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Research Article

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A.B. Kozhabergenova[1*], S.A. Aipeisova[2], G.M. Atayeva[1], W. Maniukiewicz[3], M.M. Silantyeva[4]

[1]*L. Gumilyov Eurasian National University, Astana, Kazakhstan;*
[2]*Baishev University, Aktobe, Kazakhstan;*
[3]*Lodz University of Technology, Lodz, Poland;*
[4]*Altai State University, Barnaul, Russia*
[*]*Corresponding author: asstrakozabergenova@gmail.com*

Cenoflora of the relict species *Anabasis cretacea* Pall. in the Aktobe region

The article presents the results of a study (June-September, 2025) on the cenoflora of the relict species *Anabasis cretacea* Pall. in the Aktobe region. The study confirmed the occurrence of *Anabasis cretacea* Pall. is associated with Cretaceous uplands and escarpments. Based on the analysis of herbarium materials and field investigations, the distribution sites of *Anabasis cretacea* Pall. populations were determined in the Khobdinsky and Uil districts, with a description of the identified 9 cenopopulations. The composition of the plant community, as well as the ecological and cenotic characteristics of the populations of *Anabasis cretacea* Pall. were determined, reflecting the ecological conditions of the calcareous habitats where the studied populations occur. The leading families were Asteraceae (16 species), Brassicaceae (9 species), Chenopodiaceae (8 species), Scrophulariaceae (5 species), Poaceae (4 species). The dominant genera included *Astragalus* L. (5 species), *Anabasis* L. (3 species), and *Artemisia* L. (3 species). Ecobiological analysis confirmed the desert-steppe character of the cenoflora with a minor contribution from meadow species. A complete checklist of cenoflora *Anabasis cretacea* Pall. was presented, where 84 species belonging to 68 genera and 27 families were identified.

Keywords: Anabasis cretacea Pall., cenopopulation, cenoflora, plant communities, life form.

Introduction

The Cretaceous uplands represent unique botanical and geobotanical formations located within the steppe and desert zones of Eurasia. In areas where Upper Cretaceous carbonate rocks are exposed or occur near the surface, distinct plant communities composed of calciphilous species have developed. The flora of these chalk outcrops is characterized by a high concentration of rare and predominantly endemic species. The floristic specificity is largely determined by the unique characteristics of the calcareous substrate, the localized and fragmented nature of the habitats, as well as the historical and geological context of the regions in which these outcrops are found [1].

The earliest descriptions of the vegetation of Cretaceous outcrops were given by Guldenstedt (Güldenstädt, 1787, 1791) [2-3].

A number of works (Litvinov, 1902; Dubyansky,1905; Kozo-Polyansky, 1931; Volodina, 1982; Didukh, 2018, etc.) have been devoted to the study of the flora of the Cretaceous outcrops of the Central Russian Upland, the Don River basin, and the Trans-Volga region. Cretaceous substrates were studied in England (Tansley, 1920; Tansley and Adamson, 1925; Hope-Simpson, 1940; Lloyd and Pigott, 1967, etc.), Belgium (Butaye, 2005), etc. [4–13].

A number of studies have been devoted to studying the vegetation of Cretaceous outcrops in Western Kazakhstan (Yanishevsky, 1905; Kolchenko, 1966; Cherkasova, 1970; Safronova, 1974; Gorchakovsky and Matyashenko, 1975) etc. [14–18].

According to A.N. Kupriyanov (2020), the flora of the chalk outcrops of Western Kazakhstan has been studied extensively and comprises more than 800 species [19].

The floral diversity of the Cretaceous uplands of the Urals was studied by O.A. Karimova (2017), Ya. M. Golovanov, L.M. Abramova, S.M. Yamalov (2019, 2025), where 40 species listed in the Red Books of different levels and 15 endemic species were identified in the Cretaceous highlands of the Orenburg region. Research has noted that in Kazakhstan, where chalk massifs occupy the largest areas, chalks remain largely without a special protection system [20–22]. Of great scientific interest are Quaternary relics that

penetrated from the temperate and high latitudes of Eurasia during the periods of the greatest cooling of the Pleistocene. The endangered ancient relics of Kazakhstan are subject to indispensable protection with the allocation of protected areas [23].

Studies by Lu, Y. et al. (2023) show that climate change will lead to a reduction and shift in the distribution range of typical desert species, while relict species will be less affected by climate change. This is due to the fact that, compared with desert species, relict species have a deeper evolutionary history and have developed a wider range of adaptations after drastic environmental changes [24].

The relict species is *Anabasis cretacea* Pall. occurs on chalk substrates in the West Kazakhstan and Aktobe regions [25]. *Anabasis cretacea* Pall. is confined to chalky slopes of uplands, growing within calcephytic communities that develop in erosion-prone areas, and is regarded as a rare species associated with chalk outcrops [26].

Aipeisova (2012) notes that calcephilic and petrophilic floral complexes are characterized by the presence of endems, a significant predominance in the number of subendems, and relict species, which indicates that the ancient core of the flora of the study area are calcephilic and petrophilic floral complexes, on the basis of which the main floral complexes of the modern flora of the Aktobe floral district, which includes the study area, arose [27].

In Russia, this species is classified as rare, vulnerable, and endangered by the taxon, and is listed in the Red Book of the Orenburg, Saratov, Chelyabinsk Regions, and Bashkortostan [28–31].

Floral studies of Cretaceous outcrops in Western Kazakhstan have been the object of scientific research more than once, but despite this, the study of populations of *Anabasis cretacea* Pall. in the Aktobe region was not conducted.

Chalk hills, with their exceptional flora, are widespread in Western Kazakhstan. Within the Aktobe region, they occupy a relatively large area—63,535.1 km^2 (Darbayeva, 2002), compared to the West Kazakhstan, Atyrau, and neighboring Orenburg regions [32, 33].

The aim of this study is to conduct geobotanical studies to assess the current state of the populations of the relict species *Anabasis cretacea* Pall. in the Aktobe region.

Experimental

Object of study

The relict species *Anabasis cretacea* Pall. is a perennial plant of the Chenopodiaceae family. Semi-shrub, chamaephyte, xerophyte, calciphile. The Trans-Volga-Kazakh-Turanian type [34].

It grows on chalk, marl, variegated clays, less often on gravelly slopes and outcrops of bedrock [35].

Research methods

Geobotanical studies of cenopopulations of the relict species *Anabasis cretacea* Pall. began with the study of herbariums of the genus *Anabasis* L. domestic and foreign herbarium collections to identify the distribution sites of populations of the relict species *Anabasis cretacea* in Aktobe region, in particular in Khobda, Wilsky, Yrgyzsky and Mugalzharsky districts. The floral composition of the *Anabasis cretacea* cenopopulations was studied on standard plots of 100 m^2, where areas with a high density of *Anabasis cretacea* were selected and 9 cenopopulations were surveyed.

The field work was carried out in June-September 2025 by the route-reconnaissance method, where we outlined the optimal routes for surveying the territory to obtain the most reliable data. The geographical location of the research object was obtained using a GARMIN Etrex 20x GPS navigator, and photographs were taken using a Nikon digital camera.

At the sites of the relict species *Anabasis cretacea*. The ecological conditions of the habitats of the populations were described, took into account exposure, altitude, illumination, soil cover, plant communities, and determined the species composition. The calculation of species units was carried out using the method of constructing sites based on cenopopulations. The biological and morphological classifications of I.G. Serebryakov (1962) [36] were used in the analysis of flora. The assessment of species in relation to moisture was carried out according to the A.P. Shennikov scale [37]. The vital states of the species were determined according to the classification of T.A. Rabotnov [38].

When identifying species collected from *A.cretacea* cenopopulations, the corresponding volumes of the books “Flora of Kazakhstan” (1960), “Illustrated Guide to Plants of Kazakhstan” (1969) were used. Also, certain types were specified by Doctor of Biological Sciences, Professor Aipeisova S.A.

The list of flora species is presented in accordance with the system of A.L. Takhtadzhyan [40]. Latin names of plants according to S.K. Cherepanov [41] and S.A. Abdulina [42]. Kazakh names of plants are given according to S.A. Arystangaliev and E.R. Ramazanov [43].

Results and Discussion

Location, ecological and cenotic state of populations of the relict species *Anabasis cretacea* Pall.

The territory of Aktobe region is located in steppe and desert zones [44]. It is believed that in ancient times, the Aktobe region was twice subjected to devastating floods. The last time, 50 million years ago, the sea stagnated here for a long time, and then retreated, which led to a change in the relief of these places. As a result, there are natural monuments in the Bayganinsky, Kobdinsky, Uilsky, Mugalzharsky and Khromtau districts, which were formed under the influence of destructive water and strong winds. The formations belonging to the Cretaceous period are particularly well preserved [45].

Thus, three populations of *Anabasis cretacea* were studied in the territory of the Aktobe region, in particular in the Kobdinsky and Wilsky districts, and a comprehensive study was conducted in accordance with the goals and objectives set. A geobotanical characterization of plant communities containing the studied 9 cenopopulations of *Anabasis cretacea* was carried out in order to determine their ecological and cenotic relationship (Table 1).

Table 1

Ecological and cenotic characteristics of *Anabasis cretacea* Pall. populations.

Location	GPS coordinates	The projective cover %
AO, Khobdinsky district, 30 km southwest of the village. Akyrap, Ishkargantau chalk massif	N 50°32'13.3", E 054°54'32.2" h = 241 m	40–50
AO, Wilsky district, Akshatau chalk ridge, 3 km from the village. Akshatau	N 49°20′18.0″, E054°30′ 29.7″ h = 150 m	50–60
AO, Wilsky district, Akshatau chalk ridge, 11 km northeast of the village. Akshatau, towards Mukushtau mountain	N 49°28'10.6", E 054°35'40.3" h = 135 m	40–45

The first population was studied in the Khobda district on the Ishkaragantau chalk ridge, 30 km southwest of the village of Akyrap, on the chalk ridge of the Ishkaragan River valley, on the watershed of the Bolshaya Hobda and Kiil rivers (Fig. 1).

The finely dissected western edge of the elevated watershed between two wide flat-bottomed valleys occupied by the upper reaches of the left tributaries of the Bol. Khobdy—Ishkargan and Tumansha rivers. Both rivers in this segment are drying watercourses along the talvegs of deeply embedded sayas with steep sides. The main relief of the watershed plateau is a hollow, rolling plain, the heights of which gradually decrease to the east towards the Bol River valley. Hobda; closer to the western edge, the relief becomes sharper and turns into a Cretaceous lowland melkosopochnik, actually bearing the name Ishkargantau. To the south, it passes into the similar, but less sharply dissected Karaganda Mountains massif, which forms the watershed of the tributaries of the Kiil River—the Zhusalisai and Karaganda rivers.

Smelansky I. (2012) notes that the Ishkargantau Cretaceous massif stretches along the Ishkaragan valley for about 15 km, and from 2 to 8 km deep into the plateau. It is a system of fragmentally dissected steeply sloping chalk ridges and hills separated by flat-bottomed, zigzag-shaped dry valleys, often devoid of pronounced talweg. The maximum heights of the watershed are within the massif—278-279 m above sea level. The height difference to the Ishkaragan river terrace is about 100 m, the relative heights of the slopes are within the first tens of meters, up to 50–60 m. The erosive parts of the slopes are composed of rocky chalk, passing below into crumbly and coarse-grained talus, with pediments and deluvial plumes, cones from the inner valleys of the massif, expressed on the slopes. In almost the entire territory of the massif, soils are formed on a Cretaceous substrate [46].

The Cretaceous ridge forms a system of chalk peaks and hills with steep slopes, which is located in the northwestern part of the region. Chestnut soils are represented by carbonate genera [47].

At this site, the following were investigated:1 — 2-3 cenopopulations. The coordinates of the first population are N 50°32'13.3", E 054°54 '32.2", h = 241m.

Cenopopulation 1 (CP 1) represents the tasbuyurguna-anabasis-wormwood association — ass. *Nanophyton erinaceum — Anabasis cretacea — Artemisia salsoloides*. It covers the western and

southwestern slopes, steep, shallow, with erosive forms. The slopes are formed by rocky chalk, which turns into talus and fine-grained plumes. The entire system of Ishkargantau ridges is directed so that the plateau gradually falls to the east and southeast towards the valley. The soils are underdeveloped, formed on a Cretaceous substrate. The total projective coverage is 50 %. Rising to the top, there is an arrangement of calciphilous flora adapted to cretaceous soils, such as *Nanophyton erinaceum, Anabasis cretacea,* having the greatest participation in the vegetation cover, along with rare and endemic species such as *Anthemis trotzkiana, Linaria cretacea, Crambe tataria*.

At the Cretaceous outcrops, there are also *Astragalus albicaulis, Matthiola fragrans, Ephedra distachya, Jurinea kirghisoroum, Artemisia terrae-albae;* in the depressions, one can find *Astragalus macropus, Convolvulus lineatus, Sedum hybridum,* and *Onosma borysthenica.* The community has 39 species. Rising to the top of the Cretaceous ridge, there is a decrease in the species composition.

CP 2 consists of ass. *Anabasis cretacea-Anthemis trotzkiana.* with mixed herbs. It represents the northern exposure of the chalk ridge, directed to the river valley, the erosive sections of the slope are covered with stony chalk, turning down into crumbly and coarse-grained talus. They are covered with stony chalk. The soils are underdeveloped, without a humus horizon. The relief is highly dissected. The total projective coverage is 50 %. The slope is darker, with varying degrees of calcification. The vegetation is dense and includes various grass species. The community has 36 species. Common vegetation components are Anabasis cretacea, *Artemisia terrae-albae, Echinops ritro, Galium ruthenicum.* on Cretaceous outcrops, *Tulipa biebersteiniana, Centaurea adpressa, Allium globosum, Iris scariosa, Zygophyllum pinnatum, Astragalus brachylobus, Matthiola tatarica, Ephedra distachya* (Fig. 2).

At the foot of the mountain range, carbonate soil is widespread, with a predominance of representatives of the cereals *Psathyrostachys juncea, Koeleria cristata, Stipa sareptana.* In addition, *Atraphaxis frutescens, Scabiosa isetensis, Rhammatophyllum pachyrhizum, Atriplex cana, Convolvulus lineatus* are common between the hill depressions.

CP 3 represents ass. *Anabasis cretacea — Artemisia salsoloides.* It covers the top of the chalk hills. The soils are underdeveloped, they represent small fragments of chalk, turning into large-scale cretaceous deposits closer to the foot. Cretaceous deposits are exposed due to erosion and flushing from the plateau. The total projective coverage is 40–45 %. Vegetation is sparse and spotted, and *Nanophyton erinaceum, Artemisia salsoloides, Anthemis trotzkiana, Artemisia terrae-albae,* and *Matthiola fragrans* are most involved in the vegetation cover. According to the rocky slope of *Linaria cretacea, Galitzkya spathulata, Inula multicaulis* was noted along the slope. *Serratula wolfii* is found on the sole, between the hills of *Limonium gmelinii. Euphorbia seguierana* can also be found at the top of the hill with an outlet of rocky rocks. The community is small, with 22 species. There is a decrease in species towards the top of the Cretaceous ridge.

71 species belonging to 58 genera and 25 families were identified in the vegetation cover of the first population.

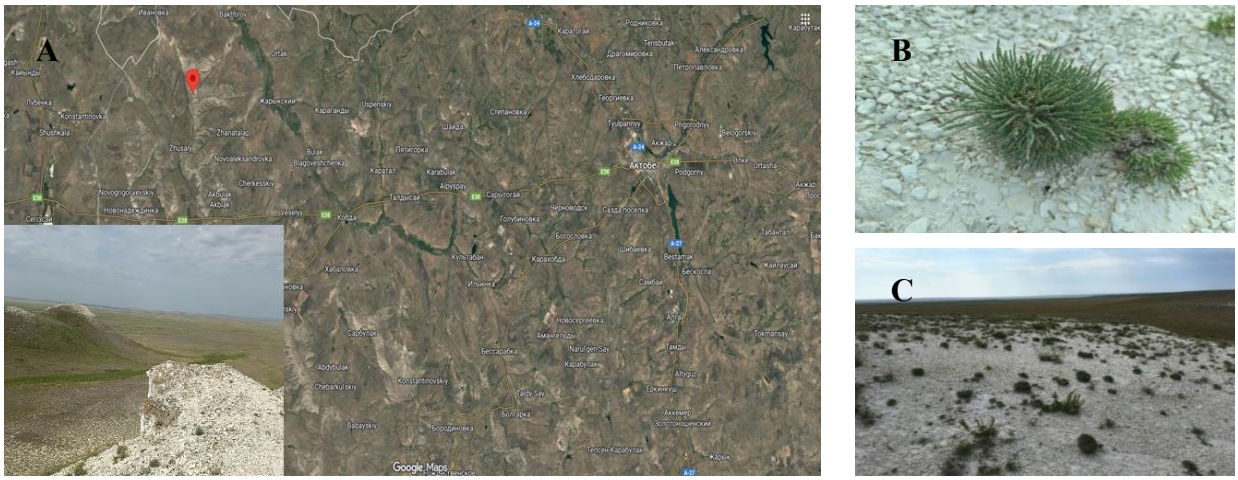

Figure 1. The first population: A, B — Ishkaragantau Cretaceous massif;
C, D — *Anabasis cretacea* population (June, 2025)

Figure 2. Zygophyllum pinnatum (A), Nanophyton erinaceum (B), Linaria cretacea (C), Anthemis trotzkiana (D)

The **second population** was studied in the Wilsky district, 3 km from the village Akshatau, located on the right bank of the Uil River, on the Akshatau chalk ridge, coordinates N 49°20'18.0", E 054°30' 29.7", h = 150 m have been determined (Fig. 3).

According to Smelansky (2012), the website Plantarium https://www.plantarium.ru/lang/en/page/landscapes/point/1517.html describes the geographical position of the Akshatau Cretaceous ridge as follows: the right side of the Uil river valley below the confluence of the Kiyl River is formed by a chink (steeply sloping scalloped edge) of a cretaceous plateau armored with calcified sandstones; the elevation difference on the plateau ledge reaches more than 100 m (up to 186 m non the brow of the slope, 80 m n.o.m. on the overflowing terrace of Uila); the general exposition of chinka—east-south-east; The edge of the plateau is deeply and fractionally dissected by valleys and dens, forming a more or less complex maze of straight and curved small-scale ridges, and single remnant hills; on the terrace under the chin, a wide plume formed by Cretaceous limestone and carbonate clays is well defined.

Light chestnut normal soils are found on watershed plains, gentle slope of hills, inter-mountain high plains and river valleys [47].

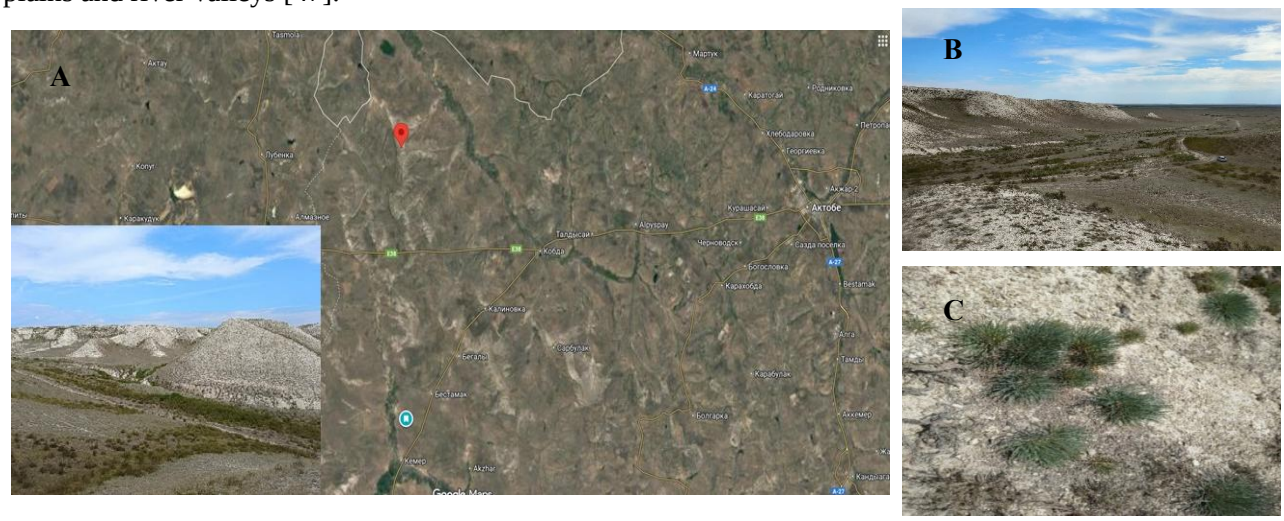

Figure 3. Akshatau Cretaceous ridge (A, B), population of *Anabasis cretacea* Pall. (C) (July-August, 2025)

CP 4 ass. *Nanophyton erinaceum — Anabasis cretacea*. It covers the southeastern slope of the Akshatau chalk ridge. Steep chalk slope caused by erosion. The soils are light chestnut. The slope is based on cretaceous rocks such as limestones, marls, interspersed with sandstones, thereby creating a solid frame and leaving it resistant to weathering. The projective coverage is 50–55 %. The cenopopulation (CPU) includes 28 species.

Rising to the top, there is an arrangement of calciferous flora adapted to the cretaceous soils that were located at the top, such as *Nanophyton erinaceum*, *Anabasis cretacea*. The slopes are covered with desert-steppe vegetation of *Artemisia terrae-albae*, *Atraphaxis frutescens*. A wormwood-biyurgun association is common at the foot, honeycombs from *Artemisia gracilescens*, *Koeleria cristata*. In terms of between the hills grows *Amygdalus nana*, *Limonium gmelinii*.

CP 5 ass. *Nanophyton erinaceum — Artemisia terrae-albae — Anabasis cretacea*. The projective coverage is 55–60 %. It represents the eastern slope, which is less steep than the western ledges. The slope is formed by cretaceous rocks reinforced with sandstones, creating ledges, and dissected by ravines. The more

or less steep walls of the slope, rising up, are covered with calciferous vegetation — *Nanophyton erinaceum*, *Anabasis cretacea*, and the gentle places are occupied by steppe vegetation, such as wormwood. The eastern slope is located near the village of Akshat, which is 3 km away, is interesting and accessible for observation. The soils are light chestnut, fully developed, with chalk inclusions. The community has 24 species.

The vegetation consists of *Nanophyton erinaceum*, *Artemisia terrae-albae*, *Anabasis cretacea*, and on the slope, a small amount of *Anabasis truncata*; closer to the base, *Anabasis salsa*, *Eremogone koriniana*.

In the hollow between the hills, *Artemisia salsoloides* and *Limonium gmelinii* are mixed in.

CP 6 ass. *Artemisia terrae-albae — Anabasis cretacea*. The projective coverage is 50 %. It covers the northeastern slope. It is based on cretaceous rocks, with admixtures of limestone, marls, and sandstones. The soils are light chestnut, fully developed. The community has 27 species. The top of the slope is covered with calciferous flora, with a predominance of *Nanophyton erinaceum* and *Anabasis cretacea*, on gentle areas wormwood-thyrsus vegetation.

There are large quantities of *Anabasis salsa*, *Artemisia terrae-albae*, from cereals — *Stipa sareptana*, *Agropyron desertorum*. 46 species (18 families, 39 genera) participate in the plant community of the second population.

The third population is in the Wilsky district, coordinates N 49°28'10.6", E 054°35'40.3", h = 135 m. It was found to the northeast, 11 km from the village. Akshatau, towards Mukushtau mountain. At this site, the following have been investigated: 7 — 8-9 cenopopulations (Fig. 4).

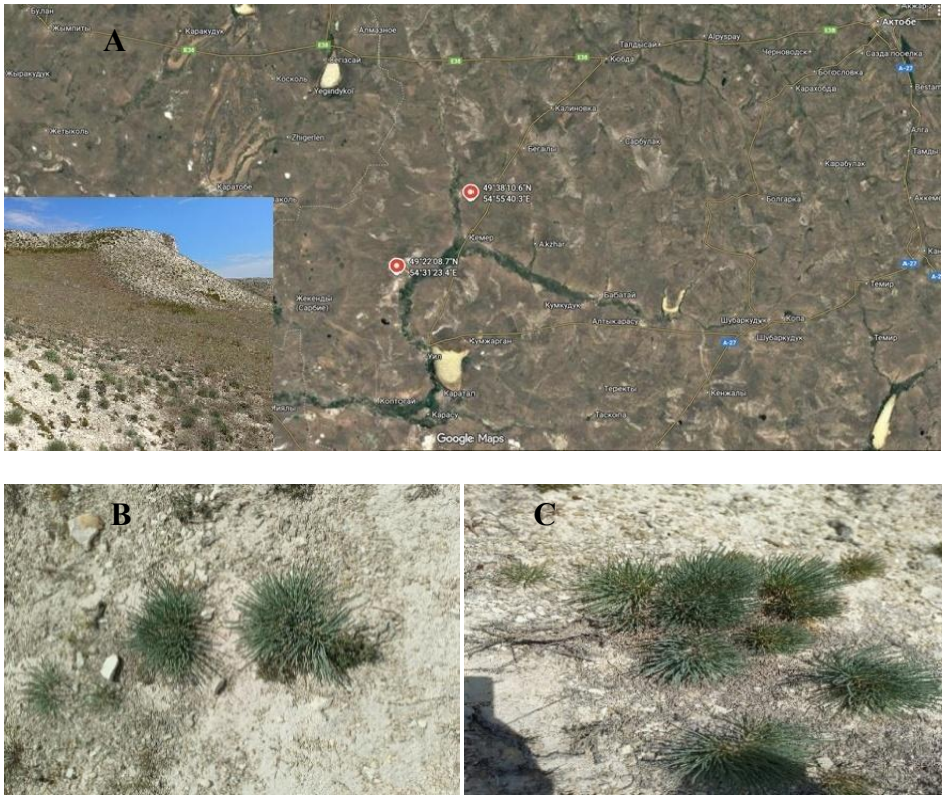

Figure 4. A — Akshatau Cretaceous ridge, B, C — *Anabasis cretacea* Pall. population (July-August, 2025)

CP 7 ass. *Artemisia terrae-albae — Anabasis cretacea*, northern slope of the chalk hills. The soils are light chestnut, with a large inclusion of chalk. The projective coverage is 40–45 %. 25 species participate in the vegetation composition, with the largest participation being *Artemisia terrae-albae*, *Anabasis cretacea*, *Anthemis trotzkiana*, *Adonis wolgensis*, *Echinops ritro*, *Onosma polychroma*, *Crambe tataria*, *Eremogone koriniana*. On the slope, *Gypsophila altissima*.

Shrubby vegetation occurs along the depressions: curly-haired *Atraphaxis frutescens*, *Spiraea hypericifolia*. On the bottom of the slope, *Thymus marschallianus*, *Veronica spuria*.

CP 8 ass. *Artemisia salsoloides — Anabasis cretacea*, south-western slope of the chalk hills. The projective coverage is 40–45 %. The soils are underdeveloped, light chestnut, with a large number of inclusions in the form of chalk. 19 species participate in the vegetation composition, the most involved are

Scabiosa isetensis, *Nanophyton erinaceum*, *Anabasis cretacea*, *Artemisia salsoloides*, *Crambe tataria*, *Echinops meyeri*, *Erysimum odoratum*, *Atraphaxis frutescens*, on the slopes *Rhammatophyllum pachyrhizum*, *Crinitaria linosyris*, *Limonium gmelinii* in the depressions, *Koeleria cristata* abundantly at the foot.

CP 9 ass. *Nanophyton erinaceum — Artemisia salsoloides — Anabasis cretacea*. It is located on the top of a chalk massif. The soils are light chestnut, with inclusions of chalk. The projective coverage is 35–40 %. The plant community consists of the following species: *Nanophyton erinaceum*, *Artemisia salsoloides*, *Anabasis cretacea*, *Anthemis trotzkiana*, *Hedysarum razoumovianum*. On the slopes of *Galium ruthenicum*, *Cephalaria uralensis*, on depressions of *Matthiola fragrans*, *Syrenia siliculosa*. There are 19 species in the cenopopulation.

37 species belonging to 32 genera and 16 families were identified in the vegetation cover of the third population.

With the aim of identifying the relict species *Anabasis cretacea*, the flora of the chalk mountain Bestau in the Khobda district was studied (N 50°18'40.5", E 056°06'02.0", h = 288 m). Despite ecological conditions and geological substrate typical for this species, no population of *Anabasis cretacea* was found. This may indicate the possible disappearance of the species from this area (Fig. 5).

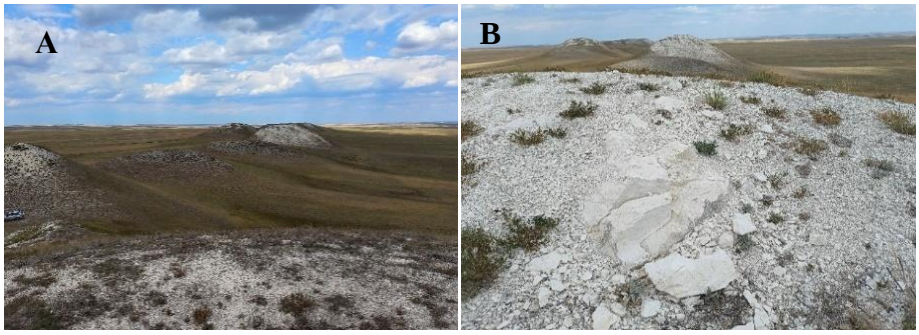

Figure 5. Chalk Mountain Bestau (August, 2025)

Table 2

Composition of cenoflora *Anabasis cretacea* Pall.

№	Families, genus, species	Ishkaragan N 50°32'13.3'', E 054°54'32.2''	Akshatau N 49°20'18.0'', E 054°30' 29.7''	Akshatau (Mukushtau) N 49°28'10.6'', E 054°35'40.3''	Life forms
1	**2**	**3**	**4**	**5**	**6**
	Magnoliphyta MAGNOLIOPSIDA				
	Ranunculidae RANUNCULACEAE				
	Adonis L.				
1	*Adonis wolgensis* Stev.	+		+	PH
	Ranunculus L.				
2	*Ranunculus polyanthemos* L.	+			PH
	Caryophlidae CARYOPHYLLACEAE				
	Dianthus L.				
3	*Dianthus cyri* Fisch. et Mey.	+			ABH
	Eremogone Fenzl.				
4	*Eremogone koriniana* (Fisch. ex Fenzl) lkonn.	+	+		SDS
	Gypsophila L.				
5	*Gypsophila altissima* L.	+	+	+	PH

Continuation of Table 2

1	2	3	4	5	6
	CHENOPODIACEAE				
	Anabasis L.				
6	*Anabasis cretacea* Pall.	+	+		SDS
7	*Anabasis salsa* (C.A. Mey.) Benth. ex Volkens		+	+	DS
8	*Anabasis truncata* (Schrenk.) Bunge		+		SDS
	Atriplex L.				
9	*Atriplex cana* C.A. Mey.	+	+		SS
	Camphorosma L.				
10	*Camphorosma monspeliaca* L.	+	+	+	SDS
	Krascheninnikovia				
11	*Ceratoides papposa* Botsch.et Ikonn.	+		+	SDS
	Nanophyton Less.				
12	*Nanophyton erinaceum* (Pall.) Bunge	+	+	+	SDS
	Salsola L.				
13	*Salsola laricina* Pall.			+	SDS
	POLYGONACEAE				
	Atraphaxis L.				
14	*Atraphaxis frutescens* (L.) C. Koch.	+	+	+	S
	PLUMBAGINACEAE				
	Goniolimon Boiss.				
15	*Goniolimon elatum* (Fisch. ex Spreng.) Boiss.	+		+	PH
	Limonium Mill.				
16	*Limonium gmelinii* (Willd.) O. Kuntze	+	+	+	PH
	BRASSICACEAE				
	Alyssum L.				
17	*Alyssum lenense* Adam	+			SDS
	Galitzkya L.				
18	*Galitzkya spathulata* (Steph.) V.Boczantzeva	+			PH
	Crambe L.				
19	*Crambe tataria* Sebeók.	+	+	+	PH
	Erysimum L.				
20	*Erysimum odoratum* Ehrh.	+		+	ABH
	Lepidium L.				
21	*Lepidium songaricum* Schrenk	+			PH
	Matthiola R. Br.				
22	*Matthiola fragrans* Bunge.	+	+	+	SDS
23	*Matthiola tatarica* (Pall) DC.	+		+	PH
	Rhammatophyllum O.E. Schulz				
24	*Rhammatophyllum pachyrhizum* (Kar. et Kir)			+	SS
	Syrenia Andrz.				
25	*Syrenia siliculosa* (Bieb.) Andrz.	+	+	+	ABH
	EUPHORBIACEAE				
	Euphorbia L.				
26	*Euphorbia seguierana* Neck.	+			PH

Continuation of Table 2

1	2	3	4	5	6
	Rosidae CRASSULACEAE				
	Sedum L.				
27	*Sedum hybridum* L.	+			PH
	ROSACEAE				
	Amygdalus L.				
28	*Amygdalus nana* L.		+		S
	Filipendula Adans.				
29	*Filipendula vulgaris* Moench	+			PH
	Spiraea L.				
30	*Spiraea hypericifolia* L.	+	+	+	S
	RHAMNACEAE				
	Rhamnus L. / *Frangula* L.				
31	*Frangula alnus* Mill.		+		S
	FABACEAE				
	Astragalus L.				
32	*Astragalus albicaulis* DC.	+			SDS
33	*Astragalus brachylobus* DC.	+			S
34	*Astragalus macroceras* C.A. Mey.	+			SS
35	*Astragalus macropus* Bunge.	+			SS
36	*Astragalus vulpinus* Willd.	+			SS
	Caragana L.				
37	*Caragana balchaschensis* (Kom.) Pojark.		+		S
	Hedysarum L.				
38	*Hedysarum razoumovianum* Fisch. et Helm.	+		+	SDS
39	*Hedysarum tsherkassovae* Knjasev sp.nov	+	+		PH
	ZYGOPHYLLACEAE				
	Zygophyllum L.				
40	*Zygophyllum pinnatum* Cham.	+			PH
	SANTALACEAE				
	Thesium L.				
41	*Thesium arvense* Horvátovszky	+	+		PH
	APIACEAE				
	Seseli L.				
42	*Seseli eriocephalum* (Pall. ex Spreng.) Schischk.	+	+	+	PH
43	*Seseli libanotis* (L.) Koch	+	+	+	PH
	CAPRIFOLIACEAE				
44	*Lonicera tatarica* L.		+		S
	DIPSACACEAE				
	Cephalaria Schrad.				
45	*Cephalaria uralensis* (Mur.) Roem. et Schult.	+	+		SDS
	Scabiosa L.				
46	*Scabiosa isetensis* L.	+	+	+	PH
	Lamiidae RUBIACEAE				
	Galium L.				
47	*Galium ruthenicum* Willd.	+	+	+	PH

Continuation of Table 2

	CONVOLVULACEAE				
	Convolvulus L.				
1	**2**	**3**	**4**	**5**	**6**
48	*Convolvulus fruticosus* Pall.	+			SS
49	*Convolvulus lineatus* L.	+			SS
	BORAGINACEAE				
	Onosma L.				
50	*Onosma borysthenica* Klok.	+	+	+	ABH
51	*Onosma polychroma* Klok. ex M. Pop.	+		+	PH
	SCROPHULARIACEAE				
	Linaria Mill.				
52	*Linaria cretacea* Fisch. ex Spreng.	+			PH
	Pedicularis L.				
53	*Pedicularis dasystachys* Schrenk	+			PH
	Verbascum L.				
54	*Verbascum phoeniceum* L.		+		PH
	Veronica L.				
55	*Veronica incana* L.	+	+	+	PH
56	*Veronica spuria* L.	+	+		PH
	LAMIACEAE				
	Phlomis L.				
57	*Phlomis tuberosa* L.	+	+		PH
	Salvia L.				
58	*Salvia stepposa* Shost.	+			PH
	Thymus L.				
59	*Thymus marschallianus* Willd.	+	+	+	SDS
	Asteridae ASTERACEAE				
	Achillea L.				
60	*Achillea nobilis* L.	+	+		PH
	Anthemis L.				
61	*Anthemis trotzkiana* Claus ex Bunge.	+		+	SDS
	Artemisia L.				
62	*Artemisia gracilescens* Krasch. et Iljin.		+		SDS
63	*Artemisia salsoloides* Willd.	+	+	+	SDS
64	*Artemisia terrae-albae* Krasch.	+	+	+	SDS
	Centaurea L.				
65	*Centaurea adpressa* Ledeb.	+	+		PH
	Cousinia				
66	*Cousinia astracanica* (Spreng.) Tamamsch.	+	+	+	PH
	Galatella L.				
67	*Crinitaria linosyris* (L.) Less.	+	+	+	PH
68	*Crinitaria villosa* (L.) Grossh.	+			PH
	Echinops L.				
69	*Echinops ritro* L.	+	+		PH
70	*Echinops meyeri* (DC.) Iljin			+	PH

Continuation of Table 2

1	2	3	4	5	6
	Hieracium L.				
71	*Hieracium virosum* Pall.		+		PH
	Inula L.				
72	*Inula multicaulis* Kar.	+			SS
	Jurinea L.				
73	*Jurinea kirghisoroum* Janisch.	+			SDS
	Serratula L.				
74	*Serratula wolfii* Andrae	+	+		PH
	Tanacetum L.				
75	*Tanacetum millefolium* (L.) Tzvel.	+	+		PH
	LILIOPSIDA Liliidae				
	IRIDACEAE				
	Iris L.				
76	*Iris scariosa* Willd. ex Link	+			PH
	LILIACEAE				
	Tulipa L.				
77	*Tulipa biebersteiniana* Schult. et Schult. fil.	+			PH
	ALLIACEAE				
	Allium L.				
78	*Allium globosum* Bieb. ex Redouté.	+			PH
	POACEAE				
	Agropyron Gaertn.				
79	*Agropyron desertorum* (Fisch. ex Link.) Schult.		+	+	PH
	Koeleria Pers.				
80	*Koeleria cristata* (L.) Pers.	+	+	+	PH
	Psathyrostachys				
81	*Psathyrostachys juncea* (Fisch.) Nevski	+	+	+	PH
	Stipa L.				
82	*Stipa sareptana* A. Beck.	+	+	+	
83	*Stipa capillata* L.	+	+	+	PH
	Кл. GNETOPSIDA				
	EPHEDRACEAE				
	Ephedra L.				
84	*Ephedra distachya* L.	+			PH

Note. Life forms: S — shrub; Ss — semi-shrub; DS — dwarf shrub; SDD — semi-dwarf shrub; PH — perennial herbs; ABH — annual and biennial herbs

Thus, 71 species belonging to 58 genera and 25 families were identified in the territory of the first population. The second population consists of 46 species belonging to 39 genera and 18 families. The third population includes 37 species belonging to 32 genera and 16 families.

As a result of the determination of the cenoflora of three populations of *Anabasis cretacea*: 84 plant species belonging to 68 genera and 27 families were identified (see Table 2). Life forms have been identified (Table 2), the leading flora families (Fig. 6).

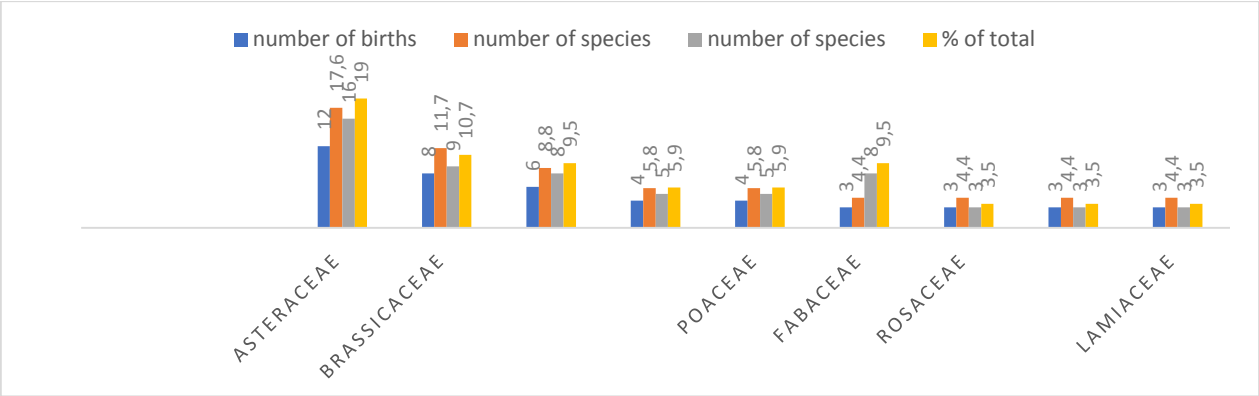

Figure 6. Leading families of the flora of *Anabasis cretacea* Pall.

As shown in Table 3, the 9 leading families account for 60 species, which is 69.7 (%) of the total composition of the cenoflora.

The most numerous in their species composition are such families as: Asteraceae (16 species), Brassicaceae (9 species), Chenopodiaceae (8 species), Scrophulariaceae (5 species), Poaceae (4 species). The leading genera are *Astragalus* L. (5 species), *Anabasis* L. (3 species), and *Artemisia* L. (3 species).

As in the flora of the Aktobe floral district (AFD) [48], Asteraceae ranks first in terms of the number of species. Brassicaceae occupies the second position in terms of the number of species, which is in third place in the flora of the AFD. This is due to the greater proportion of steppe species in the study area.

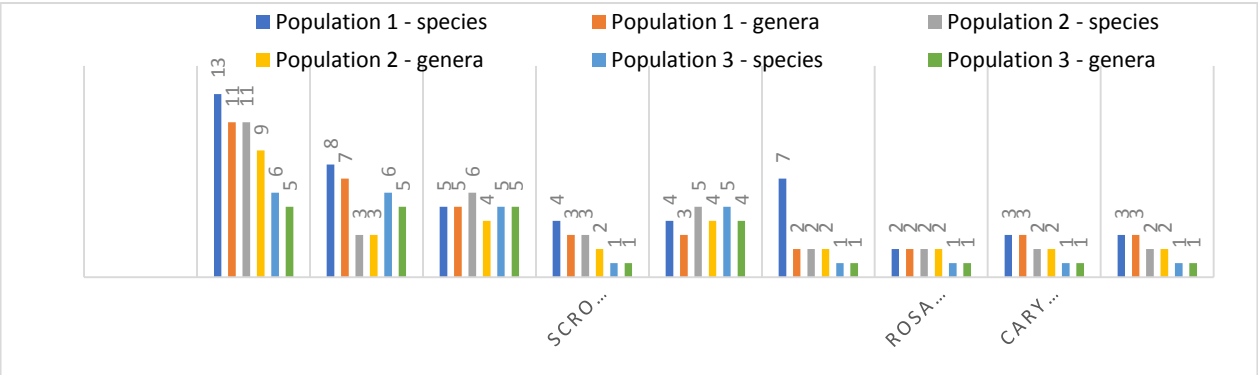

Figure 7. Comparative characteristics of species and genera by family in populations

In the first population, the family Asteraceae is represented by 13 species, Brassicaceae — 8 species, Fabaceae — 7 species, Chenopodiaceae — 5 species; in the second population, Asteraceae — 11 species, Chenopodiaceae — 6 species, Poaceae — 5 species; in the third population, Brassicaceae are more numerous — 7 species, Asteraceae — 6 species, Chenopodiaceae and Poaceae — 5 species. The remaining families are represented (19 families) by 1-2 species in each population (Fig. 7).

In addition, in the cenoflora of *Anabasis cretacea*, a significant number are perennial — 79 species, and biennial (annual-biennial) — 5 species (Fig. 8).

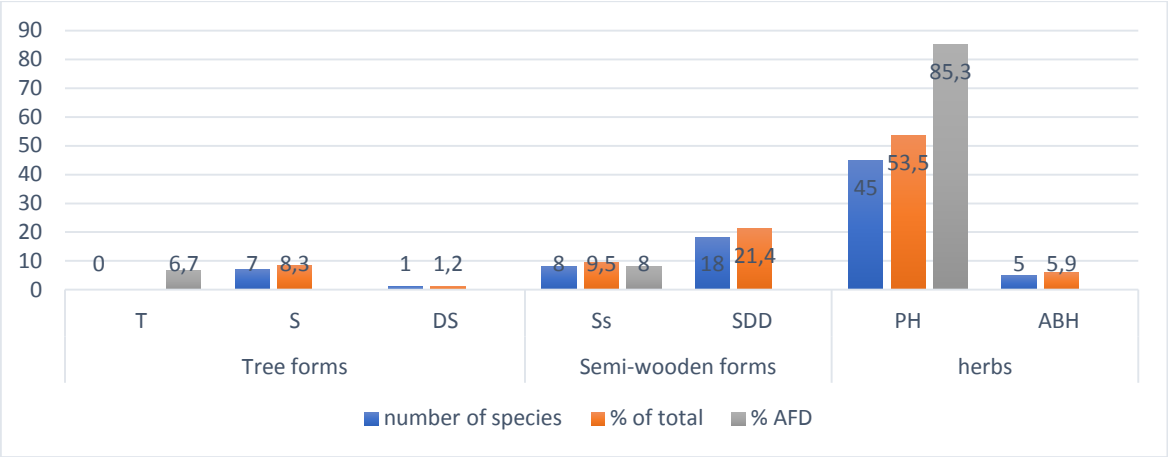

Figure 8. Proportion of life forms in different types of vegetation (%)

We have compared the ratio of life forms in different types of plants with AFD. The comparison revealed that the percentage of tree forms in the study area (9.5 %) is higher than the AFD index by 2.8 %. Herbaceous plants account for 59.5 %, which is 25.8 % less than in the flora of the AFD [48]. This is due to a large proportion of steppe species.

As shown in Table 5, the overwhelming majority of woody and semi-woody forms are represented by subshrubs (8 species), semi-dwarf shrubs (18 species), shrubs (7 species), and dwarf shrubs (1 species). There are 46 species of perennial herbaceous plants, and 5 species of biennial herbaceous plants.

Conclusion

The ecological and cenotic state and floral composition of 9 cenopopulations of the relict species *Anabasis cretacea* Pall. have been studied on the territory of Aktobe region. Calcifytic endemes are dominant in the community of three populations, which is explained by the ecological conditions of the habitats.

The cenoflora of *Anabasis cretacea* includes 84 species belonging to 27 families and 68 genera. Numerous families by species composition are Asteraceae (16 species), Brassicaceae (9 species), Chenopodiaceae (8 species), Fabaceae (8 species), Scrophulariaceae (5 species), Poaceae (5 species). The leading genera are *Astragalus* L. (5 species), *Anabasis* L. (3 species), and *Artemisia* L. (3 types).

In order to preserve the distinctive Cretaceous flora, including relict and endemic species such as *Anabasis cretacea*, a micro-reserve should be established on the Akshatau massif in the vicinity of S. Uil, as previously proposed by Aipeisova (2013) [48], which will ensure the limitation of anthropogenic impact.

Author Contributions

The manuscript was written through contributions of all authors. All authors have given approval to the final version of the manuscript. CRediT: **Kozhabergenova A.B.** — conceptualization, investigation, writing-original draft preparation, formal analysis project administration; **Aipeisova S.A.** — conceptualization, investigation, data curation, methodology, project administration; **Atayeva G.M.** — visualization, investigation; **Maniukiewicz W.** — review and editing, supervision; **Silantiyeva M.M.** — methodology, review, supervision.

Conflict of Interest

The authors declare no conflict of interest.

References

1 Матяшенко Г.В. Динамика растительности на меловых обнажениях Подуральского плато / Г.В. Матяшенко. — Новосибирск: Наука, 1985. — 111 с.

2 Güldenstädt J.A. Reisen durch Russland und im Caucasischen Gebürge / J.A. Güldenstädt; Auf Befehl der Russisch-Kayserlichen Akademie der Wissenschaften herausgegeben von P.S. Pallas. — 1787. — Saint Petersburg. Bd 1; Bd 2.

3 Гильденштедт И.А. Дневник путешествия в Южную Россию в 1773–1774 гг. / И.А. Гильденштедт // Записки Одесского общества истории и древностей. — 1879. — Т. 11. — С. 180–228.

4 Литвинов Д.И. О реликтовом характере флоры каменистых склонов в Европейской России / Д.И. Литвинов // Труды Ботанического музея Императорской Академии наук. — СПб., вып. 1. — С. 76–109.

5 Дубянский В.А. Характер растительности меловых обнажений в бассейне р. Хопра / В.А. Дубянский // Известия Санкт-Петербургского ботанического сада. — 1905. — Вып. 5(3).

6 Козо-Полянский Б.М. В стране живых ископаемых: очерк из истории горных боров на степной равнине ЦЧО / Б.М. Козо-Полянский. — М.: Госучпедиздат, 1931. — 184 с.

7 Володина Н.Г. Флора меловых обнажений Волгоградской области / Н.Г. Володина // Флора степей и полупустынь. — Волгоград, 1982. — С. 34–47.

8 Didukh, Y. Syntaxonomy of chalk outcrop vegetation of the order Thymo cretacei-Hyssopetalia cretacei / Y. Didukh, O. Chusova, O. Demina // Hacquetia. — 2018. — 17(1). — 85–109. https://doi.org/10.1515/hacq-2017-0013

9 Tansley A.G. Studies of the vegetation of the English chalk. I. Early stages of development of woody vegetation on chalk grassland / A.G. Tansley // Journal of Ecology. — 1920. — Vol. 10.

10 Tansley A.G. Studies of the vegetation of the English chalk. III. The chalk grasslands of the Hampshire‑Sussex border / A.G. Tansley, R.S. Adamson // Journal of Ecology. — 1925. — Vol. 13, No. 2. — P. 177–223.

11 Hope-Simpson J.F. Studies of the vegetation of the English chalk. VI. Late stages in succession leading to chalk grassland / J.F. Hope-Simpson // Journal of Ecology. — 1940. — Vol. 28, No. 2. — P. 386–402. https://doi.org/10.2307/2256236

12 Lloyd P.S. The influence of soil conditions on the course of succession on the chalk of Southern England / P.S. Lloyd, C.D. Pigott // Journal of Ecology. — 1967. — Vol. 55, No. 1. — P. 137–146.

13 Butaye J. Phytosociology and phytogeography of the calcareous grasslands on Devonian limestone in southwest Belgium [Electronic resource] / J. Butaye, O. Honnay, D. Adriaens, L.M. Delescaille, M. Hermy // Belgian Journal of Botany. — 2005. — Vol. 138, No. 1. — P. 24–38. — Access mode: http://www.jstor.org/stable/20794563

14 Янишевский Д.Э. Jurinea kirghisorum / Д.Э. Янишевский // Труды Общества естествоиспытателей при Казанском университете. — 1905. — Т. XV, вып. 1. — С. 1–16.

15 Кольченко О.Т. К изучению флоры меловых обнажений Подуральского мелового плато / О.Т. Кольченко, Л.И. Макарова // Материалы по флоре и растительности Северного Прикаспия. — Л.: Изд-во АН СССР, 1966. — Т. 2. — Ч. III. — С. 143–154.

16 Черкасова Г.И. Новый вид морской лаванды из меловых обнажений Западного Казахстана / Г.И. Черкасова // Бюллетень Московского общества испытателей природы. Отдел биологии. — 1970. — № 4. — С. 216.

17 Сафронова И.Н. О растительности меловых возвышенностей степной части Актюбинской области / И.Н. Сафронова // Ботанический журнал. — 1974. — Т. 59, № 11. — С. 1640–1647.

18 Горчаковский П.Л. Флора меловых холмов Западного Казахстана / П.Л. Горчаковский, Г.В. Матяшенко // Тезисы докладов XII Международного ботанического конгресса. — Л.: Изд-во АН СССР, 1975. — Т. 1. — С. 128.

19 Куприянов А.Н. Ценофлора катрана татарского (Crambe tataria Sebeók) в Западном Казахстане / А.Н. Куприянов, Б.А. Туралин, Н.В. Курбатова, М.С. Курманбаева, К.Т. Абидкулова, А.А. Базаргалиева // Экспериментальная биология. — 2020. — Т. 82, № 1. — С. 52–62. https://doi.org/10.26577/eb.2020.v82.i1.04

20 Каримова О.А. М. Анализ современного состояния популяций редких видов растений природного памятника Троицкие меловые горы (Оренбургская область) / О.А. Каримова, Л.М. Абрамова, Ю.М. Голованов // Arid Ecosyst. — 2017. — Т. 7, № 1. — С. 41–48. https://doi.org/10.1134/S2079096117010073

21 Голованов Ю.М. Меловые возвышенности Оренбургской области — уникальный ареал редких видов растений и растительных сообществ / Ю.М. Голованов, Л.М. Абрамова // Arid Ecosyst. — 2019. — Т. 9, № 1. — С. 89–96. https://doi.org/10.1134/S2079096119020069

22 Голованов Ю.М. Особенности флоры меловых возвышенностей Приуралья и сопредельных территорий / Ю.М. Голованов, С.М. Ямалов // Арид Экосист. — 2025. — Т. 15, № 1. — С. 58–68. https://doi.org/10.1134/S2079096124700574

23 Винтерголлер Б.А. Редкие растения Казахстана / Б.А. Винтерголлер. — Алма-Ата: Издательство Наука КазССР, 1976. — 200 с.

24 Lu Y. Relict plants are better able to adapt to climate change: Evidence from desert shrub communities / Y. Lu, B. Zhang, M. Zhang, M. Jie, S. Guo, Y. Wang // Plants. — 2023. — Vol. 12. https://doi.org/10.3390/plants12234065

25 Дарбаева Т.Е. Эколого-исторические свиты флоры меловых возвышенностей Северо-Западного Казахстана / Т.Е. Дарбаева // Ботанический журнал. — 2003. — Т. 88, № 9.

26 Айпеисова С.А. Редкие и исчезающие растения Актюбинской области: учебное пособие / С.А. Айпеисова. — Актобе, 2011. — 165 с.

27 Айпеисова С.А. К истории формирования флоры Актюбинского флористического округа и обзор реликтов / С.А. Айпеисова // Известия Национальной академии наук Республики Казахстан. Серия биологическая и медицинская. — 2013. — № 1 (295). — С. 3–9.

28 Красная книга Оренбургской области: редкие и находящиеся под угрозой исчезновения виды животных, растений и грибов / Институт степи Уральского отделения Российской академии наук. — Воронеж: ООО «МИР», 2019. — 488 с.

29 Красная книга Саратовской области: грибы, лишайники, растения, животные / Министерство природных ресурсов и экологии Саратовской области. — Саратов: Папирус, 2021. — 496 с.

30 Красная книга Челябинской области: животные, растения, грибы / Министерство экологии Челябинской области; Областное государственное учреждение «Особо охраняемые природные территории Челябинской области». — Москва, 2005.

31 Красная книга Республики Башкортостан [в 2-х т.] / под ред. Б.Н. Миркина. — 2-е изд., доп. и перераб. — Уфа: МедиаПринт, 2011. — Т. 1: Растения и грибы. — 383 с.

32 Дарбаева Т.Е. Конспект флоры меловых возвышенностей Северо-Западного Казахстана / Т.Е. Дарбаева. — Уральск, 2002. — 132 с.

33 Darbayeva, T.E. Chalk hills of northwestern Kazakhstan as a biodiversity refugium [Electronic resource] / T.E. Darbayeva, N.Y. Ramazanova // Bulletin of European Grassland Group. — 2012. — Vol. 17. — P. 15–18. — Access mode: https://edgg.org/publ/members/SP0042.pdf

34 Айпеисова С.А. Конспект флоры Актюбинского флористического округа / С.А. Айпеисова. — Актобе, 2012. — 34 с.

35 Флора Казахстана / под ред. Н.В. Павлова. — Алма-Ата: Издательство Академии наук КазССР, 1960. — Т. 3. — С. 288-289.

36 Серебряков И.Г. Экологическая морфология растений. Жизненные формы покрытосеменных и хвойных / И.Г. Серебряков. — М.: Высшая школа, 1962. — 380 с.

37 Шенников А.П. Экология растений / А.П. Шенников. — М.: Советская наука, 1950. — 375 с.

38 Работнов Т.А. Жизненный цикл многолетних травянистых растений в луговых ценозах / Т.А. Работнов // Труды БИН АН СССР. Серия 3. Геоботаника. — 1950. — Т. 6. — С. 7–204.

39 Иллюстрированный определитель растений Казахстана / под ред. В.П. Голоскокова. — Алма-Ата: Изд-во «Наука» Казахской ССР, 1969. — Т. 1. — 644 с.

40 Тахтаджян А.Л. Цветковые растения / А.Л. Тахтаджян. — 2-е изд. — 2009. — 871 с.

41 Черепанов С.К. Сосудистые растения СССР / С.К. Черепанов. — Л.: Наука, 1981. — 510 с.

42 Абдулина С.А. Список сосудистых растений Казахстана / С.А. Абдулина; под ред. Р.В. Камелина. — Алматы, 1998. — 187 с.

43 Арыстангалиев С.А. Растения Казахстана / С.А. Арыстангалиев, Э.Р. Рамазанов. — Алма-Ата: Гылым, 1977. — 77 с.

44 Гельдыева Г.В. Ландшафты Казахстана / Г.В. Гельдыева, Л.К. Веселова. — Алма-Ата: Гылым, 1992. — 175 с.

45 Сергеева А.М. Природное и культурное наследие Актюбинской области: охрана и рациональное использование / А.М. Сергеева, А.Ж. Әбденов, А.М. Мадемов, Г.Ж. Сулейменова, Ф.С. Досмуратов. — Алматы: Казахское национальное географическое общество, 2016. — 208 с.

46 Смелянский И. Ишкаргантау: фотографии ландшафтов и местообитаний [Электронный ресурс] / И. Смелянский. — 2012. — Режим доступа: https://www.plantarium.ru/lang/en/page/landscapes/point/1880.html (дата обращения: 20.10.2025).

47 Агроклиматические ресурсы Актюбинской области: научно-прикладной справочник / под ред. С.С. Байшоланова. — Астана: [б. и.], 2017. — 136 с.

48 Айпеисова С.А. Флора Актюбинского флористического округа / С.А. Айпеисова. — Актобе, 2013. — С. 156–185.

А.Б. Кожабергенова, С.А. Айпеисова, Г.М. Атаева, В. Манюкевич, М.М. Силантьева

Ақтөбе облысындағы *Anabasis cretacea* Pall. реликті түрінің ценофлорасы

Мақалада Ақтөбе облысындағы *Anabasis cretacea* Pall. реликті түрінің ценофлорасын (маусым-қыркүйек, 2025) зерттеу нәтижелері келтірілген, бұл *Anabasis cretacea* Pall. бор таулары мен шыңдарына сәйкес келетіндігін растады. Қазіргі уақытта зерттеліп отырған аумақта оның табиғи популяциялары мен қорғау шаралары туралы мәліметтер шектеулі, бұл жүргізілген жұмыстың өзектілігін айқындайды. Гербарий материалдары мен далалық зерттеулерді зерттеу барысында бөлінген 9 ценопопуляцияны сипаттай отырып, Қобда және Ойыл аудандарында *Anabasis cretacea* Pall. популяцияларының таралу орындары анықталды. Өсімдіктер қауымдастығының құрамы, *Anabasis cretacea* Pall. популяцияларының экологиялық-ценотикалық жарамдылығы айқындалды, мұнда ценофлора зерттелетін популяциялар пайда болатын кальцефитті тіршілік ету ортасының экологиялық жағдайларын көрсетеді. Жетекші тұқымдастар — Asteraceae (16 түр), Brassicaceae (9 түр), Chenopodiaceae (8 түр), Scrophulariaceae (5 түр), Poaceae (4 түр). Басым тұқымдастар — *Astragalus* L. (5 түр), *Anabasis* L. (3 түр), *Artemisia* L. (3 түр). Экобиологиялық талдау шалғынды түрлердің аз болуымен ценофлораның шөл-дала сипатын растады. *Anabasis cretacea* Pall. ценофлорасының толық тізімі ұсынылған, мұнда 68 туысқа, 27 тұқымдасқа жататын 84 түрі анықталды. Осылайша Ақтөбе облысындағы *Anabasis cretacea* Pall. ценофлорасының қазіргі жағдайына баға берілді.

Кілт сөздер: *Anabasis cretacea* Pall., ценопопуляция, ценофлора, өсімдіктер қауымдастығы, тіршілік формасы.

А.Б. Кожабергенова, С.А. Айпеисова, Г.М. Атаева,
В.Манюкевич, М.М. Силантьева

Ценофлора реликтового вида *Anabasiscretacea* Pall. в Актюбинской области

В статье представлены результаты исследования (июнь-сентябрь, 2025 г.) ценофлоры реликтового вида *Anabasis cretacea* Pall. в Актюбинской области, что подтвердило приуроченность *Anabasis cretacea* Pall. к меловым возвышенностям и чинкам. На данный момент сведения о его природных популяциях и охране на исследуемой территории остаются ограниченными, что подчёркивает актуальность проведённой работы. В ходе изучения гербарных материалов и полевых исследований определены места распространения популяций *Anabasis cretacea* Pall. в Хобдинском и Уилском районах, с описанием выделенных 9 ценопопуляций. Определен состав растительного сообщества, эколого-ценотическая приспособленность популяций *Anabasis cretacea* Pall., где ценофлора отражает экологические условия кальцефитных местообитаний, в которых формируются исследуемые популяции. Ведущими семействами являются Asteraceae (16 видов), Brassicaceae (9 видов), Chenopodiaceae (8 видов), Scrophulariaceae (5 видов), Poaceae (4 вида). Доминирующими родами являются *Astragalus* L. (5 видов), *Anabasis* L. (3 вида), *Artemisia* L. (3 вида). Экобиологический анализ подтвердил пустынно-степной характер ценофлоры с незначительным участием луговых видов. Представлен полный перечень ценофлоры *Anabasis cretacea* Pall., где выявлено 84 вида, относящихся к 68 родам и 27 семействам. Таким образом, дана оценка современному состоянию ценофлоры *Anabasis cretacea* Pall. в Актюбинской области.

Ключевые слова: Anabasiscretacea Pall., ценопопуляция, ценофлора, растительные сообщества, жизненная форма.

References

1 Matyashenko, G.V. (1985). *Dinamika rastitelnosti na melovykh obnazheniiakh Poduralskogo plato* [Vegetation dynamics on chalk outcrops of the sub-Ural plateau]. Novosibirsk: Nauka [in Russian].

2 Güldenstädt, J.A. (1787). *Reisen durch Russland und im Caucasischen Gebürge* [Travels through Russia and in the Caucasian Mountains]. (Vols. 1–2, P.S. Pallas, Ed.). Saint Petersburg: Imperial Academy of Sciences [in German].

3 Gildenstedt, I.A. (1879). Dnevnik puteshestviia v Yuzhnuiu Rossiiu v 1773–1774 gg. [Diary of a journey to Southern Russia in 1773–1774]. *Zapiski Odesskogo obshchestva istorii i drevnostei — Notes of the Odessa Society of History and Antiquities, 11*, 180–228 [in Russian].

4 Litvinov, D.I. (1902). O reliktovom kharaktere flory kamenistykh sklonov v Evropeiskoi Rossii [On the relict nature of the flora of rocky slopes in European Russia]. *Trudy Botanicheskogo muzeia Imperatorskoi Akademii nauk — Proceedings of the Botanical Museum of the Imperial Academy of Sciences*, 1, 76–109. Saint Petersburg [in Russian].

5 Dubyansky, V.A. (1905). Kharakter rastitelnosti melovykh obnazhenii v basseine reki Hopra [The nature of vegetation of chalk outcrops in the Khoper River basin]. *Izvestiia Sankt-Peterburgskogo botanicheskogo sada — News of the St. Petersburg Botanical Garden*, 5(3). Saint Petersburg [in Russian].

6 Kozo-Polyansky, B.M. (1931). *V strane zhivykh iskopaemykh: Ocherk iz istorii gornykh borov na stepnoi ravnine TsChO* [In the land of living fossils: an essay on the history of mountain pine forests on the steppe plain of the Central Caucasus]. Moscow: Gosuchpedizdat [in Russian].

7 Volodina, N.G. (1982). Flora melovykh obnazhenii Volgogradskoi oblasti [Flora of chalk outcrops of the Volgograd region]. *Flora stepei i polupustyn — Flora of steppes and semi-deserts* (pp. 34–47). Volgograd [in Russian].

8 Didukh, Y., Chusova, O., & Demina, O. (2018). Syntaxonomy of chalk outcrop vegetation of the order Thymo cretacei-Hyssopetalia cretacei. *Hacquetia, 17*(1), 85–109. https://doi.org/10.1515/hacq-2017-0013

9 Tansley, A.G. (1920). Studies of the vegetation of the English chalk. I. Early stages of development of woody vegetation on chalk grassland. *Journal of Ecology, 10*, 1.

10 Tansley, A.G., & Adamson, R.S. (1925). Studies of the vegetation of the English chalk. III. The chalk grasslands of the Hampshire Sussex border. *Journal of Ecology, 13*(2), 177–223.

11 Hope-Simpson, J.F. (1940). Studies of the Vegetation of the English Chalk: VI. Late Stages in Succession Leading to Chalk Grassland. *Journal of Ecology, 28*(2), 386–402. https://doi.org/10.2307/2256236

12 Lloyd, P.S., & Pigott, C.D. (1967). The influence of soil conditions on the course of succession on the chalk of Southern England. *Journal of Ecology, 55*(1), 137–146.

13 Butaye, J., Honnay, O., Adriaens, D., Delescaille, L. -M., & Hermy, M. (2005). Phytosociology and phytogeography of the calcareous grasslands on Devonian limestone in southwest Belgium. *Belgian Journal of Botany, 138*(1), 24–38. Retrieved from http://www.jstor.org/stable/20794563

14 Yanishevsky, D.E. (1905). Jurinea kirghisorum. *Trudy Obshchestva estestvoispytatelei pri Kazanskom universitete — Proceedings of the Society of Naturalists at Kazan University, 15*(1), 1–16 [in Russian].

15 Kolchenko, O.T., & Makarova, L.I. (1966). K izucheniiu flory melovykh obnazhenii Poduralskogo melovogo plato [On the study of the flora of chalk outcrops of the Podural Plateau]. *Materialy po flore i rastitelnosti Severnogo Prikaspiia — Materials on flora and vegetation of the Northern Caspian Region, 2*(3), 143–154. Leningrad: Izdatelstvo Akademii nauk SSSR [in Russian].

16 Cherkasova, G.I. (1970). Novyi vid morskoi lavandy iz melovykh obnazhenii Zapadnogo Kazakhstana [A new species of sea lavender from the chalk outcrops of Western Kazakhstan]. *Bulletin Moskovskogo obshchestva ispytatelei prirody. Otdel biologii — Bulletin of the Moscow Society of Nature Testers. Department of Biology*, 4, 216 [in Russian].

17 Safronova, I.N. (1974). O rastitelnosti melovykh vozvyshennostei stepnoi chasti Aktiubinskoi oblasti [On the vegetation of chalk uplands of the steppe part of the Aktobe region]. *Botanicheskii zhurnal — Botanical journal, 59*(11), 1640–1647 [in Russian].

18 Gorchakovsky, P.L., & Matyashenko, G.V. (1975). Flora melovykh kholmov Zapadnogo Kazakhstana [The flora of chalk hills of Western Kazakhstan]. *Tezisy dokladov XII Mezhdunarodnogo botanicheskogo kongressa — Abstracts of the XII International Botanical Congress, 1*, 128. Leningrad: Izdatelstvo Akademii nauk SSSR [in Russian].

19 Kupriyanov, A.N., Turalin, B.A., Kurbatova, N.V., Kurmanbayeva, M.S., Abidkulova, K.T., & Bazargalieva, A.A. (2020). Tsenoflora katrana tatarskogo (Crambe tataria Sebeók) v Zapadnom Kazakhstane [Cenoflora of Crambe tataria Sebeók in Western Kazakhstan]. *Eksperimentalnaia biologiia — Experimental biology, 82*(1), 52–62. https://doi.org/10.26577/eb.2020.v82.i1.04 [in Russian].

20 Karimova, O.A., Abramova, L.M., & Golovanov, Y.M. (2017). Analiz sovremennogo sostoianiia populiatsii redkikh vidov rastenii prirodnogo pamiatnika Troitskie melovye gory (Orenburgskaia oblast) [Analysis of the current state of populations of rare plant species of the natural monument Troitskie chalk hills (Orenburg region)]. *Arid Ecosystems, 7*(1), 41–48. https://doi.org/10.1134/S2079096117010073 [in Russian].

21 Golovanov, Y.M., & Abramova, L.M. (2019). Melovye vozvyshennosti Orenburgskoi oblasti — unikalnyi areal redkikh vidov rastenii i rastitelnykh soobshchestv [Chalk uplands of the Orenburg region — a unique habitat for rare plant species and plant communities]. *Arid Ecosystems, 9*(1), 89–96. https://doi.org/10.1134/S2079096119020069 [in Russian].

22 Golovanov, Y.M., & Yamalov, S.M. (2025). Osobennosti flory melovykh vozvyshennostei Priuralia i sopredelnykh territorii — Features of the flora of chalk uplands of the Pre-Urals and adjacent territories. *Arid Ecosystems, 15*(1), 58–68. https://doi.org/10.1134/S2079096124700574 [in Russian].

23 Vintergoller, B.A. (1976). *Redkie rasteniia Kazakhstana* [Rare plants of Kazakhstan]. Alma-Ata: Izdatelstvo Nauka KazSSR [in Russian].

24 Lu, Y., Zhang, B., Zhang, M., Jie, M., Guo, S., & Wang, Y. (2023). Relict plants are better able to adapt to climate change: Evidence from desert shrub communities. *Plants, 12*. https://doi.org/10.3390/plants12234065

25 Darbaeva, T.E. (2003). Ekologo-istoricheskie svity flory melovykh vozvyshennostei Severo-Zapadnogo Kazakhstana [Ecological and historical suites of the flora of Cretaceous uplands of Northwestern Kazakhstan]. *Botanicheskii Zhurnal — Botanical Journal, 88*(9) [in Russian].

26 Aypeisova, S.A. (2011). *Redkie i ischezaiushchie rasteniia Aktiubinskoi oblasti: Uchebnoe posobie* [Rare and endangered plants of the Aktobe region: A textbook]. Aktobe [in Russian].

27 Aypeisova, S.A. (2012). K istorii formirovaniia flory Aktiubinskogo floristicheskogo okruga i obzor reliktov [On the history of flora formation of the Aktobe floristic district and a review of relicts]. *Izvestiia Natsionalnoi Akademii Nauk Respubliki Kazakhstan. Seria biologicheskaia i meditsinskaia — Proceedings of the National Academy of Sciences of the Republic of Kazakhstan. The series is biological and medical*, 1(295), 3–9 [in Russian].

28 (2019). *Krasnaia kniga Orenburgskoi oblasti: Redkie i nakhodiashchiesia pod ugrozoi ischeznoveniia vidy zhivotnykh, rastenii i gribov* [Red Data Book of the Orenburg Region: Rare and endangered species of animals, plants, and fungi]. Institut stepi Uralskogo otdeleniia Rossiiskoi akademii nauk. Voronezh: OOO «MIR» [in Russian].

29 (2021). *Krasnaia kniga Saratovskoi oblasti: Griby, lishainiki, rasteniia, zhivotnye* [Red Data Book of the Saratov Region: Fungi, lichens, plants, and animals]. Saratov: Papirus [in Russian].

30 (2005). *Krasnaia kniga Cheliabinskoi oblasti: zhivotnye, rasteniia, griby* [Red Data Book of the Chelyabinsk Region: animals, plants, fungi]. Ministerstvo ekologii Chelyabinskoi oblasti & Oblastnoe gosudarstvennoe uchrezhdenie "Osobo okhraniaemye prirodnye territorii Cheliabinskoi oblasti. Moscow [in Russian].

31 (2011). *Krasnaia kniga Respubliki Bashkortostan* [Red Data Book of the Republic of Bashkortostan]. Vols. 1-2. Vol. 1: Rasteniia i griby [Plants and fungi]. Ufa [in Russian].

32 Darbayeva, T.E. (2002). *Konspekt flory melovykh vozvyshennostei Severo-Zapadnogo Kazakhstana* [Conspectus of the flora of the chalky highlands of Northwestern Kazakhstan]. Uralsk [in Russian].

33 Darbayeva, T.E., & Ramazanova, N.Yu. (2012). Chalk hills of northwestern Kazakhstan as a biodiversity refugium. *Bulletin of European Grassland Group, 17,* 15–18. Retrieved from https://www.edgg.org/publ/members/SP0042.pdf.

34 Aypeisova, S.A. (2012). *Konspekt flory Aktiubinskogo floristicheskogo okruga* [Conspectus of the flora of the Aktobe floristic district]. Aktobe [in Russian].

35 Pavlov, N.V. (Ed.). (1960). *Flora Kazakhstana* [Flora of Kazakhstan] (Vol. 3, pp. 288-289). Alma-Ata: Izdatelstvo Akademii nauk KazSSR [in Russian].

36 Serebryakov, I.G. (1962). *Ekologicheskaia morfologiia rastenii: Zhiznennye formy pokrytosemennykh i khvoinykh* [Ecological morphology of plants. Life forms of angiosperms and conifers]. Moscow: Vysshaia Shkola [in Russian].

37 Shennikov, A.P. (1950). *Ekologiia rastenii* [Plant ecology]. Moscow: Sovetskaia Nauka [in Russian].

38 Rabotnov, T.A. (1950). Zhiznennyi tsikl mnogoletnikh travianistykh rastenii v lugovykh tsenozakh [Life cycle of perennial herbaceous plants in meadow cenoses]. *Trudy Botanicheskogo Instituta Akademii Nauk SSSR. Seriia 3. Geobotanika — Proceedings of the Botanical Institute of the Academy of Sciences of the USSR. Series 3. Geobotany*, *6*, 7–204 [in Russian].

39 Goloskokova, V.P. (Ed.). (1969). *Illiustrirovannyi opredelitel rastenii Kazakhstana* [Illustrated guide to the plants of Kazakhstan]. (Vols. 1-2. Vol. 1.). Alma-Ata: Izdatelstvo "Nauka" Kazakhskoi SSR [in Russian].

40 Takhtadzhyan, A.L. (2009). *Tsvetkovye rasteniia* [Flowering plants] (2nd ed.) [in Russian].

41 Cherepanov, S.K. (1981). *Sosudistye rasteniia SSSR* [Vascular plants of the USSR]. Leningrad: Nauka [in Russian].

42 Abdulina, S.A. (1998). *Spisok sosudistykh rastenii Kazakhstana* [Checklist of vascular plants of Kazakhstan] (R.V. Kamelin, Ed.). Almaty [in Russian].

43 Arystangaliev, S.A., & Ramazanov, E.R. (1977). *Rasteniia Kazakhstana* [Plants of Kazakhstan]. Alma-Ata: Gylym [in Russian].

44 Geldyeva, G.V., & Veselova, L.K. (1992). *Landshafty Kazakhstana* [Landscapes of Kazakhstan]. Alma-Ata: Gylym [in Russian].

45 Sergeeva, A.M., Abdenov, A.Zh., Mamedov, A.M., Suleimenova, G.Zh., & Dosmuratov, F.S. (2016). *Prirodnoe i kulturnoe nasledie Aktiubinskoi oblasti: Okhrana i ratsionalnoe ispolzovanie* [Natural and cultural heritage of the Aktobe region: Protection and sustainable use]. Almaty: Kazakhstkoe natsionalnoe geograficheskoe obshchestvo [in Russian].

46 Smelansky, I. (2012). Ishkargantau: fotografii landshaftov i mestoobitanii [Ishkargantau: Photographs of landscapes and habitats]. *plantarium.ru.* Retrieved from https://www.plantarium.ru/lang/en/page/landscapes/point/1880.html [in Russian].

47 Baisholanov, S.S. (Ed.). (2017). *Agroklimaticheskie resursy Aktiubinskoi oblasti: Nauchno-prikladnoi spravochnik* [Agroclimatic resources of the Aktobe region: Scientific and applied reference book]. Astana [in Russian].

48 Aipeisova, S.A. (2013). *Flora Aktiubinskogo floristicheskogo okruga* [Flora of the Aktobe floristic district] (pp. 156–185). Aktobe [in Russian].

Information about the authors

Kozhabergenova Asstragul Bakytzhanovna — PhD-student, Department of General Biology and Genomics, L. Gumilyov Eurasian National University, Astana, Kazakhstan; e-mail: asstrakozabergenova@gmail.com; https://orcid.org/0009-0006-7491-3533

Aipeisova Saira Apraimovna — Doctor of Biological Sciences, Professor, Faculty of Agriculture, Baishev University, Aktobe, Kazakhstan; e-mail: saira_ap@mail.ru; https://orcid.org/0000-0001-5119-6953

Atayeva Gulshat Mukanovna — Candidate of Biological Sciences, Associate professor, L. Gumilyov Eurasian National University, Astana, Kazakhstan; e-mail: atayeva_gm@enu.kz; https://orcid.org/0000-0002-6624-0192

Waldemar Maniukiewicz — PhD, Lodz University of Technology, Lodz, Poland; e-mail: waldemar.maniukiewicz@p.lodz.pl; https://orcid.org/0000-0001-6094-0748

Silantyeva Marina Mikhailovna — Doctor of Biological Sciences, Professor, Altai State University; e-mail: Barnaul, Russia; msilan@mail.ru; https://orcid.org/0000-0002-7102-2675