petri dishes on wetted filter paper, in the temperature range from 22 to 24 °C. Viable seeds sprouted within 5 to 9 days. The germination rate was 6 % per 100 samples.

4 Conclusion

N. sibirica is characterized by a narrow ecological coincidence and grows only in saline large-sod steppes. The species is represented by the life form of a hypogeogenic-geoxyle vegetative-mobile shrub with an underground branching of xylorhizomes. Mature individuals form a “curtina” which consists of a primary bush and partial formations. The coenopopulation is normal, incomplete, with a centered ontogenetic spectrum. Its maintenance occurs due to the vegetative reproduction, seed renewal is weak. Seed germination in laboratory conditions is low.

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