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Current State of a Rare, Narrowly Endemic Plant of the Flora of Kazakhstan, *Rosa Potentilliflora* Chrshan. et M. Pop. (*Rosaceae*) in Low-Mountain Syugaty

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Abstract: This study provides a comprehensive ecological assessment of *Rosa potentilliflora*, a rare and narrowly endemic species of the Kazakh flora, occurring exclusively in the Syugaty low-mountain range at the eastern edge of the Zailiyskiy Alatau. The species occupies southeast-facing rocky slopes within steppe vegetation belts. Three distinct cenopopulations were identified and studied using standard geobotanical and demographic methods. Within these populations, detailed age spectra were constructed based on shoot development stages, revealing a stable regeneration process primarily through vegetative propagation. A total of 248 seedlings, 391 juvenile and immature individuals, and 329 generative shoots were documented. Floristic analysis recorded 59 associated plant species representing 21 families, with dominance of Poaceae, Asteraceae, and Brassicaceae. The plant communities showed vertical stratification and were characterized by high biodiversity and a mixture of xerophyte and mesophyte species. The major anthropogenic threat is grazing. Based on our findings, we recommend the species' introduction into botanical gardens and the creation of a protected reserve in the Syugaty region to ensure long-term conservation.

Keywords: Association, Population, Age Spectrum, Dominant, Sub-Dominant

Introduction

Rosa L. is a genus of the family *Rosaceae* (WFO Plant List, 2024). This family includes 117 genera and 6028 species (The Plant List, 2025; Abdullina, 1999). Rosa potentilliflora Chrshan. et M. Pop. is a very peculiar species from the eastern Tien Shan (Syugaty Mountains), first described by botanists V.G. Khrzhanovsky and M.G. Popov (Radice *et al.,* 2016; Prokopov and Gazitaeva, 2018). It is a Xeromesophilic shrub with erect, profusely deciduous branches covered with straight, horizontally spaced needle-like spines. Its leaves are 1 to 5 cm long, grouped in clusters on shortened twigs; the leaflets number 7-9, are narrowly elliptical. The flowers are bright yellow, up to 3 cm in diameter, numerous, and arranged singly in the branch lobes. The fruits are smooth, up to 8-9 mm in diameter (Dorni Charles, 2017).

Rosa potentilliflora is a narrowly endemic species found in the eastern part of the Zailiyskiy Alatau, growing on rocky mountain slopes and along gorge bottoms. This species, valuable for science, requires protection (Baumann, 2018). Currently, there is increasing interest in the use of herbal raw materials and their components in pharmaceutical formulations, including cosmetics, due to their wide range of activity, lack of xenobiotic effects, and the high bioavailability of organic plant compounds. The photoprotective potential and pronounced antioxidant activity of the biologically active substances in certain rosehip species have been studied and experimentally confirmed (Voskanyan, 2015; Kiralan and Yildirim, 2019). Research has identified the potential use of rosehip fruit oil in sunscreen formulations due to the carotenoids in its fatty components, as well as vitamins E and F, and triglycerides of polyunsaturated fatty acids (linoleic and linolenic), which contribute to protection from ultraviolet radiation. Literature sources (Chu and Nyam, 2021; Dąbrowska *et al.,* 2019; Kayath *et al.,* 2019; Kulaitienė *et al.,* 2020) report the high bioavailability of rosehip biomolecules, attributed to their lipid content, which is similar to the lipid layer of human skin.

Modern studies have examined various types of rosehip characteristic of different geographical regions, including *R. canina, R. nutkana, R. woodsii, R. psiocarpa, R. rugosa, R. alba, R. borboniana, R. centifolia, R. damascena, R. davurica, R. floribunda, R. gallica, R. hybrida, R. moschata, R. multiflora, R. rubiginosa,* and *R. spinosissima*, among others. These studies confirm the scientifically proven activity of organic compounds in the *Rosa* genus and highlight their high industrial interest for the pharmaceutical and cosmetic industries (Fascella *et al.,* 2019; Jiménez *et al.,* 2017).

Among the rosehip varieties currently attracting scientific attention is *R. potentilliflora*, whose chemical composition has been experimentally studied but requires further analysis of its pharmacological activity and the potential use of its raw materials in cosmetic formulations. Proven antioxidant, antibacterial, anti-inflammatory, and regenerative activities of biomolecules derived from rosehip fruit and oil extracts suggest promising applications (Tumbas *et al.,* 2011). According to the literature, the phytochemical composition of rosehip is rich in polyphenolic compounds, particularly flavonols (quercetin, kaempferol) (987.8 mg/100g) (Paunović *et al.,* 2019) catechins (epigallocatechin, gallocatechin, epigallocatechin gallate, epicatechin gallate); anthocyanins; and gallic acid (3000 mg/100 g) (Tabaszewska and Najgebauer-Lejko, 2020).

In Kazakhstan, domestic scientists have also conducted studies on the accumulation of morpho-anatomic and biologically active substances in medicinal plants (Özek *et al.,* 2022; Atabayeva *et al.,* 2022; Akhtaeva *et al.,* 2022; Nurmahanova *et al.,* 2023; Nurmahanova *et al.,* 2024; Nurmahanova *et al.,* 2024).

The aims of this study were: (1) to investigate the floristic composition and stratification of plant communities involving *R. potentilliflora*, (2) to evaluate the age spectra of three cenopopulations, and (3) to develop conservation strategies based on ecological assessment.

Materials and Methods

Study Area

The study was conducted in the Syugaty low-mountain range located at the southeastern edge of the Zailiyskiy Alatau, Kazakhstan. Elevation ranges from 1100 to 1200 meters a.s.l (Friesen *et al.,* 2021).

The climate of the Syugaty massif is characterized by moderately continental conditions with pronounced seasonality. The average annual temperature is about +6 °C, with winter temperatures dropping to –25 °C and summer temperatures reaching +30 °C. Annual precipitation ranges from 300 to 450 mm, creating moderately arid conditions (Kulymbet *et al.,* 2023). These climatic parameters contribute to the formation of specific ecosystems dominated by xerophytic and mesophytic plant species (Osmonali *et al.,* 2024). Several small rivers, such as the Syugatinka and its tributaries, as well as seasonal streams, are located within the Syugaty massif (Tynybekov *et al.,* 2024). The soil cover of the Syugaty low-mountain massif is represented by chernozems, chestnut soils, and sierozems, typical of moderately arid regions. Chernozems are formed under steppe vegetation and are characterized by a high humus content, making them particularly fertile. Chestnut soils are found in drier areas and have a lower organic matter content (Balkybek *et al.,* 2025; Amirov *et al.,* 2023).

Sampling and Site Description

Three distinct cenopopulations of *R. potentilliflora* were identified along varying slope aspects. In each cenopopulation, study sites were allocated, each measuring 10 × 10 m (Neshataev, 1987).

Floristic Analysis

To study the age structure in each cenopopulation, the boundaries of which are determined by generally accepted methods (Zlobin *et al.,* 2013), 10 model sites were laid. For an individual, we take a rooted shoot of generative or vegetative origin. In the process of work, the total (Nt), reproductive (Nr), effective (Ne) numbers are calculated (Rabotnov, 1946; Semenova, 2001). The age structure of the cenopopulation (CP) was described with the definition of recovery indices (Iv) (Ydyrys *et al.,* 2022; Ydyrys *et al.,* 2013).

Herbarium material was collected and dried following the methodology of A.K. Skvartsov (1977). Plant identification was conducted using the nine-volume Flora of Kazakhstan (1956–1966), the two-volume Illustrated Guide to the Plants of Kazakhstan (1969-1972) and according to S.K. Cherepanov (1995).

Results and Discussion

A population of the rare and narrowly endemic plant *Rosa potentilliflora* Chrshan. et M. Pop., native to Kazakhstan, was discovered in the "Syugaty" low-mountain massif, located at the eastern tip of the Zailiyskiy Alatau. Map of the study area showing the distribution area of *Rosa potentilliflora* is presented in Fig. 1. This small low-mountain massif consists of two vegetation belts: the lower desert belt and the upper steppe belt. The *Rosa potentilliflora* population occupies the southeastern exposure of the steppe belt in the Kokpek Pass area. The elevation of the site above sea level ranges from 1150 to 1200 meters. The GPS coordinates of the location are N 43 27'2" E 78 39'39.8" (Fig. 1).

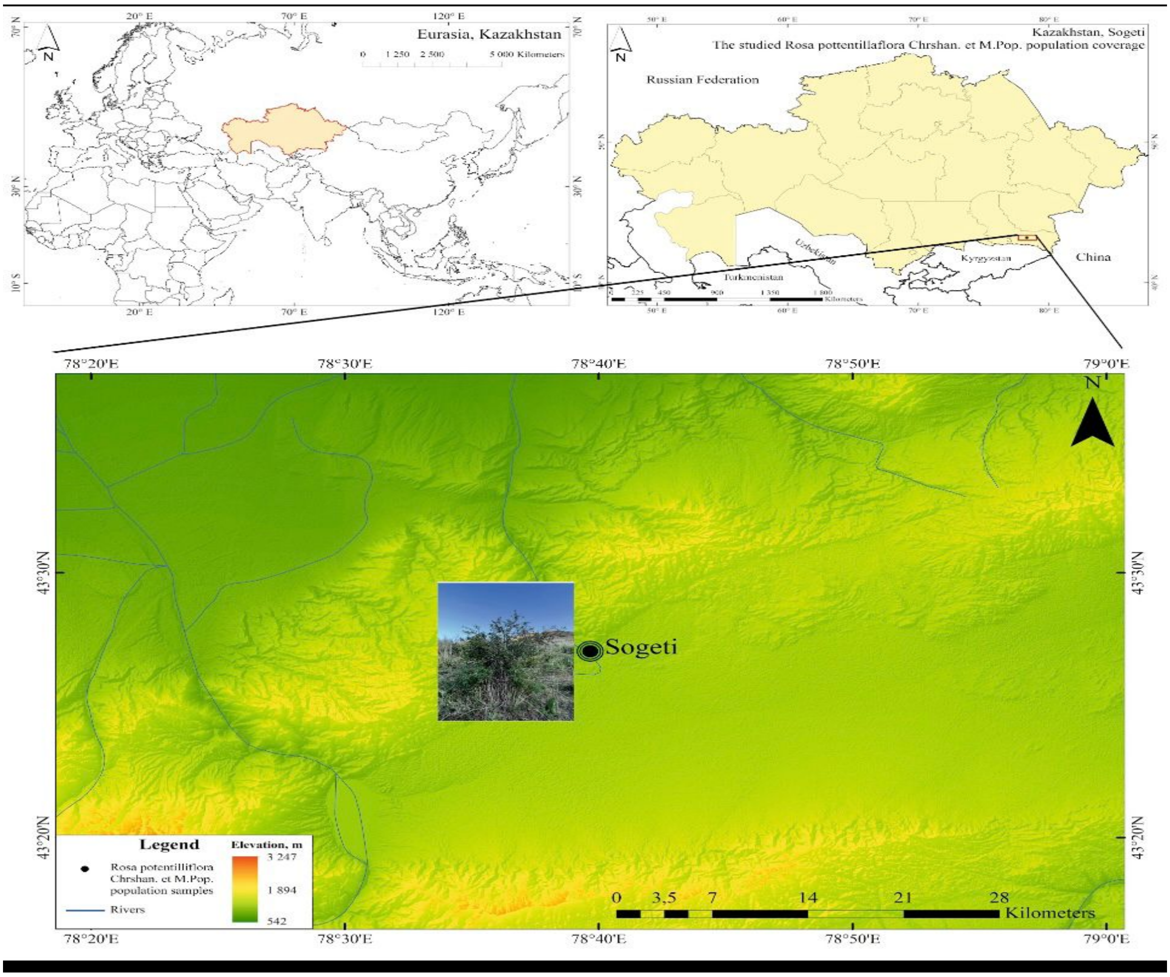

Fig.1: Map of the study area showing the distribution area of *Rosa potentilliflora*

We identified and described three cenopopulations within the population as shown in Fig. 2:

A *B* *C*

Fig. 2: *R. potentilliflora* in the CP1 (A), CP2 (B) and CP3 (C) cenopopulations

Cenopopulation 1. The area of this cenopopulation is relatively small, measuring 75-80 meters in length and not exceeding 50 meters in width. Cenopopulation 1 (ass. *Atraphaxis virgata* - *Rosa potentilliflora*). Total projective cover of 75–80%, and in the spring background, it was slightly higher due to the presence of ephemerals and ephemeroids. The soil in this area is dark brown. The vegetation cover consists of four distinct layers:

First tier. Dominated by *Rosa potentilliflora* Chrshan. et M. Pop. and *Atraphaxis virgata* (Rge) Krassn., reaching a height of 110–120 cm. Second tier: Composed of grasses such as *Elymus dahuricus* Turcz., *Milium effusum* L., and *Melica transsilvanica* Schur., with a height of 90–100 cm. Third tier: Includes species like *Eurotia ceratoides* (L.) C.A. Mey., *Artemisia sublessingiana* Krasch. ex Poljak., and *Festuca sulcata* Hak, with a height of 35–50 cm. Fourth tier: Composed of species such as *Sedum hybridum* L., *Carex taldycola* Minsh., *Potentilla orientalis* Juz., and *Thymus marschalianus* Willd., with a height of 15–30 cm. The dominant vegetation includes shrubs such as *Rosa potentilliflora* Chrshan. et M. Pop., *Atraphaxis virgata* (Rge) Krassn., and *Spiraea hypericifolia* L. Subdominants include grasses like *Elymus dahuricus* Turcz., *Milium effusum* L., *Melica transsilvanica* Schur., and *Festuca sulcata* Hack. Associated species include *Artemisia sublessingiana*

Krasch. ex Poljak., *Acroptilon repens* (L.) DC., *Allium setifolium* Shrenk., *Sedum hybridum* L., *Thlaspi arvense* L., *Kochia prostrata* (L.) Schrad., *Carex taldycola* Minsh., and others.

In cenopopulation 1, we identified 39 seedlings, 149 juvenile individuals, 173 immature individuals, and 153 virginal individuals. Transitioning into the reproductive stage poses certain challenges in determining the age spectrum of all rosehip species. This is because all rosehip species propagate not only by seeds but also vegetatively, through rhizomes. Numerous renewal buds are formed annually on the underground shoots of rosehip plants. Some buds are larger and grow upward, forming aboveground shoots, while smaller buds grow downward and develop adventitious roots. As a result, all rosehip species, including *Rosa potentilliflora*, form clones as they expand extensively. Within these clones, identifying the maternal plants is practically impossible. Therefore, it is not appropriate to discuss individual plants of rosehip species in such cases. Within a clone, we can distinguish young generative, mature generative, old generative, subsenile, and senile (i.e., dried-out) shoots. Occasionally, these extensively growing clones form dense, impenetrable thickets.

Thus, in the first cenopopulation, we identified 45 young generative, 31 mature generative, 25 old generative, 24 subsenile, and 13 senile (dried) shoots (Table 1).

Cenopopulation 2. This cenopopulation was located on the southwestern exposure of the steppe belt in the low-mountain massif "Syugaty." The elevation of the site is 1130 meters above sea level, with GPS coordinates recorded as N 43 27'2" E 78 39'8".

The vegetation cover is represented by the rosehip-herbaceous association (*Elymus dahuricus* Turcz., *Glycyrrhiza uralensis* Fisch., *Artemisia sublessingiana* Krasch. ex Poljak., *Melica transsilvanica* Schur., *Festuca sulcata* Hack., *Rosa potentilliflora* Chrshan. et M. Pop.). Total projective cover of 90–95%. The soil is dark brown. The longitudinal dimensions of the site are 70–75 meters in length and 45–50 meters in width. The vegetation cover is stratified into four tiers.

Subdominants: *Spiraea hypericifolia* L., *Atraphaxis virgata* (Rge) Krassn., and *Ephedra equisetina* Bge. Associated species are *Eurotia ceratoides* (L.) C.A. Mey., *Acroptilon repens* (L.) DC., *Kochia prostrata* (L.) Schrad., *Festuca sulcata* Hack., *Scaligeria setacea* (Schrenk) Korov., *Potentilla dealbata* Bunge., *Alyssum campestre* L., and others.

In cenopopulation 2, we found 58 seedlings, 114 juvenile individuals, 116 immature individuals, and 73 virginal individuals. Furthermore, in the *Rosa potentilliflora* Chrshan. et M. Pop., we counted 63 young generative, 64 adult generative, 53 old generative, 28 sub-senile, and 17 senile individuals, which are withered shoots. As mentioned above, it is not possible to refer to them as individuals (Table 2). The clones are replenished annually with new shoots, resulting in the formation of dense, thorny thickets.

Table 1: The age spectrum of the first cenopopulation of *Rosa potentilliflora Chrshan*. et M. Pop

Periods	Age spectrum	Cenopopulation 1
Latent state (primary rest period) (Se)	seeds	-
	seedlings(p)	39
Virginal	juvenile (j)	149
	immature (im)	173
	virginal (v)	153
	young generative (g_1)	45
Reproductive	adult generative (g_2)	31
	old generative (g_3)	25
Senile (old is incapable of, reproduction)	sub-senile (ss)	24
	senile (sc)	13

Table 2: The age spectrum of the second cenopopulation of *Rosa potentilliflora* Chrshan. et M. Pop

Periods	Age spectrum	Cenopopulation 2
Latent state (primary rest period) (Se)	seeds	-
	seedlings(p)	58
Virginal	juvenile (j)	114
	immature (im)	116
	virginal (v)	73
	young generative (g_1)	63
Reproductive	adult generative (g_2)	64
	old generative (g_3)	53
Senile (old is incapable of, reproduction)	sub-senile (ss)	28
	senile (sc)	17

Cenopopulation 3. This cenopopulation was located in the northeastern exposure of the steppe belt of the low-mountain massif "Syugaty". The elevation of the site above sea level was 1110 m. Coordinates according to the GPS navigator device: N 43°27'3" E 78°39'13" (Fig. 1). Cenopopulation 3 (ass. *Glycyrrhiza uralensis, Lasiagrostis splendens*) with the participation of shrubs: *Rosa potentilliflora* Chrshan. et M. Pop., *Rosa beggeriana* Schrenk., *Rosa iliensis* Chrshan. Total projective cover of 95-100%.

As for the conservation of the natural population of this unique plant, we recommend organizing a state reserve in the low-mountain range of "Syugaty" where *Rosa potentilliflora* is found. Entrust this to the forestry department of the Enbekshikazakh district of the Almaty region or the leadership of the Charyn National Park, whose territory is close to the low-mountain range "Syugaty", so that they constantly monitor the state of the population of this unique plant. Limit the use of those areas of Mount Syugaty where *Rosa potentilliflora* grows as pastures and prevent a fire from occurring there.

The soil is dark chestnut. The vegetation cover has a four-tier structure. First tier: *Rosa potentilliflora* Chrshan. et M. Pop., *Rosa beggeriana* Schrenk., *Rosa iliensis* Chrshan. 140-150 cm high. Second tier: *Lasiagrostis splendens* (Trim) Kunth., *Mentha arvensis* L., *Asparagus persicus* Baker. 100-125 cm high. Third tier: *Glycyrrhiza uralensis* Fisch., *Salvia deserta* Schang., *Centaurea squarrosa* Will. 55-70 cm high. Fourth tier: *Potentilla dealbata* Bunge., *Chenopodium foliosum* (Moerch) Asehers., *Alyssum dasycarpum* Streph., 15-30 cm high. This cenopopulation site was located closer to a spring source. Therefore, meadow forbs dominated here, formed by *Glycyrrhiza uralensis* Fisch. and *Lasiagrostis splendens* (Trim) Kunth., along with shrubs such as *Rosa beggeriana* Schrenk., *Rosa iliensis* Chrshan., and *Rosa potentilliflora* Chrshan. et M. Pop. Subdominant species include *Mentha arvensis* L. and *Salvia deserta* Schang. Associated species are *Scaligeria setacea* (Schrenk) Korov., *Chenopodium foliosum* (Moerch) Asehers., *Potentilla dealbata* Bunge., *Asparagus persicus* Baker., *Leonurus turkestanicus* V. Krecz. & Kuprian., *Iris sogdiana* Bunge, and others.

The site was heavily degraded for two primary reasons. Firstly, its proximity to a populated area. Secondly, a spring located near the foot of the hill contributed to this degradation. Lush mesophilic grasses grow densely around the spring, attracting cattle, sheep, and goats that graze there continuously. This grazing activity has a negative impact on the population of *Rosa potentilliflora* Chrshan. et M. Pop., as the livestock consume and trample the seedlings and juvenile plants.

As a result, the age spectrum and abundance of *Rosa potentilliflora* in this cenopopulation were notably low (Table 3)

Thus, the search for the habitat of the rare, narrow-endemic plant of Kazakhstan's flora, *Rosa potentilliflora*, yielded positive results. We managed to locate its population in the low-mountain massif of "Syugaty," which is part of the eastern edge of the Zailiyskiy Alatau. Here, it primarily grows on the southeast-facing slopes of the steppe zone, at an elevation of 1150-1200 m above sea level. We studied the current state of the populations of this unique plant using the most advanced geobotanical research methods. The results of the study confirmed that *Rosa potentilliflora* is indeed a rare, narrow-endemic plant of Kazakhstan's flora that requires conservation.

During the study of the *Rosa potentilliflora* population, we identified three cenopopulations, provided geobotanical descriptions for each, and indicated the projective cover of the soil by plants. We also examined the vertical stratification, identified dominant, subdominant, and associated species. In addition, in each cenopopulation, we established two 10 × 10 m² transects to analyze the age spectrum and population size of *Rosa potentilliflora*. As a result of this comprehensive study and assessment of the age spectrum and population size, we were able to scientifically evaluate the current state of the population of this unique plant and develop conservation measures. In addition to geobotanical descriptions, a floristic analysis of plant communities involving *Rosa potentilliflora* within the populations was also conducted (Table 4).

Table 3: Age spectrum of the third cenopopulation of *Rosa potentilliflora* Chrshan. et M. Pop

Periods	Age spectrum	Cenopopulation 3
Latent state (primary rest period) (Se)	seeds	-
	seedlings(p)	-
Virginal	juvenile (j)	20
	immature (im)	30
	virginal (v)	22
	young generative (g_1)	21
Reproductive	adult generative (g_2)	24
	old generative (g_3)	19
Senile (old is incapable of, reproduction)	sub-senile (ss)	16
	senile (sc)	9

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Table 4. Flora summary of all cenopopulations

Plant Name		Life Form, Ecological Type, Geographical Element	Importance in Agriculture
Section: *Gymnospermatophyta*			
Class: *Chlamydospermatopsida*			
1.	Family: *Ephedraceae* Wettst.		
1.1	*Ephedra equisetina* Bge.	Shrub, xerophyte, cosmopolitan	medicinal
Section: *Angiospormatophyta*			
Class: *Monocotyledoneae*			
2.	Family: *Poaceae* Gaertn.		
2.1	*Calamagrosis epigeios* (L.) Roth	Perennial, mesoxerophyte, palearctic	feed
2.2	*Elymus dahuricus* Turcz. et Griseb.	Perennial, mesophyte mountain Siberian - Iranian	feed
2.3	*Milium effusum L.*	Perennial, mesophyte, Holarctic	feed
2.4	*Melica transsilvanica* Schuz.	Perennial, mesophyte, Palearctic	feed
2.5	*Hordeum hystrix* Roth.	Annual, xerophyte, mountain Central Asian - Mediterranean	feed
2.6	*Bromus japonicus* Thunb.	Perennial, mesoxerophyte, Palaearctic	feed
2.7	*Eremopyrum orientale* (L.) Jaub.et Spach	Annual, xerophyte, Turano-Mediterranean	feed
2.8	*Festuca sulcata Hack*.	Perennial, xerophyte, Eurasian steppe	feed
2.9	*Phragmites austrialis* Trin.	Perennial, hydrophyte, cosmopolitan	feed, technical
2.10	*Lasiagrostis splendens* (Trin.) Kunth	Perennial, mesophyte, mountain Siberian - Iranian	feed, braided, brush, paper
2.11	*Aegilops cylindrica* (Cesati) Host.	Annual, xerophyte, mountain Central Asian - Mediterranean	weed
3.	Family: *Cyperaceae* Juss.		
3.1	*Carex taldycola* Meinsh.	Perennial, mesophyte, Dzungarian-Tien Shan	weed
4.	Family: *Asparagaceae* Juss.		
4.1	*Asparagus persicus* Baker	Perennial, xeromesophyte, Dzungarian -Iranian	ornamental
5.	Family: *Liliaceae* Juss.		
5.1	*Tulipa greigii* Rge.	Perennial, xeromesophyte, Dzungarian -Iranian	ornamental
6.	Family: *Iridaceae* Juss.		
6.1	*Iris sogdiana* Bunge.	Perennial, mesophyte, mountain Central Asia-Kazakhstan	ornamental, weaving
7.	Family: *Alliaceae* Borkh.		
7.1	*Allium setifolium* Schrenk.	Perennial, xerophyte, Dzungarian - East Tien Shan	food, ornamental
Class: *Dicotyledoneae*			
8.	Family: *Urticaceae* Juss.		
8.1	*Urtica cannabina* L.	Perennial, mesophyte, mountain Siberian – Tien Shan	medicinal
9.	Family: *Polygonaceae* Lindl.		
9.1	*Polygonum acetosum* M.B.	Annual, xeromesophyte, Iranian-Turanian	weed
9.2	*Atraphaxis virgata (Rgl) Krassn.*	Shrub, xerophyte, Dzungarian -Pamiro-Alai	honey, medicinal
10.	Family: *Chenopodiaceae* Vent.		
10.1	Eurotia ceratoides (L.) C. A. Mey.	Semi-shrub, xerophyte, Palaearctic	feed
10.2	*Kochia prostrata* (L.) Schrad.	Semi-shrub, xerophyte, Palaearctic	feed
10.3	*Chenopodium foliosum* (Moerch) Asehers.	Annual, halophyte, Palaearctic	food, dye
11.	Family: *Papaveraceae* Juss.		
11.1	*Papaver pavoninum* Shrenk.	Annual, xerophyte, Iranian-Turanian	toxic
12.	Family: *Brassicaceae* Burnett.		

12.1	*Camelina glabrata* (DC.) Fritsch.	Perennial, mesoxerophyte, Holarctic	weed
12.2	*Erysimum cheiranthoides* L.	Annual, mesophyte, Palaearctic	weed
12.3	*E. diffusum Ehr*h.	Annual, mesophyte, Palaearctic	medicinal
12.4	*Berteroa incana (L.) DC.*	Biennial, xerophyte, Palaearctic	weed
12.5	*Alyssum campestre L.*	Annual, xerophyte, Palaearctic	weed
12.6	*Sisymbrium altissimum* L.	Annual, xerophyte, Holarctic	medicinal, feed
12.7	*Thlaspi arvense* L.	Annual, xerophyte, Holarctic	toxic, weed
13.	Family: *Crassulaceae* DC.		
13.1	*Sedum hybridum* L.	Perennial, mesophyte, mountain Siberian-Tien Shan	medicinal, ornamental
14.	Family: *Rosaceae* Juss.		
14.1	*Potentilla orientalis* Juz.	Perennial, mesophyte, mountain Central Asian - Iranian	weed
14.2	*Potentilla dealbata* Bunge	Perennial, xerophyte, mountain Siberian - mountain Central Asian	tanning, medicinal, weed
14.3	*Spiraea hypericifolia* L.	Shrub, xeromesophyte, mountain Siberian-Iranian	ornamental
14.5	*Rosa iliensis* Chrshan.	Shrub, mesophyte, Turanian	endemic, vitamin, ornamental
14.6	*Rosa Beggeriana* Schrenk	Shrub, mesophyte, Central Asian	vitamin, ornamental
14.7	*Rosa potentilliflora* Chrshan. et M. Pop	Shrub, mesophyte, Palaearctic	endemic, vitamin, ornamental
14.8	*Cerasus tianshanica* Pojark.	Shrub, mesophyte, Holarctic	Food, honey, ornamental
15.	Family: *Fabaceae* Lindl.		
15.1	*Glycyrrhiza uralensis* Fisch.	Perennial, xerophyte, mountain Siberian - mountain Central Asian	food, medicinal, technical, erosion-resistant
15.2	*Caragana kirghisorum* Pojark.	Shrub, mesoxerophyte, Dzungarian - Eastern Tien Shan	ornamental, erosion-resistant
16.	Family: *Lamiaceae* Lindl.		
16.1	*Mentha asiatica* Boriss.	Perennial, mesophyte, Palaearctic	oil, honey
16.2	*Mentha arvensis* L.	Perennial, mesophyte, Palaearctic	oil, weed, honey
16.3	*Leonurus turkestanicus* V. Krecz. & Kuprian.	Perennial, xeromesophyte, Junggar - Pamir-Alai	honey
16.4	*Thymus marschallianus* Willd.	Semi-shrub, xerophyte, Pannion – Kazakhstan	honey, oil
16.5	*Marrubium vulgare* L.	Perennial, mesophyte, Palaearctic	medicinal, honey
16.6	*Ziziphora bungeana* Juz.	Perennial, mesoxerophyte, Altai - mountain Central Asian	medicinal, oil, honey
16.7	*Salvia deserta* Schang.	Perennial, mesoxerophyte, Pannion – Kazakhstan	honey, weed
17.	Family: *Geraniaceae* L.		
17.1	*Geranium pusillum* L.	Annual, mesophyte, Tien Shan	weed
18.	Family: *Apiaceae* Lindl.		
18.1	*Scaligeria setacea* (Schrenk) Korov.	Perennial, xerophyte, Altai-mountain-Central Asian	honey
19.	Family: *Rubiaceae* Juss.		
19.1	*Galium tricorne Stokes*.	annual, mesoxerophyte, Dzungarian - iranian	weed
20.	Family: *Caprifoliaceae* Juss.		
20.1	*Lonicera altmannii* - Regel & Schmalh.	Shrub, mesophyte, Dzungarian - East Tian Shan	decorative, oil
21.	Family: *Asteraceae* Dumort.		
21.1	*Cirsium vulgare* (Savi.) Ten.	Biennial, mesophyte, Palaearctic	weed
21.2	*Achillea setacea* Waldst. & Kit.	Perennial, mesophyte, Palaearctic	weed
21.3	*Achillea asiatica* Serg.	Perennial, mesophyte, Mountain Siberian - Tien Shan	weed
21.4	*Centaurea squarrosa* Willd.	Biennial, xerophyte, Dzungarian - Iranian	weed
21.5	*Onopordon acanthium* L.	Biennial, xerophyte, Holarctic	weed

21.6	*Artemisia sublessingiana* Krasch. ex Poljak.	Perennial, xerophyte, Altai – Central Kazakhstan – Tien Shan	feed
21.7	*Acroptilon repens* (L.) DC.	Perennial, mesophyte, Mongolian – Turano - Iranian	toxic, weed

Against the summer background, 59 species of higher plants, belonging to two sections of seed plants, were collected and identified here. The gymnosperm section (*Gymnospermatophyta*) was represented by a single species, *Ephedra equisetina* Bge. The section of angiosperms (Angiospermatophyta) is represented by two classes: Class 1, monocotyledonous (Monocotyledoneae), and Class 2, dicotyledonous (*Dicotyledoneae*). From the class of monocotyledonous plants, we collected and identified 16 plant species belonging to 16 genera. The class of dicotyledonous plants was represented by 42 species belonging to 35 genera and 14 families. The most common families are Poaceae with 11 species (19.64% of the flora of the populations), followed by Brassicaceae with 7 species (12.5%), Asteraceae with 7 species (12.5%), and Lamiaceae with 7 species (12.5%). These four leading families account for 32 species, or 57.13%, of the flora of the population. The remaining families are represented by three, two, or one species, making up 27 species, or 44.76%, of the flora of the population. According to the Raunker classification, hemicryptophytes (HC) predominate with 30 species (50.84% of the flora of the population). These are perennial herbaceous plants, with renewal buds located on the soil surface, while the aboveground part dies off in winter. The second most common life form is therophytes (T), with 17 species (28.81%). These are annual or biennial plants that survive only as seeds during winter. Phanerophytes (Ph) occupy the third place with 9 species (15.25% of the flora of the population). These are trees and shrubs with renewal buds located high above the soil surface. Chameophytes (Ch) occupy the fourth position with 3 species (5.08%). These are semi-shrubs, with renewal buds located close to the soil surface. Of the ecological types of plants, xerophytes dominate with 21 species (35.59% of the flora of the populations), followed by mesophytes with 24 species (40.67%). Mesoxerophytes come third with 7 species (11.86%), and xeromozophytes are fourth with 5 species (8.47%). Hydrophytes are represented by one species (*Phragmites australis* Trin.), and halophytes are also represented by one species (*Chenopodium foliosum* (Moench) Aschers.). This distribution of ecological types is expected for the low-mountain "Syugaty" massif, which has two vertical belts: the lower desert and the upper steppe. The plant community with *Rosa potentilliflora* occupies the well-lit southern and southeastern slopes of the steppe belt of this low-mountain massif, which explains the predominance of xerophytic species.

According to N.V. Pavlov's classification, 14 groups of economically useful plant species are found in the flora of plant communities with *Rosa potentilliflora*. The most common group is anti-erosion plants. All plant species found in these communities contribute to substrate stabilization. Rhizomatous shrubs like *Rosa iliensis*, *Rosa beggeriana*, *Rosa potentilliflora*, and *Caragana kizghisarum* play a special role in this regard. Their underground shoots spread horizontally at shallow depths, and new buds form annually. Some buds grow upward, forming new shoots, while others grow downward, producing adventitious roots. Over time, these shrubs form impenetrable thickets and effectively stabilize the substrate. Taproot shrubs such as *Spiraea hypericifolia*, *Atraphaxis virgata*, *Ephedra equisetina*, and herbaceous perennials also play a vital role in substrate fixation. Even annuals, ephemeras, and ephemeroids protect the soil surface from wind erosion during the spring season. Thus, plants in both plain and mountainous conditions effectively stabilize the substrate, preventing water and wind erosion. They also mitigate flood effects and prevent landslides, which are common in mountainous areas.

The second-largest group consists of weeds, with 15 species (25.42% of the flora). The third group includes forage plants, with 13 species (22.03%). It's worth noting that many weed species are palatable to cattle, which may increase the number of forage plants. The fourth group consists of medicinal plants, with 7 species (11.86%). The fifth group includes ornamental plants, with 6 species (10.16%), followed by honey-bearing plants with 5 species (8.47%). The remaining groups include food plants (4 species, 6.77%), and poisonous and vitamin-bearing plants (3 species, 5.08%). The remaining useful plant groups, such as essential oil and wattle plants, are represented by two species each, while tanning, technical, paper, and brush plants are each represented by one species. Many species have multiple uses. For example, *Cerasus tianschanica* is a food, honey-bearing, ornamental, and substrate-stabilizing plant. *Rosa beggeriana*, *Rosa iliensis*, and *Rosa potentilliflora* are vitamin-bearing, ornamental, and anti-erosion plants. *Ziziphora bungeana* is an essential oil, medicinal, and honey-bearing plant. *Lasiagrostis splendens* is a forage, netting, wicker, paper, and anti-erosion plant. *Phragmites australis* is both a forage and technical plant.

Floral analysis of the region reveals that the flora of plant communities with *Rosa potentilliflora* shows a conglomerate (a mixture without a system) of species from various geographical elements. This is not accidental, as the low-mountain "Syugaty" range is located at the eastern tip of the Zailiysky Alatau, at the heart of Central Asia and within the Tien Shan mountain range. The Tien Shan system, the largest in Asia, facilitates the migration of plant species from the north and east to the south (e.g., Sayan, Altai, and Tarbagatai), and from the south to the north and east (e.g., Pamir-Altai, Iranian, and Turanian species). Therefore, this mixed flora of the "Syugaty" massif is a natural occurrence. Geographical analysis shows that the Palaearctic (16 species or 27.11%) and Holarctic (6 species or 10.16%) elements dominate, followed by species from the Mountain Siberian – Iranian, Mountain Central Asian – Mediterranean, and other combinations of regional elements. This conglomerate of species is indicative of the flora's geographic relationship with other floristic regions and reflects the biodiversity of the low-mountain massif.

This study is limited by several factors: the clonal reproductive nature of the species, the small number of sampled cenopopulations, and the lack of multi-year data. Future research should include molecular genetic analysis to assess intra-population diversity and resilience, as well as long-term ecological monitoring to track the effects of climatic and anthropogenic stressors on population dynamics.

Conclusion

Thus, the study of the narrowly endemic plant species *Rosa potentilliflora* in the flora of Kazakhstan at the population level has allowed us to scientifically assess the current state of these populations and develop conservation measures for them. In general, there is no direct threat to the *Rosa potentilliflora* population in the low-mountain massif "Syugaty." The plant blooms and fruits abundantly every year. As is known, all species of wild roses, including *Rosa potentilliflora*, reproduce both by seeds and vegetatively, via rhizomes. This allows for stable growth and successful natural regeneration of the *Rosa potentilliflora* population.

The only concerns are fires and uncontrolled grazing. If a fire occurs, it could instantly destroy the *Rosa potentilliflora* population, as it occupies a relatively small area. Grazing can also, to some extent, damage the regeneration of *Rosa potentilliflora* through seeds. However, this is not highly dangerous for *Rosa potentilliflora*. First, it is a thorny shrub, so it is not a food source for cattle and horses, and sheep and goats are also reluctant to graze on such thorny shrubs. Second, *Rosa potentilliflora* is a rhizomatous plant, and besides seed propagation, it actively regenerates through rhizomes, allowing for the natural renewal of this unique plant.

Nevertheless, considering that *Rosa potentilliflora* is a rare, narrowly endemic plant in the flora of Kazakhstan with a limited distribution range, we recommend introducing it to botanical gardens in Kazakhstan. This would, first, allow the conservation of this unique, rare, and narrowly endemic plant of Kazakhstan's flora. Second, its introduction can be used for landscaping parks, squares, and city streets. Third, introduced specimens of this unique plant can be used as a parent stock for hybridization with cultivated rose varieties, with the aim of developing new Kazakhstan rose cultivars. Fourth, *Rosa potentilliflora* is not only decorative but also a valuable vitamin-bearing plant. If there is demand and financial support from the Ministry of Health, an artificial plantation of this unique species of rosehip can be established, supplying the vitamin industry in Kazakhstan with natural and inexpensive raw materials.

As for the conservation of the natural population of this unique plant, we recommend establishing a state nature reserve in the low-mountain massif "Syugaty," where *Rosa potentilliflora* is found. This responsibility could be entrusted to the forestry department of the Yenbekshikazakh district of the Almaty region or the management of the Charyn National Park, which is located close to the "Syugaty" massif. They should regularly monitor the condition of the population of this unique plant. Additionally, grazing should be restricted in areas of the "Syugaty" mountains where *Rosa potentilliflora* grows, and fires should be prevented in those areas.

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Author Contributions

Chinargul Aldassugurova: The author has conducted scientific research, collected herbarium materials of *Rosa potentilliflora* plants, identified plant communities and determined the floristic composition of the studied rare endemic species. The author has analyzed the species composition of habitats and their ecological types. Using geobotanical methods, the author has assessed the current state of the rare endemic species *Rosa potentilliflora.* The author wrote the article, interpreted data and prepared the manuscript.

Abibulla Ametov: The author conducted geobotanical studies of the rare endemic plant Rosa *potentilliflora*, determined the floristic composition of the habitat. He collected herbarium samples to determine the morphological features of the plants, identified plant species and analyzed the species composition using identification guides. The author compiled a complete list of plant species found in the phytocenotic community, determined the species composition and percentage of diversity. The author designed the study and prepared the manuscript.

Akmaral Nurmahanova: The author has mastered methods for determining the composition of phytocenoses of *Rosa potentilliflora* habitats, conducted geobotanical analyses, constructed transects, and carried out work to assess the proportion of the distribution layer in the vegetation cover. The author developed the concept and design of the study.

Aigul Akhmetova: The author determined the floristic composition and species diversity of the *Rosa potentilliflora* using herbarium methods and identification guides. A comparative analysis of floristic and phytocenological dominants, subdominants and edificators was conducted. The author designed the study and statistical analysis, developed a research plan and organized the research.

The first draft of the manuscript was written by Chinargul Aldassugurova and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that other authors have read and approved the manuscript and no ethical issues involved.

Conflict of Interest

The authors declare that they have no conflicts of interest.

References

Abdullina, S. A. (1999). *List of vascular plants of Kazakhstan* (p. 187). Almaty.

Akhtaeva, N., Boribay, E., Nurmakhanova, A., Tynybekov, B., & Moldagazyyeva, Zh. (2022). Adaptive characteristics of plants in the conditions of technogenic pollution. *Journal of Water and Land Development, 55*(X–XII), 251–258.

Amirov, B., Seytmenbetova, A., Kulymbet, K., & Tanirbergenov, S. (2023). Modelling of fertilization on the photosynthetic and yield indicators of melon (*Cucumis melo* L.) under the saline soils of southern Kazakhstan. *Research on Crops, 24*(2), 307–315. https://doi.org/10.31830/2348-7542.2023.ROC-945

Atabayeva, S., Rakhymgozhina, A., Nurmahanova, A., Kenzhebayeva, S., Usenbekov, B., Alybayeva, R., Asrandina, S., Tynybekov, B., & Amirova, A. (2022). Rice plants (*Oryza sativa* L.) under Cd stress in Fe deficiency conditions. *BioMed Research International, 2022*(1), Article 7425085.

Balkybek, Ye., Tynybekov, B., Kulymbet, K., Kurmanbay, U., Umirbayeva, Z., Nurakyn, Z., Myltykbayeva, A., Ydyrys, A., & Toktar, M. (2025). Study of soil cover of *Veronica spuria* L. populations in Ile Alatau mountains, Kazakhstan. *EQA, 66*, 99–106. https://doi.org/10.6092/issn.2281-4485/20806

Baumann, L. (2018). How to use oral and topical cosmeceuticals to prevent and treat skin aging. *Facial Plastic Surgery Clinics, 26*(4), 407–413.

Cherepanov, S. K. (1995). *Vascular plants of Russia and neighboring countries (within the former USSR)* (p. 992). St. Petersburg.

Chu, C. C., & Nyam, K. L. (2021). Application of seed oils and its bioactive compounds in sunscreen formulations. *Journal of the American Oil Chemists' Society, 98*(7), 713–726.

Dąbrowska, M., Maciejczyk, E., & Kalemba, D. (2019). Rose hip seed oil: Methods of extraction and chemical composition. *European Journal of Lipid Science and Technology, 121*(8), 1800440.

Dorni, A. I. C. (2017). Novel cosmeceuticals from plants—An industry guided review. *Journal of Applied Research on Medicinal and Aromatic Plants, 7*, 1–26.

Fascella, G., D'Angiolillo, F., Mammano, M. M., Amenta, M., Romeo, F. V., Rapisarda, P., & Ballistreri, G. (2019). Bioactive compounds and antioxidant activity of four rose hip species from spontaneous Sicilian flora. *Food Chemistry, 289*, 56–64.

Flora of Kazakhstan: Edited by N. V. Pavlov. (1956–1966). *Flora of Kazakhstan* (Vols. 1–10). Publishing House of the Academy of Sciences of the Kazakh SSR.

Friesen, N., Vesselova, P., Osmonaly, B., Sitpayeva, G., Luferov, A., & Shmakov, A. (2021). *Allium toksanbaicum* (Amaryllidaceae), a new species from Southeast Kazakhstan. *Phytotaxa, 494*(3), 251–267. https://doi.org/10.11646/phytotaxa.494.3.1

Jiménez, S., Jiménez-Moreno, N., Luquin, A. A., Laguna, M., Rodríguez-Yoldi, M. J., & Ancín-Azpilicueta, C. (2017). Chemical composition of rosehips from different *Rosa* species: An alternative source of antioxidants for the food industry. *Food Additives & Contaminants: Part A, 34*(7), 1121–1130.

Kayath, H., Dhawan, S., & Nanda, S. (2019). In-vitro estimation of photo-protective potential of rosehip seed oil and QbD-based development of a nanoformulation. *Current Nanomedicine, 9*(3), 216–231.

Kiralan, M., & Yildirim, G. (2019). Rosehip (*Rosa canina* L.) oil. In M. Ramadan (Ed.), *Fruit oils: Chemistry and functionality*. Springer. https://doi.org/10.1007/978-3-030-12473-1_43

Kulaitienė, J., Medveckienė, B., Levickienė, D., Vaitkevičienė, N., Makarevičienė, V., & Jarienė, E. (2020). Changes in fatty acids content in organic rosehip (*Rosa* spp.) seeds during ripening. *Plants, 9*(12), 1793.

Kulymbet, K., Mukhitdinov, N., Kubentayev, S., Tynybayeva, K., Tastanbekova, A., Kurmanbayeva, M., Gafforov, Y., Kaparbay, R., & Zhumagul, M. (2023). The current state of the cenopopulations of *Adonis tianschanica* in Southeast Kazakhstan. *Biodiversitas, 24*(8), 4359–4372. https://doi.org/10.13057/biodiv/d240817

Neshataev, Yu. N. (1987). *Methods of analysis of geobotanical materials* (p. 189). Leningrad University Press.

Nurmahanova, A., Ibisheva, N., Kurbatova, N., Atabayeva, S., Seilkhan, A., Tynybekov, B., Abidkulova, K., Childibaeva, A., Akhmetova, A., & Sadyrova, G. (2023). Comparative anatomical and morphological study of three populations of *Salvia aethiopis* L. *Journal of Ecological Engineering, 24*(9), 27–38.

Nurmahanova, A., Akhmetova, A., Atabayeva, S., Tynybekov, B., Childibaeva, A., Sadyrova, G., Kyrbassova, E., & Imanova, E. (2024). Study of morphogenesis and anatomical structure of *Arctium tomentosum* Mill. *Journal of Ecological Engineering, 25*(8), 325–335.

Nurmahanova, A., Akhmetova, A., Ussenbekova, A., Atabayeva, S., Alipova, R., Kartbayeva, E., & Mukhitdin, M. (2024). Comparative anatomical features of populations of *Cichorium intybus* L. *Research on Crops, 25*(4), 1–13.

Osmonali, B. B., Vesselova, P. V., Kudabayeva, G. M., Duisenbayev, S., Taukebayev, O., Zulpykharov, K., Ussen, S., & Abdiildanov, D. Sh. (2024). Salt resistance of species of the Chenopodiaceae family in the Syrdarya River Valley. *Biodiversitas, 25*, 4162–4170. https://doi.org/10.13057/biodiv/d251115

Özek, G., Chidibayeva, A., Ametov, A., Nurmahanova, A., & Özek, T. (2022). Chemical composition of flower volatiles and seeds fatty acids of *Rosa iliensis* Chrshan. *Records of Natural Products, 16*(3), 225–235.

Paunović, D., Kalušević, A., Petrovic, T. S., & Urosevic, T. (2019). Assessment of chemical and antioxidant properties of fresh and dried rosehip. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 47*(1), 108–113.

Prokopov, A., & Gazitaeva, Z. (2018). The modern concept of photoprotection and new generation sunscreens. *Les Nouvelles Esthétiques, 4*, 14–15.

Rabotnov, T. A. (1946). The experience of age determination in herbaceous plants. *Botany Journal, 31*(5), 42–48.

Radice, M., Manfredini, S., Ziosi, P., Dissette, V., Buso, P., Fallacara, A., & Vertuani, S. (2016). Herbal extracts, lichens and biomolecules as natural photo-protection alternatives to synthetic UV filters. *Fitoterapia, 114*, 144–162.

Semenova, G. P. (2001). Program and methodology for studying rare and endangered species of Siberian flora. *Bulletin of Ecology, Forestry and Landscape Studies, 2*, 27–36.

Skvartsov, A. K. (1977). *Gerbarij: Posobie po metodike i tekhnike* (p. 199). Nauka.

Tabaszewska, M., & Najgebauer-Lejko, D. (2020). Antioxidant properties of rose hip tinctures. *NFS Journal, 21*, 50–56.

The illustrated determinant of plants of Kazakhstan. (1969–1972). Vols. 1–2. Alma-Ata: Science of the Kazakh SSR.

The Plant List. (2025). http://www.theplantlist.org/

Tumbas, V. T., Canadanović-Brunet, J. M., Četojević-Simin, D. D., Ćetković, G. S., Dilas, S. M., & Gille, L. (2011). Effect of rosehip phytochemicals on stable free radicals and human cancer cells. *Journal of the Science of Food and Agriculture, 92*(6), 1273–1281.

Tynybekov, B., Imanaliyeva, M., Kuatbayev, A., Satybaldiyeva, G., Boribay, E., Kulymbet, K., Umirbayeva, Z., Mamytova, N., Bekbossyn, N., Kurmanbay, U., Sadyrova, G., Toktar, M., Nazarbekova, S., Abdullayeva, B., & Nurmahanova, A. (2024). Adaptation features of *Gentiana tianschanica* Rupr. *ES Energy & Environment, 26*, 1–26. https://doi.org/10.30919/esee1361

Voskanyan, O. S. (2015). *The properties of liposomes and their use in cosmetology* (p. 184). Pishchepromizdat.

WFO Plant List. (2024). https://wfoplantlist.org/

Ydyrys, A., Mukhitdinov, N., Ametov, A., Tynybekov, B., Akhmetova, A., & Abidkulova, K. (2013). States of coenpopulations of *Limonium michelsonii* and their protection. *World Applied Sciences Journal, 26*, 934–940. https://doi.org/10.5829/idosi.wasj.2013.26.07.13525

Ydyrys, A., Abdolla, N., Seilkhan, A., Masim-Zhan, M., & Karasholakova, L. (2022). Importance of geobotanical study in agriculture. *E3S Web of Conferences, 222*, 04003. https://doi.org/10.1051/e3sconf/202022204003

Zlobin, Yu. A., Sklyar, V. G., & Klimenko, A. A. (2013). *Population of rare plant species: Theoretical foundations and methods of study* (p. 439). University Book.