

ABSTRACT

of the doctoral dissertation on the topic: «Study of the current state of the population of the rare, endemic plant *Rosa iliensis* Chrshan. in the floodplains of the Ili and Sharyn rivers» submitted for the degree of Doctor of Philosophy (PhD) in the specialty «6D061300 – Geobotany» of **CHILDIBAYEVA ASSEL ZHUMAGULOVNA**

The relevance of the dissertation work. Nowadays, protection and effective use of the plant gene pool, including the study of rare, highly endemic and relict species is the one of the urgent problems. Haphazard exploitation of plant resources leads to changes in individual plant communities and their components, as a result of which a number of species have even become close to extinction. Especially rare endemic plant species are particularly at risk. Therefore, one of the most pressing issues of preserving plant biological diversity is to identify the distribution of natural populations of rare, endemic species and study them in geobotanical and floristic aspects, to give a scientifically based assessment of their current state. To achieve this, along with the study of natural populations of rare, endemic species, there is a need to study their cenopopulations within the same population. Only the results of studies conducted in this way allow us to give a scientifically based assessment of the current state of populations of rare, endemic species, as well as ensuring their natural development and sustainable existence. According to some data, at the global level, 10% of important endemic species are on the verge of extinction in the foreseeable future. According to the well-known florist V.P.Goloskokov (1969), there are 760 endemic and 116 relict plant species with a limited distribution area in the flora of Kazakhstan. All of them require comprehensive study and protection. Many of these plants have particularly important beneficial properties. Among them there are medicinal, vitamin, technical, medicinal, food, honey-bearing and ornamental plant species. One of such rare, narrowly endemic species is *R.iliensis*. The places where natural populations of this species grow in the floodplains of the Ili and Sharyn rivers are under great environmental pressure. On the one side, due to the construction of the Kapchagai hydroelectric power station in the valley of the middle course of the Ili River, the main part of the populations of *R.iliensis* completely died out, being under an artificial lake. Only from the floodplain of the upper reaches of the river Or in the area of the bridge over the Almaty-Khorgos highway can *R.iliensis* be found. On the other side, in the valley of the middle course of the river Or lower from the Kapchagai hydroelectric power plant, the level of river and groundwater has sharply decreased. This is due to the regulation of the flow of the Ili River, in the absence of flooding of its floodplain over the past 45-50 years. As a result, the area occupied by *R.iliensis* populations has decreased, and in most places its ability to recover naturally has decreased. Therefore, our task was to find and mark on the map the distribution sites of *R.iliensis* populations, conduct a geobotanical and floristic study, give a scientifically based assessment of their current state and prepare specific recommendations related to the protection of this plant.

Our research covers all of above mentioned issues. Through the implementation of the work, we managed to find the three largest populations of *R.iliensis* in the floodplains of the Ili and Charyn rivers, characterized them geobotanically and analyzed the floral composition of the plant community. Also, we examined the morpho-anatomical features of the structure of the vegetative organs (leaf, stem, root) of this plant and, since it is a vitamin plant, phytochemical studies were carried out and biologically active substances were identified in its vegetative and generative organs.

The object of research are three natural populations of *R.iliensis*: the first population is the floodplain of the Sharyn River, the second population is the floodplain of the upper reaches of the Ili River, the third population is the floodplain of the middle reaches of the Ili River, lower from the Kapshagai hydroelectric power station.

The subject of the study is ecological-biological, geobotanical, morpho-anatomical and biochemical characteristics of biologically active substances of populations of a rare and endemic plant *R.iliensis*.

The aim of the work: To find and make a geobotanical description of the population of a rare and endemic plant *R.iliensis* in the floodplains of the Ili and Sharyn rivers, to analyze the floral composition and plant communities with the participation of this species and to give a scientifically

based assessment of the current state of their populations. To achieve this aim, the following tasks were implemented:

1. Find and make a geobotanical description of the population of a rare, endemic plant *R. iliensis* in the floodplains of the Ili and Sharyn rivers;
2. Identify cenopopulations within the population of *R. iliensis* and determine the age spectrum of this species;
3. Determine the floral composition of plant communities with *R. iliensis* and give them a comprehensive analysis;
4. Investigate morpho-anatomical features of vegetative organs (stem, root and leaf) of *R. iliensis*;
5. Identify biologically active substances in leaves, flowers, fruits and seeds of *R. iliensis*;
6. Introduce *R. iliensis* into the steppe zone of the Trans-Ili Alatau

Theoretical and methodological basis: For herbarization and determination of plants nine-volume «Flora of Kazakhstan», two-volume «Illustrated Determinant of plants of Kazakhstan», ten-volume «Determinant of plants of Central Asia», thirty-volume «Flora of the USSR» were used. Geobotanical research methods, types and classification of the cenopopulation were determined by the methods of T.A.Rabotnov, Yu.A.Zlobin, L.A.Zhivotovsky, the indicator of seed productivity by the method of T.A.Rabotnov, I.V.Vainagiy; the age composition of the cenopopulation by the method of T.A.Rabotnov, A.A.Uranov. Morpho-anatomical research methods were recorded by the Strasburger-Flemming method and generally accepted methods of morpho-anatomical research of M.N.Prozina, A.I.Permyakov and R.G.Barykina et al were used Biometric indicators were measured using an eyepiece-micrometer MOB-15. Images of anatomical sections were taken using a microscope MS-300 with a video camera CAM V400/ 1.3 m. Statistical processing of biometric indicators was carried out according to the methods of G.F.Lakin and N.L.Udolskaya, as well as using the Microsoft Office Excel 2007 program. Phytochemical research methods were used to analyze volatile substances obtained from flowers and seeds by MSD-SPME, GC-FID and GC/MS methods to obtain volatile substances. Ascorbic acid in fruits and leaves was determined by HPLC. The UPC 2 method was used to analyze alpha-tocopherol and beta-carotene in fruit pulp and seed extracts. The total content of phenols (TRS) in total extracts obtained from flowers, leaves, fruit pulp and seeds was determined by the Singleton method as the equivalent of gallic acid (GAE) using FCR (Folin-Chocalteu reagent). General extracts prepared from flowers, leaves, fruit pulp and seeds, their antioxidant activity, the absorption effect of DPPH free radical samples was determined using a modified Brand-Williams method. Simultaneous detection of several elements (Na, K, Ca, Pb, Ni, Cd, Fe, Cr, Cu, Ti and Al) was carried out using the ICP-OES system. Methods of studying the root system were carried out by the trench method by washing the roots with a jet of water from a hydropult. Methods for determining soil samples humus layer (humus) of the soil according to I.Tyurin, carbonate - carbon dioxide pycnometric CO₂, pH value according to GOST 26423-85 ionometric, easily hydrolyzable nitrogen according to Tyurin-Kononova, mobile phosphorus according to Machigin (GOST 26205-91), mobile potassium according to Protasov (GOST 26205-91), absorbed calcium and magnesium according to Arinushkina method in Grabarov's modification, absorbed sodium and potassium in Grabarov's modification according to the Karataev and Mametov methods, the granulometric composition with hygroscopic humidity was performed according to Kachinsky. Methods of introduction the conditions of seed selection for planting plants, as well as the method of determining their germination were carried out according to GOST 13056.6-97.

The author's personal contribution to obtaining a scientific result. The author of the work showed great responsibility and competence in selecting an object and developing a research concept, determining the purpose of the work, setting research tasks. She also managed to organize expedition trips to study *R. iliensis* in the field, independently planned experimental work carried out in the open ground and in the laboratory, collecting and processing the data obtained.

Scientific novelty and significance of the dissertation work. For the first time, three populations of a rare, narrowly endemic plant *R. iliensis* were found in the floodplains of the Ili and Sharyn rivers. Geobotanical characteristics are given to them and the analysis of the floral composition of plant communities with the participation of this species is carried out. The features of the morpho-

anatomical structure of the vegetative organs of *R.iliensis* (leaf, stem, root) are studied, their characteristics are given. Biologically active substances contained in flowers, leaves, fruits, seeds have been identified. In addition, soil sections were laid at the sites of all three populations of *R.iliensis*, morphological characteristics of genetic horizons were described, samples were taken from each horizon and chemical analysis was carried out. In particular, the humus content in the soil, the pH value of the medium and the humidity level were determined. The analysis of the mechanical and chemical composition of soils was also carried out. As a result of such a comprehensive study, a number of new, fresh data concerning the biological and ecological features of *R.iliensis* were obtained. These data allowed us to give a scientifically based assessment of the current state of the studied populations of *R.iliensis* and to develop specific recommendations for its protection.

Scientific and practical significance of the dissertation work. For the first time, three populations of a rare, narrowly endemic plant *R.iliensis* were found in the floodplains of the Ili and Sharyn rivers, based on the results of a comprehensive study of the populations, a scientific assessment of their current state was given. Seeds collected from three populations of *R.iliensis* in the floodplains of the Ili and Sharyn rivers were introduced in the conditions of the city of Talgar, located in the steppe zone of the Trans-Ili Alatau. In the conditions of Talgar, a good growth of seedlings was noted, as well as flowering and fruiting in the third year. Seeds collected from the artificial plantation of *R.iliensis*, in order to preserve the gene pool of the species, were transferred to the laboratory of «Protection of the gene pool and introduction of wild fruit plants named after A.D. Dzhangaliev» of the Republican state enterprise on the right of economic management «Institute of Botany and Phytointroduction» of the Committee of Forestry and Wildlife of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan. *R.iliensis* is an excellent ornamental and medicinal plant, so we recommend using its introduced forms in breeding works, as a queen bee for the purpose of breeding new Kazakhstani, decorative varieties of roses. The results of phytochemical studies of fruits, seeds, flowers and leaves of *R.iliensis* have shown that they contain a number of biologically active substances. These include vitamin "C" and "E", antioxidants, essential oils and others. These substances are in great demand in medicine. The content of vitamin "C" in the fruits of *R.iliensis* exceeds 12.5%, which is a high indicator. If there is financial and other support from the state, then we are ready to grow *R.iliensis* plantations and provide the pharmaceutical and vitamin industry of the Republic of Kazakhstan with the necessary cheap natural raw materials.

Provisions for to be defended: The endemic status of *R.iliensis* is directly related to the limited range of its distribution and ecological and cenotic features. Therefore, the populations of *R.iliensis* need a comprehensive study and on their basis to prepare a scientifically based assessment of the current state of the studied species. To solve this problem, the following tasks were formulated:

1. To carry out a search and identify the ecological and cenotic confinement of the *R.iliensis* population to certain sites;
2. To study the floral composition of communities with the participation of a narrowly endemic plant *R.iliensis*;
3. To study and identify the peculiarities of the variability of biometric indicators based on morpho-anatomical studies of vegetative (stem, leaf, root) and generative (flower, fruit, seeds) organs of *R.iliensis*;
4. Lay soil sections on the plots of all three populations of *R.iliensis*. Identify genetic horizons in them, describe them and take samples for chemical analysis of soils;
5. To introduce *R.iliensis* into the introduction in the conditions of the steppe belt of the Trans-Ili Alatau;
6. Conduct a phytochemical analysis of the leaves, flowers and fruits of *R.iliensis*.

The author's personal contribution to obtaining a scientific result. Based on the materials of the research work, 13 articles of the author have been published.

Approbation and approval of the results of the work. Based on the results of the research work:

The results of the dissertation research were reported at international scientific and practical conferences:

1. Чилдибаева А.Ж. Шарын өзенінің жайылмасында сирек кездесетін, эндемдік *Rosa iliensis* Chrshan. өсімдігіне сипаттама VI Халықаралық Фараби оқулары. Студенттер мен жас ғалымдардың «Фараби әлемі» халықаралық ғылыми конференция материалдары. Алматы: Қазақ университеті, Қазақстан. 2-12 сәуір, 2019 ж. 10-11 бб.

2. Чилдибаева А., Аметов А., Назарбекова С. Растительные сообщества с участием *Rosa iliensis* Chrshan. поймы реки Шарын. Научно-исследовательский центр «Знание» Сборник статей. LX Международная заочная конференция «Развитие науки в XXI веке» г. Харьков, 15 мая 2020 г. УДК 082 ББК 94.3 ISSN 5672 – 2605. С.23-28.

3. Чилдибаева А.Ж., Аметов А.А. Шарын өзенінің жайылмасында сирек кездесетін, эндемдік *Rosa iliensis* Chrshan. популяциясының өсімдіктер жабынының геоботаникалық сипаттамасы. С.Аманжолов атындағы Шығыс Қазақстан университеті «Ғылым мен білімді дамытудың өзекті мәселелері» «Уәлиев оқулары-2020» Халықаралық ғылыми-тәжірибелік онлайн-конференциясының материалдары. 26 қараша 2020 жыл. Өскемен - Усть-Каменогорск. 251-255 бб.

4. Чилдибаева А.Ж. Шарын өзенінің жайылмасында кездесетін өсімдіктер жабынына қысқаша шолу жасау. «Фараби әлемі» атты студенттер мен жас ғалымдардың халықаралық ғылыми конференция материалдары. Алматы. Қазақстан. 6-8 сәуір, 2021 ж. – 65-66 бб.

5. Чилдибаева А.Ж., Аметов А.А. Шарын өзенінің жайылмасында сирек кездесетін, тар эндемдік, дәрілік және техникалық *Rosa Iliensis* Chrshan кездесетін өсімдік жамылғысы және оның қазіргі жағдайын бағалау. Қазақстан Республикасы тәуелсіздігінің 30-жылдық және Х.Досмұхамедов атындағы Атырау университетінің б.ғ.д., профессор Сағындықова Софья Зұлхарнайқызының 65-жасқа толу мерейтойына арналған «Жаратылыстану ғылымдарының қазіргі заманғы келелі мәселелері және пәнаралық зерттеулер» атты халықаралық ғылыми-практикалық онлайн конференциясының материалдары. 23 сәуір, 2021 ж. 101-105 бб.

6. Чилдибаева А.Ж., Аметов А.А. Особенности развития корневой системы редкого, узкоэндемичного растения *Rosa iliensis* Chrshan. в поймы реки Или Алматинской области. Биология ғылымдарының докторы, профессор, ҚР ҰҒА-ның құрметті мүшесі, ҚазҰЖҒА академигі Мухитдинов Наштай Мухитдинұлының 80 жылдығына және «Қазақстан тәуелсіздігі: «Биоалуантүрлілікті сақтау аспектілері» Халықаралық ғылыми-практикалық конференциясының материалдары. Алматы, Қазақ университеті. 26 қараша 2021 ж. - 183-186 бб.

7. Чилдибаева А.Ж., Аметов А.А. Алматы облысының Шарын өзені жайылмасында сирек кездесетін, тар эндемдік *Rosa iliensis* Chrshan. өсімдігінің тамыр жүйесінің дамуының ерекшеліктері. Педагогика ғылымдарының докторы, профессор Шілдебаев Жұмәділ Бәйділдәұлының 75 жылдық мерейтойына арналған «Қазақстан тәуелсіздігінің 30 жылдығы: Орта және жоғары мектептерде биологиялық және экологиялық білім берудің өзекті мәселелері (инновация және тәжірибе)» атты халықаралық ғылыми-практикалық конференциясының материалдары. 20-21 желтоқсан 2021 ж. 416-419 бб.

Journals recommended by KKSON MES RK:

1. Аметов Абибулла, Чилдибаева Асел, Сулейменова Назгүл, Елепбай Гулайым. Қапшағай су электростанциясынан төменгі ағысы аңғарының флорасы мен өсімдіктер жабынының трансформациялануы ҚазҰУ Хабаршысы. Экология сериясы. №3 (56). 2018. 115-124 бб.

2. А.Ж. Чилдибаева, А.А. Аметов, Б.М. Тыныбеков. Іле өзенінің жайылмасындағы ареалы шектеулі эндемдік *Rosa iliensis* Chrshan. кездесетін кейбір өсімдіктер қауымдастықтарының сипаттамасы ҚазҰУ Хабаршысы. Биология сериясы. №1 (78). 2019. 58-73 бб.

3. А.Ж.Чилдибаева, А.А.Аметов Опыты интродукции редкого, находящегося под угрозой исчезновения, узкоэндемичного растения *Rosa iliensis* Chrshan. В условиях степного пояса Заилийского Алатау. Вестник КазНУ. Серия биологическая. №3 (84). 2020. 26-36 бб.

4. А.Ж. Чилдибаева, А.А. Аметов, Сербаева А.Д. Іле өзенінің жоғарғы ағысында сирек кездесетін, эндемдік *Rosa iliensis* Chrshan. өсімдігінің популяциясының өсімдіктер жабынының геоботаникалық сипаттамасы. ВЕСТНИК Карагандинского университета. Серия «Биология. Медицина. География». Казахстан, рекомендуемый ККСОН МОН РК № 1(101). 2021. 74-81 бб.

In journals included in the Scopus and Web of Science databases:

1. Gulmira Özek, Assel Childibayeva, Abybulla Ametov, Akmaral Nurmahanova, Temel Özek. Chemical composition of flower volatiles and seed fatty acids of *Rosa iliensis* Chrshan, an endemic species from Kazakhstan. Records of Natural Products Volume: 16 Year: 2022 Issue: 3 May-June 225-235 pp. <http://www.acgpubs.org/journal/records-of-natural-products>

2. Childibayeva A.Zh., Ametov A.A., Kurbatova N.V., Akhmetova A.B., Tynybekov B.M., Mukanova G.A. Structural characteristics of *Rosa Iliensis* Chrshan. under conditions of the floodplains of the rivers Ili and Sharyn. JEE Journal of Ecological Engineering 2022, 23(1), 296–304 ISSN 2299–8993, License CC-BY 4.0

Conclusion.

1. Using traditional and modern methods of geobotanical research, we characterized three populations of a rare, endangered, highly endemic plant of the flora of Kazakhstan, *R.iliensis*, found in the floodplains of the Ili and Sharyn rivers of the Almaty region. We paid attention to the percentage of soil surface coverage by plants, communities forming each population, tiers, dominant and subdominant plants and related species were distinguished. In all three populations, *R.iliensis* belongs to the number of related species and therefore does not play a decisive role in the formation of vegetation cover. In the floodplain of the Sharyn River, where there are dense shady forests of *Fraxinus sogdiana* Bge. *R.iliensis* grows only in open areas. Therefore, in this population, its vital condition in some places is in a satisfactory condition, and in others it is somewhat worse. This is due to the following reasons: firstly, for the distribution of *R.iliensis*, this is the maximum height above which this species does not occur at all. Secondly, in a shady dense forest of *Fraxinus sogdiana* Bge. there is not enough light for *R.iliensis*. Thirdly, the Sharyn River is mountainous with a strong current, so its floodplain is abundantly flooded in spring and in the summer months, as a result of which *R.iliensis* suffers from high humidity. The population of *R.iliensis* found in the upper reaches of the Ili river (the second population) is in satisfactory condition. The vital condition of the *R.iliensis* population found in the middle reaches of the river Or below the Kapshagai hydroelectric power station is somewhat better compared to the two aforementioned populations. The plant blooms and bears fruit annually. Firstly, the natural conditions of this place are most favorable for the *R.iliensis* plant. Secondly, as a result of the unfavorable ecological situation that has developed over the past 45-50 years in the floodplains of the middle course of the Ili River, below the Kapshagai hydroelectric power station, the main forest-forming tree species that create competition for *R.iliensis* for light have dried up and destroyed. Therefore, the population of *R.iliensis* is in somewhat better condition here. It is also noted that the *R.iliensis* plant begins to adapt to xerophilic conditions. This is clearly seen in the anatomical structure of the leaf and stem of *R.iliensis*.

2. In all 3 populations of *R.iliensis* found in the floodplains of the Ili and Sharyn rivers, we identified 3 cenopopulations, laid transects in them, determined the age spectrum of individuals of this species (seedlings, juvenile, virginal, immature, young generative, adult generative, old generative, sub-senile, senile) and gave a scientifically based assessment of the modern the state of populations. It is proved that in all 3 populations *R.iliensis* reproduces mainly vegetatively, by rhizomes. But we do not exclude the reproduction of *R.iliensis* by seeds.

3. The results of studies of the floral composition of plant communities in which *R.iliensis* occurs were as follows: 62 species of vascular plants belonging to 2 divisions, 3 classes, 25 families, 51 genera were registered in the floodplain of the Sharyn River (the first population); 136 species of vascular plants were registered in the floodplain of the upper Ili River (the second population), belonging to 3 divisions, 4 classes, 42 families, 110 genera. We found and registered 130 species of vascular plants belonging to 3 divisions, 4 classes, 39 families, 100 genera, lower from the Kapshagai hydroelectric power station in the middle reaches of the Ili River (the third population). In plant communities where populations of *R.iliensis* from plant life forms are found, the predominance of hemicryptophytes is clearly traced, of the ecological types of mesophytes, anti-erosion plants and weed species occupy the first place in economic importance, Holarctic and palearctic species predominate from botanical and geographical elements. For alluvial meadow soils of the floodplain of the river, this is a natural process.

4. The results of studies of the morpho-anatomical structure of the vegetative organs of *R.iliensis* have shown that this species is a true mesophyte. The leaf plate of *R.iliensis* especially from the floodplain of the Sharyn River (the first population) is thin, the color is transparent. In a dense shady forest consisting of *Fraxinus sogdiana* Bge. there is not enough light for *R.iliensis*. And the leaves collected in the upper reaches of the Ili River and in the lower Kapshagai hydroelectric power station, were somewhat thicker and the color was thicker. At the same time, the outer part of the epidermis is covered with a thin layer of cuticles and hairs. This is especially evident in the middle course of the river Or below the Kapshagai hydroelectric power station. There are no significant differences in the anatomical structure of the stem. Only due to the ecological state of their growing environment, there are minor differences in the biometric indicators of cells. Rocky cells – idioblasts are clearly visible in the core of the stem. The difference in the cross-section of the root taken from all three populations was not observed at all.

5. The results of phytochemical studies and analyses of the leaves, flowers, fruits and seeds of *R.iliensis* found in the floodplain of the Ili and Sharyn rivers showed that its leaves and flowers contain 51 different volatile substances. The main ones include benzaldehyde, citronellol and monoterpenes saturated with essential

oil. These substances are an integral part of cosmetics. At the same time, it was shown that a large amount of vitamins ("C" and "E"), provitamins, phenols, and antioxidants accumulate in fruits. From this point of view, there is reason to consider the *Rosa iliensis* plant a reliable source of natural antioxidant. The unsaturated part of fat in fruits and seeds contains large amounts (90%) of fatty acids ω 3, ω 6 and ω 9, which play a vital role necessary for human health, they can be safely recommended as functional food additives and ingredients in food additives. At the same time, the presence of vitamins ("C" and "E"), provitamins (α -tocopherol, β -carotene), phenolic compounds and minerals in fruits, seeds and leaves indicates their high importance as food additives and components of various cosmetic products, as well as in medicine. The main commercial value of rosehip species is its fruits and the content of essential oils (rose oil) in them.

6. The introduction of the *R. iliensis* plant in the conditions of the steppe high-altitude band of the Trans-Ili Alatau gave a positive result. Its individuals, grown both from seeds and cuttings, bloomed and bore fruit in the third year. This should be understood as a great success, because in natural conditions this process can last for decades, and sometimes longer. The introduction of the *R. iliensis* plant, firstly, is the most effective way to ensure its preservation. Secondly, introduced individuals of the *R. iliensis* plant can be used in breeding work as cultivated varieties of rosehip and in breeding new ornamental varieties of roses. Thirdly, by introducing the *R. iliensis* plant into the introduction, it is possible to grow its artificial plantation and provide the pharmaceutical and vitamin industry of Kazakhstan with cheap natural raw materials.

The structure and scope of the dissertation is determined by the purpose and logic of the research. The dissertation consists of an introduction, three sections, conclusions and conclusions, a list of references containing 315 titles. The volume of the work is 190 pages. There are 42 tables, 3 diagrams and 16 figures in the text of the dissertation.