sciendo

Ekológia (Bratislava) - Journal of the Institute of Landscape Ecology, Slovak Academy of Sciences Vol. 41, No. 2, p. 147–154, 2022

DOI:10.2478/eko-2022-0015

ASSESSMENT OF THE POPULATION STATUS OF *Allium oschaninii* O. FEDTSCH. IN THE MOUNTAINS OF UZBEKISTAN

SHAKHNOZA SARIBAEVA ✉, OZODBEK ABDURAIMOV, AKMAL ALLAMURATOV

Institute of Botany Academy of Sciences Republic of Uzbekistan, Tashkent, 100125, Uzbekistan; e-mail: ssaribayeva@list.ru

✉ Corresponding author

Received: 9 March 2022 / **Accepted:** 5 May 2022

Abstract

Saribaeva S., Abduraimov O., Allamuratov A.: Assessment of the population status of *Allium oschaninii* O. Fedtsch. in the mountains of Uzbekistan. Ekológia (Bratislava), Vol. 41, No. 2, p. 147–154, 2022.

Currently, the genetic resources of plants are on the verge of gradual disappearance, called genetic erosion. The erosion of genetic diversity implies the loss of diverse genes in individual plant species. Therefore, special attention should be paid to the collection and conservation of genetic resources of endangered plants for future use. The aim of this study is to research the natural coenopopulation of the ancestral species of cultivated plant, *Allium oschaninii* in the mountains of Uzbekistan. Field studies were conducted in nine coenopopulations in the Turkestan, Gissar, and Alai ranges. For each coenopopulation, a phytocoenotic characteristic given on the sites of 100 m^2. When determining the structure of *A. oschaninii* and the characteristics of the coenopopulation, transects from 10 to 30 sites of 1 m^2 were established. The condition of the coenopopulation was assessed by the age structure of *A. oschaninii* and using a demographic indicator. We found that the condition of the coenopopulation is normal, but incomplete. The condition of the coenopopulations 1, 8, 9 is under threat due to anthropogenic load (overgrazing) and unfavorable factors of the ecotype. The ontogenetic spectrum is centered with a peak on average generative individuals and does not coincide with the characteristic one. Coenopopulations with a left-sided type, with a predominance of juvenile individuals, are formed on stony-gravelly, fine-grained gravel, and soft-soil mountain plains. By biological nature, the ontogenetic spectrum of *A. oschaninii* is left- sided, with an absolute maximum on one of the pregenerative groups. According to the demographic indicators, in diverse communities and in low-mountain and medium-category habitats and in a static substrate with grazing, the coenopopulation is young, mature, and in a transitional state.

Key words: biodiversity, coenopopulation, ontogenetic structure, mountains of Uzbekistan, genetic erosion, *Allium oschaninii*.

Introduction

Plant genetic resources (PGR) play an important role in providing the population with agricultural and food products. One of the main directions of the exploration of PGR is the study of wild relatives of cultivated plants (WRCP), their rational use in conditions, conservation in *ex situ* conditions, and the development of measures for their protection (Akparov et al., 2009). According to Dzyubenko et al. (2010), more than half of the cultivated plants of the world flora have agricultural and food value, but only 10% of them are used. There are 4,350 species of vascular plants in the flora of the Republic of Uzbekistan (Sennikov et al., 2016), of which 5% (217 species) are considered to be WRCP (Abduraimov et al., 2021).

The local flora of the Republic of Uzbekistan is a rich source of the gene pool of plants of food and agricultural importance. But the WRCP of Uzbekistan are poorly studied. It should be noted that most of the research is devoted to the study of plants widely used in agriculture.

Many scientific researches of scientists at the Scientific Research Institute of Plant Genetic Resources of the Academy of Sciences of the Republic of Uzbekistan are devoted to the conservation, study, and rational use of genetic resources of cultivated plants (Abdullaev, Baymetov, 2021; Baymetov, Abdullaev, 2020; Shmaraev et al., 2003). The institute's gene pool contains a world collection of agricultural crops, consisting of 43,347 samples of more than 100 types of agricultural crops, including grain, fodder, technical, vegetable, fruit crops, and grapes (Abdullaev, Baymetov, 2021). These collections contain rare and endangered forms, ancient local varieties, WRCP, and breeding varieties from many countries of the world (Amanov et al., 2020).

As a part of research on the conservation and effective use of the WRCP, different studies have evaluated different types of cotton. Most of his work and students devoted to the study of types of cotton (Abdullaev, 2016; Abdullaev et al., 1978, 2017; Abdurakhmonov et al., 2013).

Other studies focus mainly on the study of walnuts, almonds, apples, hawthorn, and other plants (Arzumanov et al., 2015; Mavlyanova, et al., 2020; Abdullaev, Abdumuhtorov, 2020; Baymetov, Abdullaev, 2020).

A number of studies have been devoted to the study of WRCP of the genus *Allium* (Kamenetsky et al., 2004), which were mainly carried out on wild onion species used in folk medicine.

© The Author(s) 2022. This is an open access article licensed under the Creative Commons Attribution-NonCommercial-NoDerivs License (http://creativecommons.org/licenses/by-nc-nd/3.0/).

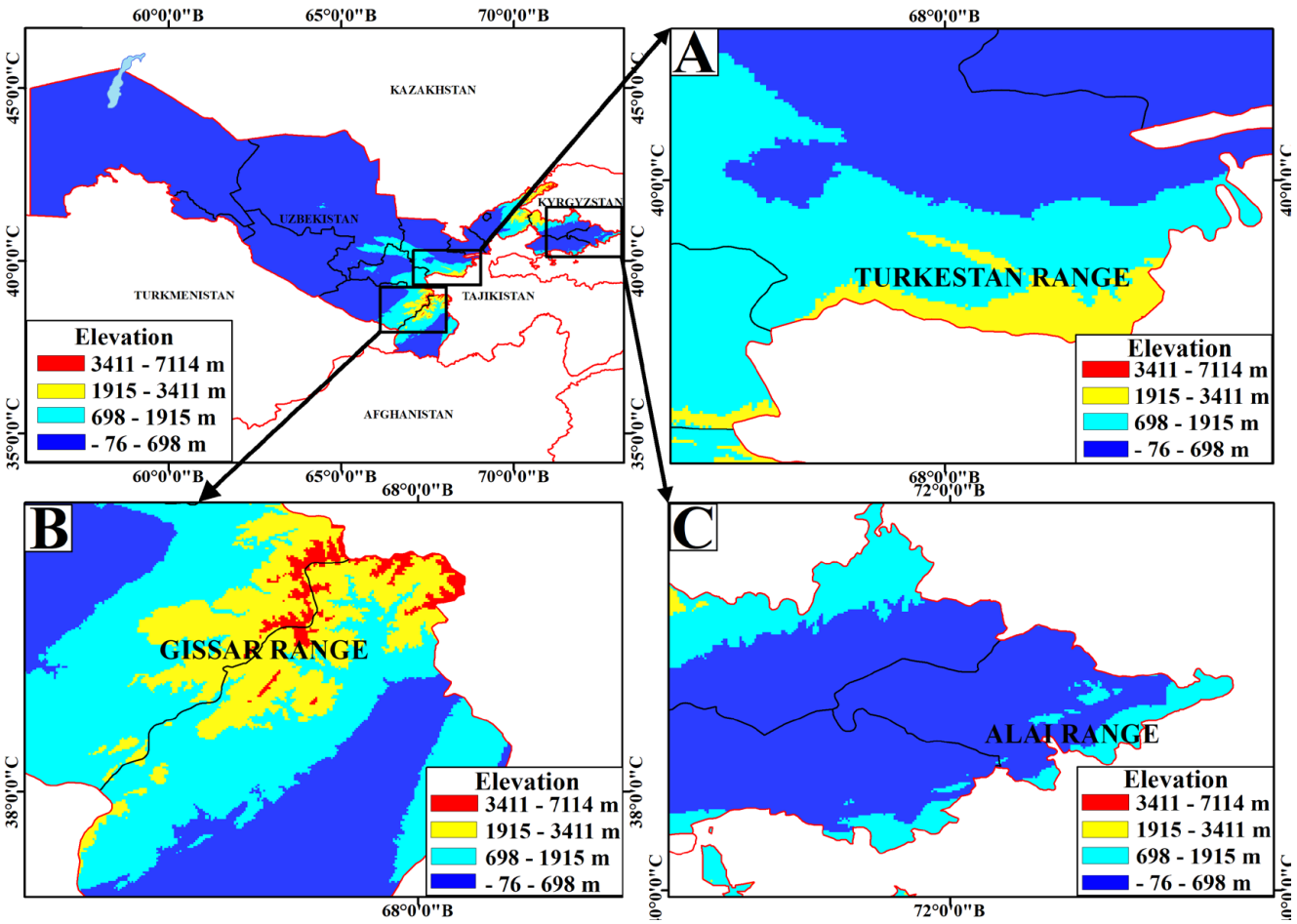


Fig. 1. Research locations on the map.

Kamenetsky et al. (2007) studied wild relatives of cultivated *Allium sativum* L. and their genetic resources. Biochemical and molecular studies have shown that the highest level of heterogeneity is observed within the Central Asian gene pool, which may contain genes of interest for future use in genetic research, as well as for plant improvement programs.

The conservation of the genetic resources of plants in Central Asia has become an important issue due to the deterioration of environmental conditions and the acceleration of genetic erosion. The study of the natural population of the gene pool of WRCP and the influence of environmental factors is relevant.

In many countries, scientists study natural coenopopulations (CPs) of certain plant groups with systematic, genetic, and molecular studies and their preservation in situ (Astashenkov et al., 2019; Cheremushkina et al., 2020; Nabiev et al., 2020; Golovanov et al., 2021). Studies are being conducted in Uzbekistan to assess the state of CPs of rare and endangered plant species included in the Red Book of Uzbekistan (Akhmedov et al., 2015; Shomurodov, Abduraimov, 2017; Saribaeva, Shomurodov, 2017; Shomurodov et al., 2021; Saribaeva et al., 2022).

The purpose of the study is to assess the current state of the population of *A. oschaninii* O. Fedtsch in the mountains of Uzbekistan.

Material and methods

Study area

This research was conducted in various mountain of Uzbekistan: Turkestan ridge, Gissar ridge, and Alai ridge (Fig. 1). According to the natural and climatic conditions, Uzbekistan belongs to the continental territories (https://hydromet.uz/index.php/ru/node/1295). The studied territories differ in natural and climatic data. The Turkestan ridge is one of the northern extensions of the Pamir-Alai system. This ridge runs in an east–west direction, north of the Zerafshan ridge, forming the southern border of the Fergana Valley in Tajikistan and the Hungry Steppe in Uzbekistan. The height of the Turkestan Range is up to 5,621 m. According to its natural and climatic conditions, the territory has a cold, semi-arid climate (https://ru.climate-data.org/азия/узбекистан/джизакская-область/заамин -24837/). This area is characterized by relatively cool and humid summers and moderately cold winters. The average annual temperature is 13.2 °C, and the amount of annual precipitation per year is 629 mm.

The Gissar ridge represents the southern branch of the Alai ridge. The height of the Gissar Range is up to 4,643 m. The research area is located in the southwestern branch of the Gissar

ridge. The southwestern branch of the Gissar ridge consists of a series of uplifts with numerous spurs bearing various local names and composing the vast mountainous system between the Karshi steppe and the valley of the Surkhan River. According to the natural and climatic conditions, the territory of the studied CPs differs. The territory of Baysun and Sangardak is classified as semi-arid based on climatic conditions (https://ru.climate-data.org/азия/узбекистан/сурхандарьинская-область/термиз-2782/). The average annual temperature is 12.2 °C, and the average precipitation is 530 mm. The climate of Kugitang is more arid, the average annual temperature is 19.4 °C, and the average annual precipitation is 202 mm.

The Alai ridge stretches along the southern edge of the Fergana Valley, separating the latter from the Alai Valley, located to the south between the Alai and Zaalai ranges. At the same time, the Alai ridge is the watershed of the greatest rivers of Central Asia – the Syr Darya and Amu Darya. Ridge height is up to 5,569 m. Natural and climatic conditions include a cold, semi-arid climate. The average annual temperature is 14.7 °C. The average annual precipitation rate is 384 mm (https://ru.climate-data.org/азия/узбекистан/андижанская-область/андижан- -2901/).

In order to assess the phytocenotic closure of populations using traditional geobotanical methods, we made geobotanical descriptions of plant communities in localities with an area of 100 m^2. The relief area at each site was 100 m^2 (Ponyatovskaya, 1964). Plant species were determined according to the book "The flora of Uzbekistan" (Khassanov, 2017). We used Latin names of plant species according to Czerepanov (1995) and in accordance with the international taxonomic database POWO (https://powo.science.kew.org/). Identification of age-related conditions and methodological principles and approaches were used by the studies Rabotnov (1950) and Uranov, Smirnova (1969). The following age conditions were assessed according to the standard criteria: juvenile (j), immature (im), virginal (v), young generative (g1), medium generative (g2), old generative (g3), and senile (s). The structure of the CPwas processed by the generally accepted methods of Uranov (1975) and Smirnova et al. (1976). The transects were 10 m long and were divided into platforms of 1 m^2. Each population had from 10 to 30 localities with an area of one m^2. The ontogenetic structure of CPs was defined as the ratio in the CP of individuals of different ontogenetic states. An individual was taken as a counting unit. The type of CP was determined according to the classification of Uranov, Smirnova (1969). The assessment of the state of the CP was carried out according to the classification "delta–omega" by Zhivotovsky (2001), based on the joint use of age indices (D) (Uranov, 1975) and efficiency (ω) (Zhivotovsky, 2001). The population density was determined by the number of individuals per unit area. At the same time, special attention was paid to indicators of average density, the number of individuals per unit of the entire space (total area), and ecological density – the number per unit of the real occupying population (Odum, 1986).

The object of the study was the ancestral species of the cultivated plant, *Allium oschaninii* O. Fedtsch. According to biology, the studied species is a loose-grain particulating monocentric rhizomatous–bulbous plant (Cheremushkina, 2004). *A. oschaninii* is distributed in the transition zone from Central to Southwest Asia. It is found in the northeast of Iran (Hanelt, 1985). It is often found only in hard-to-reach places because livestock eats the leaves, and its large bulbs are collected by local residents. Plants are very diverse in morphology and sometimes resemble *Allium cepa*. Previously, it was thought that it is similar to it (*A. cepa* var. *sylvestre* Regel), but recent molecular studies have shown that it is a related group of *A. cepa* and *A. vavilovi* – an evolutionary line of origin (Friesen, Klaas, 1998). By molecular analysis (Fritsch, Friesen, 2002; Yusupov et al., 2021), having found out that the "French gray shallot" is a domesticated *A. oschaninii* (Fritsch, Friesen, 2002).

The vegetation cover of the mountain ecosystem of Uzbekistan is diverse. Various types of ephemera, mixed-grass, and semi-shrub formations grow in the low mountains. Some mountain slopes are covered with Eremurus and tulips in spring. There are almost no ephemeral plants in the midlands. Trees and shrubs are better developed here. Highlands (above 2,500 m above sea level) are characterized by steep rocky slopes, subalpine and alpine meadows, and steppes. It is dominated by bluegrass-steppe and light brown soils with typical herbaceous vegetation (Mailun, 1984).

A. oschaninii participates in various communities of petrophytic slopes at the bottom of the mountain and the middle part of the mountains in the Adyr belt. Most species of the genus *Allium* L. do not play a significant role in the composition of vegetation. Only some species act as edifiers or dominants (Cheremushkina, 2004). In the mountains of Central Asia, communities with the dominance of *A. hymenorhizum* Lebed. and *A. platyspathum* Schrenk on meadow soils are described, with coverage ranging from 70 to 80% (Kultiasova, 1952; Stepanova, 1962). *A. oschaninii* is found in communities in the mountains of Central Asia as a member of the community (Ibragimov, 2010; Turginov, 2017).

Results and discussion

Distribution and characteristics of plant communities with the participation of Allium oschaninii

The analysis of literary data, geobotanical descriptions with the participation of *A. oschaninii*, material of the TASH Herbarium (National Herbarium of Uzbekistan, Tashkent), material of the MW Herbarium (Moscow University Herbarium, Moscow), material of the Plantarium Plants and lichens of Russia and neighboring countries (Plantarium, 2022), and material of the Global diversity information facility (GBIF) showed that the studied species is widespread in the mountains of Central Asia (Fig. 2).

In the course of field research, the structure of *A. oschaninii* of nine CPs in communities in different regions of Uzbekistan was studied (Fig. 1).

The first CP (CP 1, Fig. 3) was studied in the Turkestan ridge on a rocky, coarse-grained, stony-gravelly slope and an elevation of 962 m a.s.l., which contained *Crataegus turkestanica* communities, with a grass coverage of 17%. The floral composition of the community consisted of 17 species of vascular plant species. The dominant species were *Spiraea hypericifolia, Eremurus regelii,* and *Crataegus turkestanica*.

The second CP (CP 2, Fig. 3) is located in the Turkestan ridge on a rocky-gravelly slope and height above 1,025 m a.s.l., in the community where *Prunus bucharica* dominated. Floristic composition included 20 species, and the grass coverage was 17%. The community of *P. bucharica* and *Eremurus regelii* was dominant.

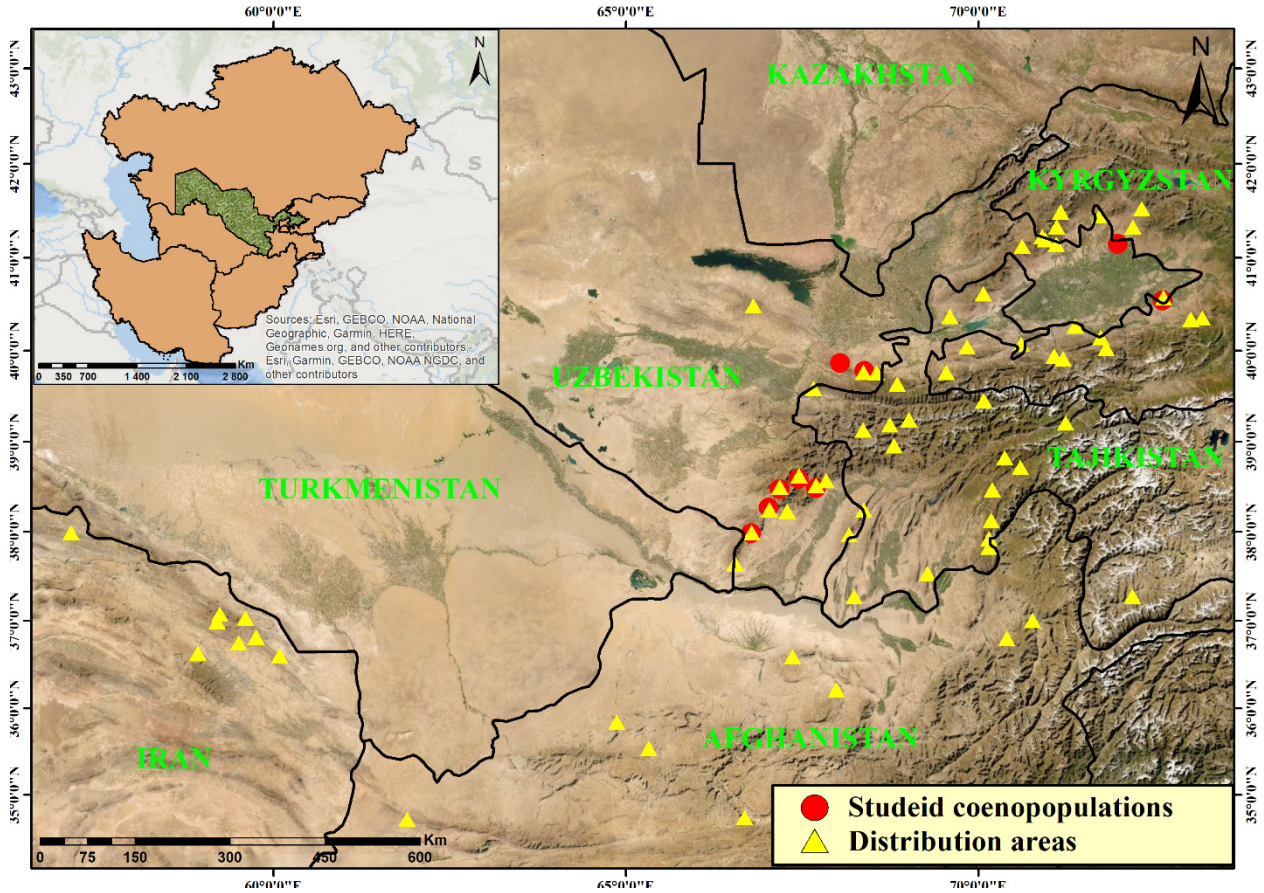


Fig. 2. Distribution of *Allium oschaninii* (according to herbarium data) and studied coenopopulations.

The next CP (CP 3, Fig. 3) was studied in the Gissar ridge, Baysun district, on a gravelly soft soil slope and an elevation of 1,250 m a.s.l. The *Ephedra equisetina* community was dominated by *Prunus divaricata* and *Ephedra equisetina*. The grass projective cover was 10%, and the floral composition of the community consisted of 17 species.

The fourth CP (CP 4, Fig. 3) was studied in the Baysun mountain on a rocky-gravelly slope and an elevation of 1,875 m a.s.l. The dominant species of the *Juniperus seravschanica* community were *Prunus bucharica* and *Juniperus seravschanica*. Nineteen vascular species participated in the community; their projective coverage was 14%.

The following three CPs were studied in the Gissar ridge: the fifth CP (CP 5) was common in the Kugitang ridge on a rocky, finely gravelly gravel slope and an elevation of 1,490 m a.s.l., in the community of *Prunus bucharica*; the dominant species were *P. bucharica* and *Ferula nevskii*. The floral composition consisted of 12 species, and the projective coverage was 15%. The sixth CP (CP 6) was studied in the Hissar ridge in the Sangardak mountains in the vicinity of the Nile on a rocky-gravelly slope and an elevation of 919 m a.s.l. in the community of *Prunus bucharica*. The dominant species were *P. bucharica, P. divaricata,* and *Vitis vinifera*, with a grass coverage of 10%. The floral composition of the communities consisted of 14 species. The next CP (CP 7) was studied in the Hissar ridge in the vicinity of Bogcha in the Sangardak mountains on a rocky-gravelly slope and an elevation of 1,695 m a.s.l. The dominant species were *Prunus bucharica, Iris warleyensis,* and *Rheum maximowiczii*. Twenty-two species participated in the community, and the grass coverage was 10%. The last two CPs (CP 8 and CP 9) were studied in the Alai ridge in the vicinity of the Imamota on the mother rock, with a rocky slope and an elevation of 840 m a.s.l., in the community dominated by *Eremurus turkestanicus, E. soogdianus,* and *Artemisia scoparia*. There were 22 species in the community, and their projective herbage coverage was 10%. CP 9 was located in the vicinity of Govasoy on the rocky slope and an elevation of 1,017 m a.s.l., in the community of *Eremurus soogdianus*. The community was dominated by *Er. soogdianus, Er. turkestanicus, Artemisia sogdiana,* and *Medicago sativa*. The community consisted of 33 species, and the projective grass cover was 12%. In all studied reports, the participation rate of *Allium oschaninii* did not exceed about 2%, and this indicator of occurrence can be considered during flowering (Table 1).

Ontogenetic structure of Allium oschaninii and CP characteristics

In the studied CPs according to Uranov, Smirnova (1969), *A. oschaninii* was normal, but incomplete. In some CPs, we found no individuals of juvenile (CP 1, 6) and senile state (CP 2–7). There were two types of ontogenetic spectra of the CP: left sided and centered. By biological nature, the ontogenetic character of *A.*



Fig. 3. Ontogenetic structure of *Allium oschaninii* CP. Y-axis – age stages, %; X-axis – age stages.
Notes: j – juvenile; im – immature; v – virginal; g1 – young generative; g2 – middle-aged generative; g3 – aging generative; s – senile, %; CP – coenopopulation.

oschaninii was left sided, with an absolute maximum on one of the pregenerative groups (Cheremushkina, 2004).

In most CPs of *A. oschaninii*, a left-sided ontogenetic spectrum was dominant (CP 2–7). The spectrum maximum was noted for the group of virginal individuals (31.81–55%). Their habitats were confined to rocky-gravelly, fine-grained gravel, and soft-soil mountain plains. According to Cheremushkina (2004), abundant seed renewal contributes to the stable development of young individuals in CPs. This means that *A. oschaninii* seed stocks in the soil are abundant, moisture remains in the soil for a long time, and conditions are created for the growth and development of young seedlings. The predominance of virginal individuals in CPs is explained by the fact that in rhizomatous-bulbous species, vegetative reproduction begins in the generative period (Smirnova, 1987), as well as the early onset of the spring onion vegetation in mountainous areas, the absence of species in the vegetation cover. The average density of individuals in CPs ranged from 1.0 to 6.5 individuals per 1 m^2. The ecological density was quite high, from 2.0 to 10.0 individuals per m^2.

The recovery index of the CP was from 1.2 to 9.66. This indicates their good replenishment with young individuals. The low aging index of the CP (Ic = 0) is explained by the absence of old individuals. According to the classification of delta–omega by Zhivotovsky (2001), CPs belong to the young category (Table 2).

Another type of ontogenetic spectrum is formed in the conditions of petrophytic burning – centered (CP 1, 8, 9). Middle-aged generative groups of individuals predominate in CPs (23.8–36.84%). The studied CPs are distributed on rocky, coarse-grained, stony-gravelly slopes at rock outcrops. As a result, spring torrential rains often wash away young individuals.

Table 1. Characteristics of plant communities with *Allium oschaninii*.

№. CP	Geographic locations CP	Geographic coordinates Elevation (m)	Community/ dominant species	Number of species in the community	Total projective cover (%)	The projective cover of *A. oschaninii,* (%)
1	Turkestan ridge, Molguzar neighborhood	N 39.863717 E 68.038639 962 m a.s.l.	*Spiraea hypericifolia*, *Eremurus regelii*, *Crataegus turkestanica*	17	17	≤1
2	Turkestan ridge, surroundings of Ettikechow	N 39.779097 E 68.380494 1,025 m a.s.l.	*Prunus bucharica, Eremurus regelii*	20	16	≤2
3	Gissar ridge, Boisun district, Darband neighborhood	N 38.273339 E 67.02342 1,250 m a.s.l.	*Prunus divaricata, Ephedra equisetina*	17	10	≤2
4	Gissar ridge, Baysun district, environs of Kentala	N 38.478775 E 67.178794 1,875 m a.s.l.	*Prunus bucharica, Juniperus seravschanica*	19	14	≤1
5	Gissar ridge, Kugitang, Khatak neighborhood	N 37.984316 E 66.775627 1,490 m a.s.l.	*Prunus bucharica, Ferula nevskii*	12	15	≤1
6	Gissar ridge,Uzun district, Sangardak, Neelu neighborhood	N 38.491909 E 67.695821 919 m a.s.l.	*Prunus bucharica, Prunus divaricata, Vitis vinifera*	14	10	≤2
7	Gissar ridge,Uzun district, Sangardak, Bogcha neighborhood	N 38.590974 E 67.445211 1,695 m a.s.l.	*Prunus bucharica, Iris warleyensis, Rheum maximowiczii*	22	10	≤1
8	Alai ridge, Andijan region, Imomota neighborhood	N 40.542926 E 72.617033 840 m a.s.l.	*Eremurus turkestanicus, Artemisia scoparia*	22	10	≤1
9	Alai ridge, Namangan region, environs of Govasoy	N 41.152593 E 71.978386 1,017 m a.s.l.	*Eremurus soogdianus, Artemisia sogdiana*	33	12	≤1

Note: CP – coenopopulation.

Table 2. Demographic characteristics of *Allium oschaninii* CPs.

CP	Demographic indicators					Types of CP
	I_r	I_a	Density Individuals/m²	P_{ecol} Individuals/m²	The number of individuals in the CP (copies)	
1	0.59	0.07	1.9	3.2	38	Transitional
2	5.12	0	4.9	8.9	98	Young
3	2.0	0	1.2	2.4	24	Young
4	2.1	0	1.4	2.8	28	Young
5	5.66	0	1.0	2.9	20	Young
6	1.2	0	1.1	2.0	22	Young
7	9.66	0	6.5	10.0	130	Young
8	0.5	0.01	1.5	3.3	30	Maturing
9	1.0	0.04	1.1	2.3	21	Young

Notes: CP – coenopopulation; I_r – recovery index; I_a – aging index; P_{ecol} – ecological density.

In this regard, generative individuals accumulate in CPs (Fig. 2). The seedlings that have appeared do not have time to go into a juvenile state and die. The habitats are subject to intensive grazing, which contributes to an increase in the number of mature individuals. In the Turkestan mountains, *A. oschaninii* has a long life cycle; the duration of the generative period lasts about 15–16 years (Cheremushkina, 2004). Despite the duration of the generative period, the average density is insignificant and ranges from 1.1 to 1.9 individuals per 1 m^2. The ecological density is from 2.3 to 3.3 individuals per m^2, respectively (Table 2). The recovery index of coenopopulations is from 0.5 to 1.0. This suggests that the relative static nature of the substrate contributes to the accumulation of generative individuals in CPs. The indicator of the aging index is 0.01–0.07. According to the classification of delta–omega by Zhivotovsky (2001), CPs belong to transitional, maturing, and young (Table 2).

Conclusion

The studied CPs of *A. oschaninii* are normal, but incomplete. The incompleteness of the CP is associated with the peculiarities of vegetative reproduction, shallow rejuvenation of daughter individuals, and slow rates of development in the virginal and young generative state. CPs with a young, mature, and transitional ontogenetic spectrum are found in diverse communities and in low and medium category habitats and in a static substrate with weak grazing with low anthropogenic influence. CPs with a left-sided type, with a predominance of juvenile individuals, are formed on stony-gravelly, fine-grained gravel, and soft-soil mountain plains. CPs with a centered ontogenetic type are formed in the unfavorable factors of the ecotope (rocky, coarse-grained, rocky-gravelly slopes at rock outcrops). CPs with a centered ontogenetic spectrum do not coincide with the characteristic one. The fluctuation in the number ranging from 1.0 to 6.5 individuals/m^2 reflects the influence of anthropogenic load. Both anthropogenic and natural factors pose a threat to the studied CP: overgrazing, extreme environmental conditions, habitat, climate change, and desertification.

Acknowledgements

The work was carried out within the framework of the project of the state scientific and technical program of the Republic of Uzbekistan, "Assessment of the current state of populations and creation of a living collection of economically valuable species of wild relatives of cultivated plants of the flora of Uzbekistan."

References

Abdullaev, A.A. (2016). The main evolutionary signs of precocity of the genus Gossypium L. (in Russian). *Reports of the Academy of Sciences of the Republic of Uzbekistan*, 1, 82–83.

Abdullaev, A.A. & Baymetov K. (2021). Conservation and use of the world's collections of cultivated plants and their wild relatives (in Russian). *Science and Innovative Development*, 3, 65–72.

Abdullaev, A.A., Lemeshev N.K. & Uzakov M.F. (1978). *Mexican cotton species (in Russian)*. Tashkent.

Abdullaev, F.H. & Abdumuhtorov S.X. (2020). The world maize gene pool is the basis for creating the source material for breeding (in Russian). In *Problems and scientific solutions of biology, ecology and soil sciences* (pp. 54–57). Republican scientific and practical seminar of the National University of the Republic of Uzbekistan, Tashkent.

Abdullaev, F.H., Rizaeva, S.M., Arslonov, D.M., Muminiv, X.A. & Samanov Sh.A. (2017). *World, collection of cotton: conservation and use.* IV Vavilov International Conference. Ideas N.I. Vavilov in the modern world, 20-24 November 2017. St. Petersburg.

Abduraimov, O.S., Mahmudov, A.V., Aytmurodov, R.P., Saribayeva, Sh.U. & Mavlanov B.J. (2021). Rare species of wild relatives of cultivated plants of the Republic of Uzbekistan (in Russian). *Bulletin of the Academy of Sciences of the Republic of Uzbekistan Karakalpak branch*, 3, 37–43.

Abdurakhmonov, I.Y., Abdullaev, A., Buriev, Z., Shermatov, S., Kushanov, F.N., Makamov, A., Shapulatov, U., Egamberdiev, S.S., Salakhutdinov, I.B., Ayubov, M., Darmanov, M., Adylova, A.T., Rizaeva, S.M., Abdullaev, F., Namazov, S., Khalikova, M., Saydaliev, H., Avtonomov, V.A., Snamyan, M., Duiesenov, T.K., Musaev, J., Abdullaev A.A. & Abdukarimov A. (2013). Cotton germplasm collection of Uzbekistan. *The Asian and Australian Journal of Plant Science and Biotechnology,* 7(2), 1–15.

Akhmedov, A.K., Cheremushkina, V.A. & Shomurodov H.F. (2015) Ontogeny and ontogenetic structure of coenopopulations of *Lagochilus gypsoseus* Vved. (*Lamiaceae*) in Kyzylkum, Uzbekistan (in Russian). *The Flora of Asian Russia*, 2(18), 32–38.

Akparov, Z.I., Askerov, A.M., Kadirov, I.G. & Mamedov A.T. (2009). Rare and endangered wild relatives of cultivated plants of the flora of Absheron and Kobustan (in Russian). *Bulletin of the Nikitinsky Botanical Garden,* 99, 26–30.

Amanov, A., Abdullaev, F.H., Bajmetov, K.I. & Alikulov S.M. (2020) *World gene pool of agricultural crops: conservation, enrichment, study and use* (pp. 176–180). Modern trends in scientific support of the agro-industrial complex. Ivanovo: PressSto.

Arzumanov, B.A., Butkov, E.A., Turdiyeva, M.K., Baymetov, K.I. & Yushev A.A. (2015). *Plant resources of fruit and nut plants of Central Asia and their role in the formation of the local assortment.* Rome: Bioversity International.

Astashenkov, A.Yu., Cheryomushkina, V.A., Myrzagalieva, A. & Medeubaeva B. (2019). Ontogenesis, estimation of coenopopulation state and component composition in *Nepeta densiflora* individuals of East. *International Journal of Environmental Studies,* 76(5), 634–647. DOI: 10.1080 / 00207233.2018.1509496.

Baymetov, K. & Abdullaev F. (2020). Wild-growing types of fruit crops of Central Asia are a source of valuable traits and properties for breeding. In *International scientific and practical conference dedicated to the 100 th anniversary of the discovery of the law of homological series and the 133rd anniversary of Academician N.I. Vavilov* (pp. 27–29). 24-25 November 2020, Saratov.

Cheremushkina, V.A. (2004). *Biology of Eurosian onions (in Russian)*. Novosibirsk: Nauka.

Cheremushkina, V.A., Guseva, A.A., Makunina, N.I., Astashenkov, A.Yu. & Denisova G.R. (2020). Phytocenotic characteristics, ontogenetic structure and assessment of the state of coenopopulations of *Scutellaria scordiifolia* (Lamiaceae) in Siberia (in Russian). *Rastit. Res.*, 56(2), 138–150. DOI: 10.31857/S003399462002003X.

Czerepanov, S.K. (1995). *Vascular plants of Russia and adjacent states (the Former USSR)*. Cambridge: Cambridge University Press.

Dzyubenko, N.I., Smakalova, T.N., Chuxina, I.G., Dzyubenko, E.A. & Malishev L.L. (2010). *Creation of areas of cultivated plants and their wild relatives in the electronic atlas of economically significant plants and harmful objects in Russia and neighboring countries*. St. Petersburg.

Friesen, N. & Klaas M. (1998). Origin of some minor vegetatively propagated *Allium* crops studied with RAPD and GISH. *Genet. Resour. Crops Evol.*, 45, 511–523. DOI: 10.1023/A:1008647700251.

Fritsch, R.M. & Friesen N. (2002). Evolution, domestication and taxonomy. In H.D. Rabinovitch & L. Currah (Eds.), *Allium group science: Recent advances* (pp. 5–30). Wallingford: CABI. DOI: 10.1079/9780851995106.0005.

Golovanov, Y.M., Mustafina, A.N., Abramov, L.M. & Shigapov Z.Kh. (2021). Some rare plant species in the Aktolagay cretaceous massif (Republic of Kazakhstan): the characteristics of populations. *Acta Biologica Sibirica*, 7, 363–379. DOI: 10.3897/abs.7.e72819.

Hanelt, P. (1985). Zur taxonomie, Chorologie und Ökologie der Wildarten von *Allium* L. sect. *Cepa* (Mill) Prokh. *Flora*, 176, 99–116. DOI: 10.1016/ S0367-2530(17)30106-8.

Ibragimov, A.J. (2010). *Flora of Surkhandarya State Reserve (Kugitang Range) (in Uzbek)*. Tashkent.

Kamenetsky, R., Khassanov, F., Rabinowitch, H.D., Auger, J. & Kik C. (2007). Garlic biodiversity and genetic resources. *Medicinal and Aromatic Plant Science and Biotechnology*, 1(1), 1–5.

Kamenetsky, R., Shafir, I.L., Baizerman, M., Khassanov, F., Kik, C. & Rabinowitch H.D. (2004). Garlic (*Allium sativum* L.) and its wild relatives from Central Asia: Evaluation for fertility potential. *ISHS Acta Horticulturae*, 637, 1–8. DOI: 10.17660/ActaHortic.637.9.

Khassanov, F. (2017). *The flora of Uzbekistan*. Tashkent: Navruz Press.

Kultiasova, G.M. (1952) Onions in the Aksu-Dzhabagly Reserve (in Russian). *Bulletin of the Main Botanical Garden of the USSR*, 12, 104–108.

Mailun, Z.A. (1984). Mountain high-grass meadows. In N.M. Salnikova & T.A. Shur (Eds.), *Vegetation cover of Uzbekistan and ways of its rational use* (pp. 164–170). Tashkent: FAN.

Mavlyanova, R.F., Abdullaev, F.H. & Mansurov X.G. (2020). New varieties of mung bean created on the basis of the world gene pool of the world vegetable growing center (in Russian). In *Agrarian Science for Agriculture: collection of materials: XV International Scientific and Practical Conference* (pp. 261–263). 12-13 March, 2020. Barnaul.

Odum, Yu. (1986). *Ecology (in Russian)*. Moscow.

Plantarium (2022). *Plants and lichens of Russia and neighboring countries: open online galleries and plant identification guide*. https://www.plantarium.ru/lang/en.html

Ponyatovskaya, V.M. (1964). Accounting for abundance and features of species placement in natural plant communities (in Russian). In E.M. Lavrenko & A.A. Korchagina (Eds.), *Field geobotany* (pp. 209–289). Moscow-Leningrad.

Rabotnov, T.A. (1950). Life cycle of perennial herbaceous plants in meadow coenoses. *Proceedings of the Biological Sciences*, 3(6), 7–204.

Saribaeva, Sh.U. & Shomurodov Kh.F. (2017). Actual state of coenopopulations of *Astragalus centralis* Sheld. Under condition of Kuldzhuktau ridge (Kyzylkum desert). *Arid Ecosystems,* 7(4), 265–270. DOI: 10.1134 / S2079096117040096.

Saribaeva, Sh.U., Shomurodov, Kh.F. & Abduraimov O.A. (2022). Ontogenesis and ontogenetic structure of local populations of the *Astragalus holargyreus* Bunge (Fabaceae) of the narrow-local endemic of Kyzylkum. *Arid Ecosystems*, 12(1), 78–84. DOI: 10.1134/S2079096122010103.

Sennikov, A.N., Tojibaev, K.Sh., Khassanov, F.O. & Beshko N.Yu. (2016). The flora of Uzbekistan project. *Phytotaxa,* 282(2), 107–118. DOI: 10.11646/ PHYTOTAXA.282.2.2.

Shmaraev, G.E., Abdullaev, F.H. & Mamatov T.M. (2003). The height and lodging of plants is an important indicator in the cultivation of corn under irrigated conditions in Uzbekistan (in Russian). *Bulletin of Agrarian Science of Uzbekistan*, 1, 111–113.

Shomurodov, Kh.F. & Abduraimov O.S. (2017). Ontogenetic structure and assessment of the state of coenotic populations of *Tulipa borszczowii* (Liliaceae) in Uzbekistan. *Botaničeskij Žurnal,* 102(8), 1123–1136. DOI: 10.1134/S0006813617080051.

Shomurodov, Kh.F., Abduraimov, O.S. & Adilov B.A. (2021). Assessment of the state of *Tulipa lehmanniana* Mercklin populations under the conditions of the Kyzylkum Desert. *Arid Ecosystems,* 11(1), 83–90. DOI: 10.1134/S2079096121010133.

Smirnova, O.V. (1987). *The structure of the grass cover of broad-leaved forests*. Moscow: Nauka.

Smirnova, O.V, Zaugolnova, L.B., Toropova, N.A. & Falokov L.D. (1976). Criteria for the identification of age-related conditions and features of the course of ontogenesis in plants of various biomorphs. In Coenopopulations of the plants: General definitions and structure (pp. 14–44). Moscow: Nauka.

Stepanova, E.F. (1962). *Vegetation and flora of the Tarbagatai ridge (in Russian)*. Alma-Ata: Academy of Sciences of Kazakhstan.

Turginov, O.T. (2017). *Flora of Baisun botanical-geographical region (in Russian)*. Dissertation abstract of the doctor of philosophy (PhD) on biological sciences, Tashkent.

Uranov, A.A. (1975). Age diversity of phytocoenopopulations as the function of time and energetic wave processes (in Russian). *Biological Sciences*, 2, 7–34.

Uranov, A.A. & Smirnova O.V. (1969). Classification and main features of the development of populations of perennial plants (in Russian). *Bulletin MOIP*, 74(2), 119–134.

Yusupov, Z., Tao Deng, Volis, S., Khassanov, F., Makhmudjanov, D., Tojibaev, K. & Hang Sun (2021). Phylogenomics of *Allium* section *Cepa* (Amaryllidaceae) provides new insights on domestication of onion. *Plant Diversity,* 43(2), 102–110. DOI: 10.1016/j.pld.2020.07.008.

Zhivotovsky, L.A. (2001). Ontogenetic states, effective density, and classification of plant populations. *Russian Journal of Ecology*, 32, 1–5. DOI: 10.1023/A:1009536128912

https://ru.climate-data.org/

https://hydromet.uz/index.php/ru/node/1295

https://ru.climate-data.org/азия/узбекистан/джизакская-область/заамин-24837/

https://ru.climate-data.org/азия/узбекистан/сурхандарьинская-область/термиз-2782/

https://ru.climate-data.org/азия/узбекистан/андижанская-область/андижан- -2901/

https://ru.climate-data.org/азия/узбекистан-161/

https://powo.science.kew.org/