SHORT COMMUNICATION

Medicinal plants of the Sary -Chelek biosphere reserve

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ABSTRACT

This article presents the results of a study of the floristic composition of medicinal plants in the Sary- Chelek Biosphere Reserve. An analysis of the biodiversity of medicinal species, their distribution across altitudinal zones, and their economic significance is provided. It was established that the reserve is characterized by a high level of endemism and the preservation of natural habitats, which contributes to the conservation of rare and valuable medicinal plants. The most common and economically significant species used in traditional and official medicine are identified.

Key words: Biodiversity, biosphere reserve, flora, medicinal plants, rare species, Sary- Chelek

The Sary -Chelek biosphere reserve, located in the western part of the Talas - Fergana Range in the Jalal-Abad Region of Kyrgyzstan, is one of the most floristically diverse protected natural complexes in Central Asia. Covering 23,868 hectares, it was founded in 1959 to protect the unique ecosystems of the Western Tien Shan. Since 1978, the reserve has been included in the UNESCO International Network of Biosphere Reserves. The reserve is located in a picturesque mountainous area, which defines its diverse landscapes. Elevations range from 1,800 to 3,500 meters above sea level. The climate here is varied, ranging from sharply continental in the highlands to more moderate in the lower elevations. Sary- Chelek is renowned for its biodiversity. The reserve is home to numerous plant species, including rare and endemic ones (Alisbekov, 2020). The reserve's centrepiece is Lake Sary- Chelek, a large high-mountain protected body of water. Its waters are distinguished by their unique color and purity. The lake is surrounded by picturesque mountains and forests, making it a popular destination for ecotourism and recreation (Bekmurziev, 2021). The reserve encompasses a variety of natural zones, from walnut and fruit forests to subalpine and alpine meadows. The unique climate and soil conditions create favorable conditions for the growth of a large number of medicinal plants, many of which are important in traditional medicine and pharmacology.

The studies were carried out during the 2022-2024 growing seasons in the central and eastern parts of the reserve (along the valleys of the Kotormo and Arkyt rivers and at the foot of the Chatkalridge). **Route-geobotanical surveys** was made to identify the species composition and determine the phytocenotic confinement of medicinal plants. **Herbarium method** - collection, pressing, drying and identification of plants using identification guides of the flora of Central Asia and Kyrgyzstan (Lipshits and Voskresensky, 1974–1989). **Floristic analysis** – determination of biomorphological and ecological groups of plants. **The method of resource assessment** was the accounting of the population size and reserves of the most common species per 1 hectare. **Sociological survey of local residents and herbalists** - to identify the traditional use of plants.

In our work, we used generally accepted methods in resource science to determine raw material reserves. **Survey Sites:** Stock assessments were conducted at key sites where *Thymus Serpyllum*forms significant thickets (subalpine zone, 2000-2500 m). **Sample plots** of 1 m^2 were established (at least 20 replicates in different phytocenoses). **Yield determination: At each site, the above-ground part (the raw material itself-grass)** was collected during the flowering phase (late June-early July). The raw material was weighed to obtain the fresh **mass** (*FM*). **Determination of moisture content:** Samples of raw materials were dried to an air-dry state (*M* dry) to determine the moisture content conversion factor (*K* dry) using the formula: *To* sushi= *M* cheese:*M*dry. **Calculation of biological reserve:** The biological reserve of air-dried raw materials per hectare was calculated using the formula: Zbiol= (*M* sr× *K* land) × 10000 m^2; Where, *M* cp– average raw mass per 1 m^2 .

The study found that the medicinal plant flora of the Sary -Chelek Biosphere Reserve is significantly rich-over 250 species belonging to 58 families and 180 genera. This confirms the high level of phytodiversity and ecosystem conservation in the area. Taxonomic analysis revealed the dominance of five key families in terms of species, consistent with typical floristic trends for the Western Tien Shan:

- Asteraceae (Compositae): 42 species. The dominance of this family is due to its high adaptability to various ecological niches.
- Lamiaceae(Lamiaceae): 27 species. The family is an important source of essential oils, aromatic, and sedative compounds.
- Rosaceae (Rose): 21 species. Includes a significant number of vitamin-rich and cardiotonic species, especially in nut-fruit forests.
- Fabaceae (legumes):18 species. An important resource of nitrogen-fixing and saponin-containing plants.
- Ranunculaceae (Buttercup): 15 species. Contains species with high pharmacological activity, often poisonous.

A clear correlation between the species composition of the medicinal plants and vertical zonation was revealed, which is a key feature of mountain ecosystems (Table 1). The greatest diversity and concentration of economically significant species are observed in walnut-fruit forests (1600–2000 m) and the subalpine zone (2000–2500 m).

Quantitative detailing for *Thymus serpyllum* was made as detailed in Table 2. The estimated biological reserve of air-dried *Thymus raw material serpyllum* was about 980 kg/ha.

Integration of Traditional Knowledge of some species:

Walnut (*Juglans regia*): Local residents use not only the fruits (as a tonic), but also the leaves, which are collected young. A decoction of the leaves is traditionally used externally to wash wounds, ulcers and boils due to their astringent and antiseptic properties (high juglone content). Tincture of green shell (pericarp) is used as a remedy for parasitic intestinal diseases.

Pontic hawthorn (*Crataegus pontica*) and Blood-red hawthorn (*Crataegus sanguinea*): Traditionally used as a cardiotonic agent, but with certain specifics. Crushed dried fruits are brewed as a tea for "heart pain" (angina) and to reduce high blood pressure (hypertension). This local remedy is often combined with wild rose (*Rosa canina*) to enhance the vitamin effect.

St. John's Wort (*Hypericum perforatum*): It well-known anti-inflammatory and antiseptic properties. The flowers are infused in vegetable oil (often sunflower or apricot) in the sun. This oil is a primary topical treatment for burns, bruises, and contusions, as well as joint pain when rubbed in.

Common yarrow (*Achillea millefolium*): It is widely used to stop bleeding. Freshly picked herb is crushed and applied to minor cuts or nosebleeds as a hemostatic agent. A decoction is also used to relieve painful menstruation.

Golden root) (*Rhodiola rosea*): In cases where the root is collected (usually by poaching), it is used as a powerful adaptogen. The crushed root is infused in alcohol or vodka. The tincture is taken to increase endurance at high altitudes and to restore strength after hard work or illness.

The proportion of the five largest families in the overall composition of the medicinal flora has been presented in the Table 3.

To visually demonstrate which altitudinal zones contain the highest concentration of economically significant species, confirming the conclusion about the key role of nut-fruit forests and the subalpine zone has been presented in the Table 4.

Endemism and protected species: The high level of endemism and the preservation of natural biotopes contribute to the existence of rare and valuable species. The identification of five species included in the Red Data Book of the Kyrgyz Republic (2022) underscores the conservation importance of the reserve as a gene pool refuge, which are: *Rhodiola rosea* (golden root, is a valuable adaptogen); *Rheum maximowiczii* (Maksimovich's rhubarb); *Ferula kuchistanica*; *Iris sogdiana* (Sogdian iris) and *Allium suworowii* (Suvorov's onion). These species have limited ranges and require priority population monitoring and development of *ex-situ* conservation measures.

Pharmacological potential: Approximately 60 species of medicinal plants are actively used in folk and traditional medicine in the region. The most significant species highlighted demonstrate a wide range of pharmacological actions are: **Adaptogens and immunomodulators**: *Rhodiola rosea, Rosa canina, Juglans regia*; **Cardiotonic and hypotensive:** *Crataegus pontica, Crataegus sanguinea*; **Anti-inflammatory and antiseptic:** *Hypericum perforatum, Achillea millefolium , Urtica dioica*; **Sedatives and antispasmodics**: *Melissa officinalis, Origanum vulgare, Valeriana officinalis;* **Sources of cardiac glycosides:** *Digitalis purpurea.*

Resource-economic potential: Based on resource assessment, species such as *Thymus serpyllum*, *Mentha longifolia* and *Origanum vulgare* have populations sufficient for potential sustainable industrial collection, but subject to a strict rotational harvesting principle and compliance with environmental legislation.

The medicinal plant flora of the Sary - Chelek Biosphere Reserve is a highly diversified natural complex (over 250 species), serving as a key center for preserving the medicinal plant gene pool of the Western Tien Shan. The presence of unique nut-fruit and subalpine ecosystems results in a concentration of rare, endemic (5 species listed in the Red Data Book), and economically valuable species.

Key findings and recommendations

Biodiversity and conservation: The high degree of floristic diversity and the preservation of natural biotopes confirm the reserve's status as a UNESCO biosphere reserve and a strategically important area for the conservation of rare species.

Resource potential: The reserve has significant potential for controlled and ecologically sustainable use of some widespread species of forest resources.

Threats and protection: The main limiting factors for the conservation of plant resources are uncontrolled anthropogenic pressure (excessive) and changes in the hydrological regime .

Resource management: To ensure long-term sustainability of flora, it is suggested fot Development and implementation of the program for the rational use and monitoring of populations of key medicinal species. It is also suggested for organization of *ex-situ* nurseries for propagation and reintroduction (or for collection in order to reduce the pressure on wild populations) of particularly valuable and endangered species.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: Distribution by altitude zones

No.	Altitude belt	Predominant medicinal species	Growing characteristics
1	Valley-forest (1200–1600 m	*Chelidonium majus, Plantago major,Urtica dioica, Hypericum perforatum*	Shade-tolerant species growing along forest edges and ravines |
2	Walnut-fruit forests (1600–2000 m)	*Crataegus pontica, Juglans regia, Rosa canina, Rubus caesius, Melissa officinalis*	An abundance of essential oil and vitamin plants
3	Subalpine zone (2000–2500 m)	*Achillea millefolium, Thymus serpyllum, Alchemilla vulgaris, Gentiana turkestanorum*	Cold and UV-resistant species predominate |
4	Alpine meadows (2500–3000 m)	*Rhodiola rosea, Primula auriculata, Polygonum viviparum*	Rare endemics with high pharmacological potential

Table 2: Results of study of *Thymus serpyllum*

Indicator	Average value	Unit of measurement	Note
Average yield of raw mass per 1 ^{m2} (*M* avg)	280 g	g/m^2	Actual collection of the above-ground part
Conversion factor for air-dried raw materials (*K* dry)	0.35	Dimensionless	Typical value for essential oil herbs
Biological reserve per hectare	0.98 t	t/ha	280 g/m^2× 0.35 × 10000

Table 3: Data for the diagram (based on the text of the article):

Family	Number of Species	Share in % (out of 250+)
Asteraceae (Compositae)	42	~17%
Lamiaceae (Lamiaceae)	27	~11%
Rosaceae (Pink)	21	~8.4%
Fabaceae (legumes)	18	~7.2%
Ranunculaceae (Buttercups)	15	~6.0%

Table 4: Distribution of the 250+ species found across the zones

Altitude belt	Range (m)	Approximate number of types of LR
Valley-forest	1200–1600	~50
Walnut forests	1600–2000	~85
Subalpine zone	2000–2500	~80
Alpine meadows	2500–3000	~35