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Diversity of the genus *Rosa* L. in the conditions of the Dzungarian Alatau mountains

The article presents and describes the plants of the genus *Rosa* L. growing on the territory of the Dzungarian Alatau. As a result of the study of literature sources, it was found that out of 57 species of the *Rosaceae* family, growing in the territory of the CIS countries, there are 10 species of the genus *Rosa* L. (*R. beggeriana* Schrenk, *R. canina* L., *R. platyacantha* Schrenk, *R. laxa* Retz., *R. spinosissima* L., *R. alberti* Regel, *R. schrenkiana* Crep., *R. acicularis* Lindl., *R. majalis* Herrm, *R. nanothamnus* Bouleng.). The state of the vegetation cover of the Dzungarian Alatau for 2015, 2017 and 2020 was also studied using the program. The gradual degradation of the plant community of this mountain system is determined.

Keywords: genus *Rosa* L., diversity, medicinal plant, rosehip, Dzungarian Alatau.

Introduction

Rosehip is considered one of the plants with the best and most effective medicinal properties. This is due to its nature, because all parts of this plant, as well as the roots, are considered useful. Among the flowering plants the genus *Rosa* L., which belongs to the *Rosaceae* family, has a great variety of species. Plants of the genus *Rosa* L. are an important group used for medicinal and other economic purposes. The genus *Rosa* L. has about 200 species and 18 000 subspecies. The exact number of species is unknown, since there is no single criterion in the taxonomy of this genus by which it would be possible to determine, which group of plants is autonomous and which is not. Despite the species diversity, modern varieties are mainly considered interspecific hybrids descended from 10 species of wild rose (*R. canina, R. chinensis, H. foetida, R. gallica, R. gigantea, R. moschata, R. multiflora, R. phoenicea and R. rugosa* and *R. wichuraina*).

There are also several species in Dzungarian Alatau. The botanical and geographical elements of the Dzungarian Alatau have their own regional features. On the territory of Dzungarian Alatau a huge number of medicinal plants grows, the useful properties of which determine their use in folk medicine [1–3]. The genus includes widely distributed plant species with high decorative properties intended for gardening as valuable berry crops. Wild rosehip plants are of particular importance due to the rich biochemical composition of the fruits, which can be important sources of biologically active compounds for food fortification.

Often used by the local population in medicine, the prickly rose (*Rosa acicularis* Lindl) is quite widespread in the territory of the Dzungarian Alatau. The distribution area of *Rosa acicularis* Lindl. is are the valleys of rivers and mountain rivers at different mountain heights. According to the research, the length and biomass of shrubs depend on external factors that dominate the plant habitat. Low-growing shrubs of the prickly rose reach a height of 30 to 60 cm and are more common in areas with dry soil. *Rosa acicularis* reaches a height of 3 m and even higher in areas with well-moistened soil and access to sufficient light, especially in the valleys of rivers and lakes. In addition, the fruiting of the shrub depends on the favorability of external factors.

Most often, rosehip fruits are used, as they contain a large amount of active substances. The major bioactive compounds within rosehips is ascorbic acid. The fruits of cultivated rosehip species are characterized by a high content of vitamins C and P, the content of vitamin C in the fruit pulp ranges from 684 to 4215 mg per 100 g, which is 10–15 times higher than that of black currant berries [4]. Vitamin C concentrates from it are more effective than synthetic ascorbic acid.

According to the researchers, the average content of vitamins in the fruit from the middle and northern regions is 5 times higher than of species from the southern regions (5029 mg/100 g and 1027 mg/100 g, respectively). One explanation is that for this variety-in the middle and northern regions grow species rich in vitamin C: *Rosa cinnamomea* L., *R. acicularis* L., etc., and in the southern — *R. canina* L., which are

significantly inferior to other species in this indicator. In addition, the fruits of *R. canina* L. taken from mountain regions are richer in vitamin C than samples taken off the coast [5–7]. The amount of ascorbic acid varies significantly between the types of rosehip and the different parts of the fruit (pulp and seeds). The content of ascorbic acid in fruits is never constant, the difference in vitamin C content in fruits may depend on the plant species, variety, environmental factors, and altitude [8, 9].

Due to the characteristic useful properties of rosehip, it is widely used in all types of industry.

Rosehip can be called one of the most popular natural components used in folk medicine independently and in combination with other components. In the XX century rosehip became a medicinal and technical raw material when the high multiculturalism of the plant was revealed [10].

In addition to its unique healing properties, rosehip itself is a very beautiful plant and many people successfully use it as a hedge in their garden. Also, the growing consumer demand for natural and delicious food has made rosehip plants a popular natural product in Europe. Rosehip in the food industry is mainly used as a liquid extract to enrich the compositions of new food products [11]. Fresh and dried rosehip fruits are used for the production of fortified juices, purees, multivitamin concentrates: extracts, syrups, dragees. Rosehip fruits are commonly used in some European countries, especially in Germany, Poland, Portugal, Finland, Romania and Sweden as components of traditional herbal teas, marmalades, jams, food additives, and nectar [12, 13]. In addition, the fruit is used as an ingredient in probiotic drinks and yogurts.

High cold resistance, unpretentiousness to the soil composition, the biochemical composition of berries makes rosehip plants a very attractive decorative and berry crop for enriching the natural flora and horticulture of Kazakhstan.

Despite the use of many medicinal plants of the Dzungarian Alatau, including wild rose hips, by local residents the number of works on the species composition and characteristics of rose hips populations is small. Rational use of wild rosehip as a wild rose, especially as vitamin rich and forest-reclamation plants, is possible only with scientific knowledge of their species composition, understanding of biological properties that differ in accordance with different natural conditions of their growth. Therefore, the study of the distribution of medicinal rosehip plants is of great importance for the conservation of biological diversity, as well as for the rational use of biological resources.

Materials and methods

Objects: plants of the genus *Rosa* L, growing on the territory of the Dzungarian Alatau.

The state of the natural mountain vegetation cover was assessed using the normalized relative vegetation cover index (NDVI) (normalized difference-vegetation cover). To study the total vegetation cover of the Dzungarian Alatau the product temporarily Smoothed NDVI, eMODIS NDVI C6 of the Early Warning and Environmental Monitoring Program (early Warning and environmental monitoring program) was used [14]. It is built according to the Aqua satellite, the MODIS radiometer, from 2002 to the present, has a 10-day accumulation period and a resolution of 250 m.

When determining and describing the diversity and distribution of medicinal and food plants of rosehip, to identify representatives of the genus Rosa keys books and publications that distinguish different plants, sometimes accompanied by images of morphological features of the identified plants were used [15–17].

The distribution of species on the territory of the Dzungarian Alatau is given in accordance with the zoning adopted in the work of V.P. Goloskokov (1984), and the general distribution is given in accordance with the areas adopted in the 9-volume edition of «Flora of Kazakhstan» (1956–1966) [16, 18].

Results and discussion

The product eMODIS NDVI C6, available on the website of the Early Warning and Environmental Monitoring Program, was used to monitor the state of natural mountain plants of the Dzungarian Alatau. As a characteristic of the state of vegetation cover, the NDVI (Normalized Difference Vegetation Index) of the Dzungarian Alatau was used for the period of July 11–20 of 2015, 2017 and 2020, which is quite stable. However, over the past three years they were characterized by fairly low values of NDVI, which indicates a negative dynamics of the plant's condition (Figure 1).

Due to the gradual degradation of the vegetation cover of the Dzungarian Alatau, the study of the distribution of economically valuable plants, including rosehip plants great valuable for the food and pharmaceutical industries, is of great relevance.

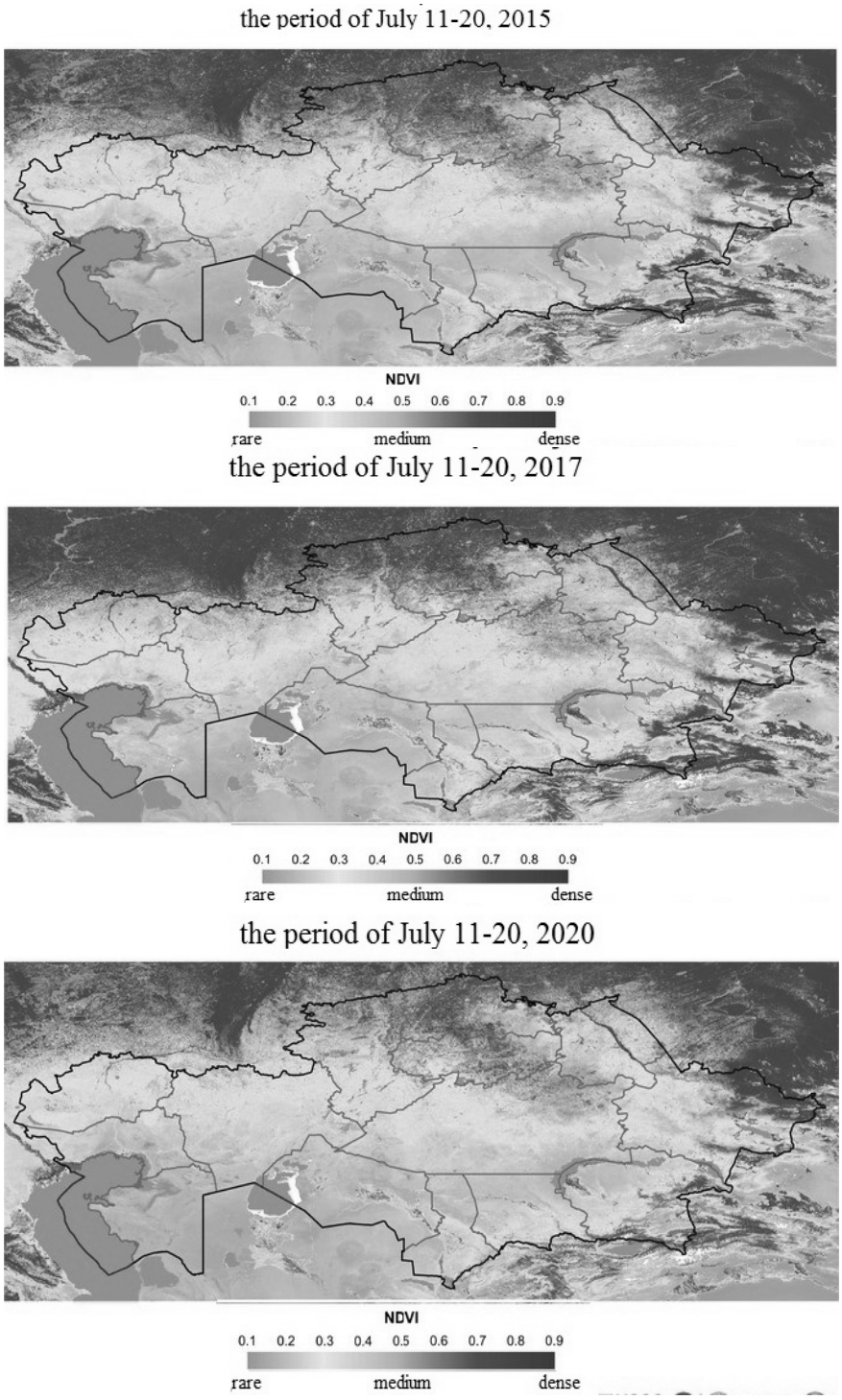

Figure 1. 2015–2020 development of mountainous areas of the Dzungarian Alatau.
Dynamics of values of the NDVI growing index for the period of July (11–20 July)

Dzungarian Alatau is a mountain system, the flora of which has a mixed, transitional character. The place of this region in the botanical and geographical zoning is unclear. Various authors believe that the Tien Shan, Altai, and Dzungarian Alatau can be floristically independent mountain systems. The transitional nature of the flora of the Dzungarian Alatau indicates the presence of one type of vegetation with the southern and northern mountain systems of Central Asia, in particular with the Tarbagatai and Altai [7]. The natural forage resources of the Dzungarian Alatau are very rich, but they are not fully used and are often used irrationally. Large areas of natural landscapes, including Semirechye, are quickly developed for agricultural and industrial use. In these places the vegetation cover is sharply disturbed, and some rare

species can completely disappear. Therefore, it is necessary to develop recommendations that not only stop some negative phenomena in natural landscapes but also restore their original state.

Over the years of research, sharp fluctuations in temperature, humidity, and other climatic phenomena have been observed. Over the years of research the supply of plants with moisture during the growing season can be considered satisfactory.

At least 1,200 species belonging to 57 genera of the *Rosaceae* family are found in nature of the CIS countries.

As a result of the study of literature sources, it was found that out of 57 species of the *Rosaceae* family growing in the territory of the CIS countries, about 10 species of the genus *Rosa* L are found in the flora of the Dzungarian Alatau (Table 1):

1. *Rosa beggeriana* Schrenk.
2. *Rosa canina* L.
3. *Rosa platyacantha* Schrenk.
4. *Rosa laxa* Retz
5. *Rosa spinosissima* L.
6. *Rosa alberti* Regel
7. *Rosa schrenkiana* Crep.
8. *Rosa acicularis* Lindl.
9. *Rosa majalis* Herrm
10. *Rosa nanothamnus* Bouleng.

Table 1

Species of the genus *Rosa* L found in the flora of the Dzungarian Alatau

Species	Biological features
1	2
Steppe belt	
Rosa platyacantha Schrenk	Shrub up to 3 (4) m. The same large, small or hard sickle-shaped curved spikes; leaves 2–12 cm long, oval or round; fruits 0.5–1.4 cm long.
Shrubs and steppe belt	
Rosa platyacantha Schrenk	Shrub up to 3 (4) m. The same large, small or hard sickle-shaped curved spikes; leaves 2–12 cm long, oval or round; fruits 0.5–1.4 cm long.
Rosa beggeriana Schrenk.	The height is 1–2.5 m. the Thorns are bent. Young leaves are purple. The flowers are white, 30 pieces on the branches. The fruit is red, rounded, and resembles a pea about 1 cm in diameter.
Rosa schrenkiana Crep.	Shrub 1–1. 5 m high, with branches with slightly curved bluish-green bark; spines thin, straight or slightly curved at the top, slightly flattened, oval; sepal very long, rises after flowering and remains when the fruit is ripe.
Rosa acicularis Lindley	Shrub up to 2 m, the bark of the trees is gray-brown; the stems and branches are straight, covered with rare slightly bent spines. Leaves up to 12 cm. hypanthia is elliptical, ovate or pear-shaped, rarely spherical, the sepal is directed upwards, the fruits are red
Shrubs belt	
Rosa laxa Retz	Shrub up to 2 m tall, bluish-green, with young thin and straight spines, on thick branches the spines are stiff, hook-shaped, low-curved or slightly upward; hypanthias are oval; fruits are rounded or elliptical, 12–18 mm in diameter
R. spinosissima L.	Bush height (30) 75 cm — 2 m. straight, thin, densely spiny branches; hypantia rounded or slightly longer in width; fruits 6 — 14 mm., round, black in a ripe state
Rosa nanothamnus Bouleng.	Shrub height 1.5–2.5 m, spreading, prickly, very short branches; thorns straight, thin; leaves 1–5.5 cm long; flowers from 1 to 3, pink or white; fruits rounded or oval, sometimes glabrous, red.
Rosa alberti Regel	Shrub up to 1.5 m high, with long arched-pointed branches; spines are thin, straight; hypanthium is oval, elliptical or bottle-shaped; long, often smooth, individual leaf of the flower bowl, slightly expanded at the top; fruits are oval or elliptical, up to 1.5 cm long.
Spruce forest	
Rosa beggeriana Schrenk	The height is 1–2.5 m; the thorns are bent; young leaves are purple; the flowers are white, 30 pieces on the branches; the fruit is red, rounded, and resembles a pea about 1 cm in diameter.

1	2
Valley of mountain rivers	
Rosa canina L.	Shrub 1.5–2 m high, with arched branches covered with green or red-brown bark; spines small, hard, sickle-shaped, curved; 5–7 leaves, large, usually elliptical, up to 5 cm long, pointed, glabrous; fruits rounded or elongated-oval, bright or red.
Rosa majalis Herrm.	Shrub is up to 2 m tall, with thin branches covered with brown-red bark, with a rare hard crescent-shaped crest; the leaves are complex, with a total length of up to 7 cm. The flowers are large, 3–7 cm in diameter; the sepal is whole, narrow, up to 3 cm long; the fruits are rounded, rarely oval or elliptical, orange or red in color

Among the species identified in the Dzungarian Alatau regions, *Rosa canina* L., *Rosa beggeriana* Schrenk., *R. acicularis* Lindl. and *Rosa majalis* Herrm species have an important economic significance and is distributed in the region, they are found in the wild in all administrative districts, among which people can choose promising productive forms with a complex of economically valuable features.

Conclusions

As a result of the study of literature sources, it was found that out of 57 species of the *Rosaceae* family growing in the territory of the CIS countries, about 10 species of the genus *Rosa* L. (*R. beggeriana*, *R. canina*, *R. platyacantha*, *R. laxa*, *R. spinosissima*, *R. alberti*, *R. schrenkiana*, *R. acicularis*, *Rosa nanothamnus*, *R. majalis*). According to the research results, the most suitable for breeding work are large-fruited, widespread and vitamin-rich plants. In Dzungarian Alatau the most common rosehip is considered to be the prickly rose.

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Жоңғар Алатауы жағдайындағы *Rosa* L. тұқымының әртүрлілігі

Мақалада Жоңғар Алатауы аумағында өсетін *Rosa L.* тектес өсімдіктер ұсынылған және сипатталған. Әдеби дереккөздерді зерттеу нәтижесінде ТМД елдерінде өсетін Rosaceae тұқымдасының 57 түрінің 10-ға жуық түрі *Rosa* L. (*R. beggeriana* Schrenk, *R. canina* L., *R. platyacantha* Schrenk, *R. laxa* Retz., *R. spinosissima* L., *R. alberti* Regel, *R. schrenkiana* Crep., *R. acicularis* Lindl., *R. majalis* Herrm, *R. nanothamnus* Bouleng) анықталған. Бағдарламаның көмегімен 2015, 2017 және 2020 жылдардағы Жоңғар Алатауының өсімдік жамылғысының жағдайы зерттелді. Бұл тау жүйесінің өсімдіктер қауымдастығының біртіндеп тозуы анықталды.

Кілт сөздер: *Rosa* L, алуан түрлілік, дәрілік өсімдік, итмұрын, Жоңғар Алатауы.

А.С. Канаев, Р.К. Карипбаева, А.Н. Турлыкожа

Разнообразие рода *Rosa* L. в условиях Джунгарского Алатау

В статье представлены и описаны растения рода *Rosa L.*, произрастающие на территории Джунгарского Алатау. В результате изучения литературных источников было установлено, что из 57 видов семейства розоцветных, произрастающих на территории стран СНГ, около 10 видов рода *Rosa L.* (*R. beggeriana* Schrenk, *R. canina* L., *R. platyacantha* Schrenk, *R. laxa* Retz., *R. spinosissima* L., *R. alberti* Regel, *R. schrenkiana* Crep., *R. acicularis* Lindl., *R. majalis* Herrm, *R. nanothamnus* Bouleng). С помощью программы также было изучено состояние растительного покрова Джунгарского Алатау за 2015, 2017 и 2020 гг. Определена постепенная деградация растительного сообщества этой горной системы.

Ключевые слова: *Rosa L.*, разнообразие, лекарственное растение, шиповник, Джунгарский Алатау, растительный покров.

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