

Original Research Paper

# Localization of Some Medicinal Plants in the Ile Delta on the Southern Macrosurface of the Zhetysu Alatau (Kazakhstan)

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**Abstract:** In the article, the floral composition of the vicinity of the Ile River on the southern macrosurface of Zhetysu Alatau is determined and a brief description of the endemic species is given. Through the examination and evaluation of expedition data, along with comprehensive research and literature analysis, the study successfully identified species that have experienced a reduction in their distribution range within the study area. Furthermore, the study was able to establish a comprehensive overview of the ecological characteristics and life forms exhibited by the flora in the examined region. An analysis of the indicators of the introduction of some medicinal species (phenological control indicators and seed quality) was conducted in the collection plot of medicinal plants in the main botanical garden and a brief conclusion was drawn based on the information of the introduction.

**Keywords:** Southern Macrosurface, Endemic, Ecological Types, Life Forms, Localization Indicators

## Introduction

Zhetysu Alatau is a complex of mountain ridges and intertidal depressions located between the Alakol and Ile rivers from north to south. The northern and southern macrosurfaces extending in the meridian direction and lying parallel to each other are divided along the valleys of the Koxsu and Borotola rivers (Gvozdetskii and Mikhailov, 1987; Ogar and Evstifeev, 1993).

According to botanical-geographical zoning, Zhetysu Alatau belongs to the Dzungar-Northern Shan Mountain Province. This province consists of branches of the mountainous province of Kungei-Teriskei-Ketpen-South Dzungar, characteristic of the Ile-North Dzungar belt type-North Dzungar and Kungei Teriskei-Ketpen belt type (Akzhygitova *et al.*, 2003).

Based on the scheme of Akzhygitova *et al.* (2003), the climate of the southern macrosurface of the Zhetysu Alatau is a dry region with a variable climate and sharp weather changes (Akzhygitova *et al.*, 2003). The flora of the region includes 8 endemic species (*Berberis iliensis* M., *Dendrostellera ammodendron* (Kar. Et Kir.) Botsch., *Astragalus amabilis* M. Pop., *A. sphaerophysa* Kar. et Kir., *Ferula iliensis* Frasn., *Eremostachys rotata* Schrenk ex Fisch. Et Mey., *Lonicera iliensis* Pojark, and

*Limonium michelsonii* Lincz.) and 12 sub-endemic species. They make up 3.38% of the total number of plant species (Nesterova and Inelova, 2012).

Despite the great ecological isolation of the river valley, the number of endemics is not large. Three relict species were identified in the pastures of the Ile Delta: *Fraxinus sogdiana* (only in pastures), *Populus diversifolia* and *Populus pruinosa* and six endemics (*Allium iliense*, *Rosa silverhjelmii*, *Iris palasii*, *Ferula iliensis*, *Polygonum iliensis*, *Berberis iliensis*). The Red Book of the Kazakh SSR includes 5 species with reduced habitats: *Fraxinus sogdiana*, *Populus diversifolia*, *Rosa silverhjelmii*, *Ferula iliensis*, *Berberis iliensis* (Gemedzhieva, 2016).

The modern Ile River valley starts from fishing point 6 and is divided into three main branches: East-Zhideli, center-Ile, and west-topar (Plisak, 1981). Today the valuable materials of Plisak (1981); Ogar *et al.* (1993) on the study of vegetation and soil of the Ile Delta and their dynamics are of great importance. Also, an analysis of the flora of the sandy area on the banks of the Ile River was carried out by Inelova (2009); Nesterova *et al.* (2018), and it is widely used in studies.

Botanical gardens play an important role in biodiversity conservation. They accumulate genetic resources by creating a collection of plants. Zhersindir is

located at an altitude of 880 m above sea level, on the slopes of Ile Alatau, in light brown, saline soil, Almaty city. It was carried out in the collection plot of medicinal plants of the main botanical garden. The climate of this place is characterized by immediate continental, temperature fluctuations during the day are quite high, annual precipitation is from 460-790 mm, and early spring maximum (up to 42%). The average daily temperature + 10°C is 164-182 days (Yerekeeva *et al.*, 2021).

The research expedition described in the article was conducted in 2019 in the sandy desert area of the Ile Delta on the southern macrosurface of the Zhetisu Alatau, in various shrubby, perennial herbaceous plant associations at an altitude of 380-430 m above sea level. And the research works on localization (introduction) in Almaty City. It was conducted in the experimental open field of the main botanical garden on the Alatau slopes at an altitude of 830 m above sea level. The objectives were determining and describing the life state of plants were carried out on the basis of the methods of scientists.

## Materials and Methods

The systematization of species is given according to the APG IV system (Beideman, 1960). The species names of the studied plants are taken from the open online atlas of lichens with plants of Russia and neighboring countries-the defining Planetarium, from the plant list and plants of the world online databases, and from the red book of the Republic of Kazakhstan (Geltman, 2019; Plantarium, 2019; Plants of the world online, 2019; List, 2013).

Control of plant growth and development was carried out according to the methodology of Beideman (1960) as well as "recommendations for the study of the ontogenesis of introduced plants in botanical gardens of the (USSR, 1975) were used. Phenological studies were conducted on the basis of "methodology of phenological monitoring in USSR (1975).

The determination of the yield of raw materials and seeds was carried out according to the "Research methodology during the introduction of medicinal plants" (Vainagii, 1974; Firsova, 1959). Introductory studies also used methods adopted in botanical gardens (Chernykh, 2004; The Red Book of Kazakhstan, 2014) with minor modifications depending on local conditions.

## Results

The climate of Zhetysu Alatau's southern macrosurface is arid and distinctly continental. The vegetation of the river valley creates a unique intrazonal natural environment, connecting the unique ecological situation with various natural processes of the river. According to this, the riverside flora, where the research

expedition was carried out, had various shrubs and perennial herbaceous plant associations.

The floral composition of the studied area consists of 24 species of 12 genera. Among the species, there was a mixture of herbaceous plants, semi-shrubs, and shrubs, among which there were 3 endemic species. *Berberis iliensis* is a protected plant of the III category in the red book of the Republic of Kazakhstan, it is a rare species whose growth area has rapidly decreased. Furthermore, the research provides an overview of the life forms and ecological types exhibited by the species. It reveals that there were five categories of shrubs, two categories of trees, twelve categories of perennials, two categories of semi-shrubs, as well as six categories of Xeromesophytes, two categories of mesohygrophytes, five categories of mesophytes and seven categories of Xerophytes (Table 1).

The main botanical garden in Almaty is conducting research on four types of species found within the study area, which are being studied in the medicinal plant collection plot. These species include *Glycyrrhiza glabra*, *Glycyrrhiza uralensis*, *Inula pallasii*, and *Inula sogdiana*.

*G. glabra*-weight 30-80 (150) sm perennial herbaceous plant.

It grows well in the steppe zone, in the desert, and in the desert, in the grove where the groundwater is close. It grows from seeds and rhizomes.

Roots and rhizomes are included in the publications of all domestic pharmacopeias and in the pharmacopeias of many countries of the world. Dry powder and extract are obtained from them. In official medicine, it is used as an expectorant, laxative, respiratory tract disease, and anti-cold medicine.

*G. ralisensis*-Perennial herbaceous plant with a height of 50-70 (100) cm. Roots and rhizomes are used in medicine. Your variety grows in meadows, steppes, and groves, on the banks of mountain rivers (Table 2).

Roots and rhizomes are included in the pharmacopeia of many countries. The use of oral licorice in medicine and veterinary medicine is the same as that of red licorice. In Tibetan, Chinese and Mongolian medicine, it is used alone or with other mixtures to treat lung and respiratory tract inflammation, asthma, pulmonary tuberculosis, whooping cough, ulcer diseases, kidney and gall bladder, anemia, diabetes, headache, etc., b. Heals diseases. It is mainly an endangered species (Nasonova, 1966).

*I.sogdiana*-it is a perennial plant reaching 20-40 cm in height, distinguished by a thick branched rhizome (up to 1-1.5 cm). Every year, their rhizomes grow and form a large pile (up to 70 cm wide). The leaf at the bottom of the vegetative and generative stem is ribbon-shaped. They bloom in the spring at the end of April-May, and the fruit (a large spiked trilobite) ripens in June-July (Nasonova, 1966).

**Table 1:** Floral composition of the studied area

No	Kindred	Type	Life form	Relative to moisture
1.	<i>Tamaricaceae</i>	<i>Tamarix ramosissima</i> ledeb	A tree	Xeromesophyte
2.	<i>Fabaceae</i>	<i>Vexibia alopecuroides</i> (L.) yakovl	Perennial	Xeromesophyte
		<i>Oxytropis puberula</i> Boriss	Grass on the ground	?
		<i>Glycyrrhiza uralensis</i> fisch. Ex DC	Perennial	Mesohygrophyte
		<i>Glycyrrhiza glabra</i> L	Perennial	Mesophyte
		<i>Halimodendron halodendron</i> (Pall.) Voss	Bush	Xerophyte
3.	<i>Elaeagnaceae</i>	<i>Elaeagnus angustifolia</i> L. (= <i>E. iliensis</i> Muscheg)	A tree	Xeromesophyte
4.	<i>Asteraceae</i>	<i>Scorzonera laciniata</i> L	Perennial	Xeromesophyte
		<i>Galatella angustissima</i> (Tausch) novopokr	Perennial	Xeromesophyte
		<i>Galatella fastigiiformis</i> novopokr	Perennial	?
		<i>Artemisia terrae-albae</i> Krasch	Semi-bush	Xerophyte
		<i>A.serotina</i> Bunge	Semi-bush	Xerophyte
		<i>Cirsium arvense</i> (L.) Scop	Perennial	Xeromesophyte
		<i>Saussurea salsa</i> (Pall.) Spreng	Perennial	Mesohygrophyte
5.	<i>Iridaceae</i>	<i>Iris sogdiana</i> Bunge	Perennial	Mesophyte
		<i>I. pallasii</i> Fisch. Ex Trevir	Perennial	Mesophyte
6.	<i>Rosaceae</i>	<i>Rosa silverhjelmi</i> Schrenk (= <i>R.iliensis</i> chrshan)	Bush	Mesophyte
		<i>Potentilla virgata</i> Lehm. (= <i>P. dealbata</i> Bung)	Perennial	Xerophyte
7.	<i>Asparagaceae</i>	<i>Asparagus angulofractus</i> Iljin (= <i>A. soongaricus</i> Iljin)	?	?
8.	<i>Poaceae</i>	<i>Achnatherum caragana</i> (Trin.) Nevski	Semi-bush	Xerophyte
9.	<i>Solanaceae</i>	<i>Lycium dasystemum</i> pojark	Bush	?
10.	<i>Zygophyllaceae</i>	<i>Zygophyllum fabago</i> L	Perennial	Xerophyte
11.	<i>Nitrariaceae</i>	<i>Nitraria schoberi</i> L	Bush	Xerophyte
12.	<i>Berberidaceae</i>	<i>Berberis iliensis</i> popov (3 категория)	Bush	Mesophyte
Total: 12 genus, 24 species				

**Table 2:** Rare and endemic species in the studied area

Genus/species	According to the planetarium rare or protected plants (CIS)	*Category in the red book of the Republic of Kazakhstan				
		0	1	3	3	4
<i>Tamaricaceae/Tamarix ramosissima</i> ledeb	+	-	-	-	-	-
<i>Fabaceae/Glycyrrhiza uralensis</i> Fisch. Ex DC	+	-	-	-	-	-
<i>Asteraceae/Galatella angustissima</i> (Tausch) novopokr	+	-	-	-	-	-
<i>Saussurea salsa</i> (Pall.) Spreng	+	-	-	-	-	-
<i>Iridaceae/Iris pallasii</i> fisch. Ex trevir	+	-	-	+	-	-
<i>Nitrariaceae/Nitraria schoberi</i> L.	+	-	-	-	-	-
<i>Berberidaceae/Berberis iliensis</i> popov	-	-	-	+	1	-
<i>Rosa silverhjelmi</i> schrenk	-	-	-	+	1	-
Total: 6 genus, 7 species	6			3		

*Inula pallasii* typically grows to a height of around 30-60 centimeters. It has sturdy stems that are covered with soft, hairy leaves. The leaves are lance-shaped or elliptical, with toothed margins and they emit a pleasant aromatic scent when crushed. The plant produces vibrant yellow flowers that form in clusters at the top of the stems. These flowers are daisy-like, with numerous ray florets surrounding a central disc.

The period of vegetational development of plants directly depends on the external environmental factor, i.e., climatic conditions, air humidity, and rainfall, so there may be differences in the process of flowering and fruiting in natural conditions. In the studied species, under natural conditions, the flowering period of *G. glabra*, *G. uralensis* begins in June and July, their flowering period is about two months, the fruiting process of these two species begins in August and September and the fruiting process lasts more than one and a half months, while *I. pallasii*, I The flowering period of

Sogdiana plants began in April and May, the flowering period lasted for one month and the fruiting of both species gave full seeds in May and June.

Almaty based on the results of the transplanting work carried out in the main botanical garden, *G. uralensis* blooms in July and August, the flowering period lasts for two months and fruiting occurs in September and November. In our case, the *G. glabra* plant does not go through the full period of vegetative development, that is, it grows but does not flower and bear fruit. *I. pallasii*, *I. Sogdiana* bloom in May, and the flowering period begins in the first ten days of May and lasts for about a month and fruiting occurs in early June. At this time, they will fully bloom and the seeds will ripen.

## Discussion

After conducting a thorough analysis of the flora in the studied area using planetarium data, we discovered information on six species belonging to six different

genera. These species include *Tamarix ramosissima*, *Glycyrrhiza uralensis*, *Galatella angustissima*, *Saussurea salsa*, *Iris pallasii* and *Nitraria schoberi*. Notably, we also obtained data on endemic species, such as *Iris pallasii*, *Berberis iliensis*, and *Rosa silverhjelmii*, which are listed in the Red Book of the Republic of Kazakhstan.

*Berberis iliensis*-A shrub 2-3 m high, branched into strong branches. One-year branches are thorny with many branches, flowering in May. The fruit; ripens in September and October, and the seeds are densely pointed or oval, smooth, and shiny. Roots are dyestuffs, fruits are used in wine production, medicine, all parts are used in agriculture, etc., an endemic species distributed in Kazakhstan in the eastern part of the Zhetysu Plateau and the Ketpen mountain range, the southern part of the Dzungar Plateau, the banks of the Sharyn, Shelek rivers, the Ile-Balkash region (Flora of Kazakhstan, 1961). Chemical composition: The roots and leaves of the barberry contain various alkaloids (the main ones are: *Barberine*, *palmatine*, *yatroricin*, *columbamine*). The leaves of the shoots contain ascorbic acid, tocopherols, carotene, malic and citric acid. In China, green-colored acid (chloro) is obtained from *Berberis iliensis*, which is included in the drug CNKI:SUN:XJZY.0.2001-02-009 (Berberis, 1937).

*Iris pallasii*-A perennial plant. The height is 15-25 cm, the roots are twisted like threads. The cell is thick, about 3 cm thick. The lesson is short. The sickle-like leaves are arranged in two rows on the stem. The number of flowers is 2-6, sometimes singly, odorless, and bluish in color, they emerge from leaf axils. The outer parts of the corolla are long. About 5 cm, the inner ones are longer. 3 cm, blood-like. Grows from seeds. It blooms and bears fruit in April-May, its flowers are beautiful and bloom for a long time, so it is grown for ornamental purposes (Flora of Kazakhstan, 1961).

*Rosa silverhjelmii*-A mesophilic thorny shrub with greenish-brown branches up to 1.5 m in height, leaves 6-7 cm long, with 2-3 contiguous leaves, mostly white flowers, fruit small, glabrous and smooth, always

round. Its diameter is 5-7 mm, and it blooms from May (Nasonova, 1966) (Table 3).

In the study of medicinal plants, the localization index is a crucial factor that helps determine the suitability and adaptability of a species to a specific geographical area. The localization index is often determined by considering various factors, including seed quality and specific indicators such as Index of Technological Potential (ITP). Seed quality plays a significant role in assessing the potential of a medicinal plant species to establish and thrive in a particular area. Parameters such as the weight of 1000 seeds, laboratory seed germination rates, and growth capacity provide insights into the reproductive potential and vigor of the species. These indicators are evaluated to determine the viability and success of seed propagation in the study area.

Based on the results of the research, in our case, the method of scarification was used to determine the laboratory germination of the seeds of the species studied, this method is used for seeds with a thick and hard seed coat, breaking the seed coat by a mechanical method and creating favorable conditions for their water absorption and growth. In the introduced species, the ITP ranged from 3-6. *G. glabra* is also 3, this species grows but does not go through the full development cycle, that is, does not flower and does not produce seeds. In the remaining species, fully mature seeds, stability of seed weight, and stable germination were observed (Table 4).

Species<sup>TM</sup> proposed to divide birds and plants into 8 categories before including them in the red book with rare or endangered animals and when we compared the species in our study area according to this category, we got the above information. That is, 5 species from 5 genera fit into this category, among which the least endangered species are the following 4 species: *Tamarix ramosissim*, *Glycyrrhiza glabra*, *Elaeagnus angustifolia*, *Nitraria schoberi*, and the *Berberis iliensis* plant can be attributed to rare endangered species.

**Table 3:** Relative development stages of domesticated medicinal plants

Type	Plant (generative branch) height, cm		Vegetation periods			
	-----		Flowering		Fruiting	
	Natural environment	Localized	Natural environment	localized	Natural environment	Localized
<i>G. glabra</i>	60-80	60-110	VIVII	-	VIII-IX	-
<i>G. uralensis</i>	70-90	90-130	VI-VII	VII-VIII	VIII-IX	IX-X
<i>I. pallasii</i>	30-65	77-83	IV-V	V	VI-VII	VI-VII
<i>I. sogdiana</i>	25-60	37-40	IV-V	V	VI-VII	VI-VII

**Table 4:** Localization indicators of medicinal plants

Type	Placed in year	Seed quality Weight of 1000 seeds, g	Laboratory germination of seeds (sk), %	Seed growth potential, %	ITP
<i>G. glabra</i>	2015	-	-	-	3
<i>G. uralensis</i>	1985	0.3	5-7	5	6
<i>I. pallasii</i>	2016	17.4	10	10	5
<i>I. sogdiana</i>	2016	23.6	40-50	30	5

One of the important indicators of the introduction of plants is considered to be the passage of the studied species through the full vegetation period, during which it is possible to monitor the features of their growth and full development rhythm and to study the condition of their further introduction.

## Conclusion

In conclusion, the research findings provide several important insights.

Firstly, the vegetation in the southern Balkhash area near the Ile River comprises a diverse combination of herbaceous plants, semi-shrubs, shrubs, and trees. However, the floral composition in the river valley is relatively simple, with frequent repetition of species. Furthermore, the study highlights the critical conservation status of the *Berberis iliensis* plant, which is classified as a rare and endangered species. Its distribution area has experienced a rapid decline, emphasizing the urgency for conservation efforts. Despite the proximity to a large river, the studied area does not exhibit a high number of endemic species. Only three endemic species, as identified in the Red Book, were found. This indicates the need for further research and conservation initiatives to protect and preserve the unique flora in the region. Additionally, the research identifies differences between naturally occurring and transplanted medicinal plants. Deviations from natural conditions vary slightly depending on weather conditions and rainfall. Based on these findings, it is evident that the studied area has experienced a decrease in the growth area of certain species. However, it also presents an excellent opportunity for further research, cultivation, and propagation of valuable food and medicinal plants, contributing to biodiversity conservation efforts. These conclusions underscore the importance of ongoing monitoring, conservation measures, and sustainable practices to safeguard diverse plant species, promote ecosystem health and ensure the availability of valuable medicinal resources for future generations.

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## Author's Contributions

**Bedel Kaliyev:** Participated in all experiments, coordinate the data analysis and contributed to the written of the manuscript.

**Anar Musrat, Gulnar Sitpayeva, Bakytzhan Rakhmetolinovich Saikenov, and Aubakirov Nurimzhan:** Designed the research planned and organized the study.

**Svetlana Yerekeyeva:** Coordinated the mouse work.

## Ethics

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

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