

Studying the species distribution of rhubarbs (*Rheum* L.) in Kazakhstan

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Abstract. Critical processing of herbarium materials revealed the distribution in Kazakhstan of 10 species of the genus *Rheum*, including *Rheum compactum* L., *R. wittrockii* Lundstr., which are classified as rare and declining in number. *R. altaicum* Losinsk. was discovered – relict and endemic of Altai. To clarify the distribution in Kazakhstan and compile a summary of species of the genus *Rheum*, 143 herbarium sheets (1840 – 2024) from the Altai Botanical Garden (ABG), Institute of Botany (AA), and the digital herbarium of Moscow State University (MW) were reviewed and processed. 253 actual places of growth were identified for 10 species of rhubarb from the flora of Kazakhstan, belonging to 5 sections: *Rhapontica* A. Los., *Deserticola* Maxim., *Orbicularia* A. Los., *Spiciformia* A. Los., *Ribesiformia* A. Los. A high species diversity of rhubarb was established in the Dzungarian Alatau, Altai, Tarbagatai and Ile Kungei Alatau. Geographically, the most widespread are *R. tataricum*, *R. nanum* and *R. wittrockii*. The research made it possible to systematize, clarify and supplement information on the species diversity and distribution of the genus *Rheum* in the flora of Kazakhstan.

1 Introduction

Representatives of the genus *Rheum* L. are well-known economically valuable species of the Polygonaceae family. The genus includes more than 50 species [1], of which 10 are recorded for the flora of Kazakhstan (Figure 1).

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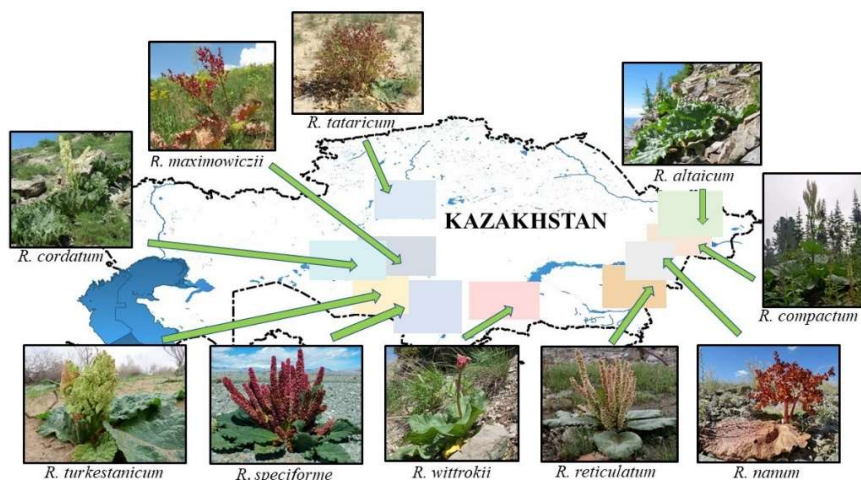


Fig. 1. Species of the genus *Rheum* L. in Kazakhstan

Rhubarb has wide practical applications as fodder and medicinal plants. [2-6]. *Rheum compactum* and *R. wittrokii* are included in the Red Book of Kazakhstan (2014) [7] and have the status: Category III – rare species, with declining numbers *R. altaicum* is a relict and endemic of Eastern Kazakhstan [8].

The relevance of studying rhubarb is high. Quite a lot of research has been carried out to study the phytochemical composition of rhubarb species [9; 10], molecular genetics [11-13], karyology of the genus [14] and morphometric structure [15; 16]. Unfortunately, work on the distribution of species in Kazakhstan is small and fragmentary [17-19; 8].

The purpose of this study was to systematize, clarify and supplement information on the presence and distribution of *Rheum* species in various floristic regions of Kazakhstan.

2 Materials and methods

To further clarify the species composition and modern distribution of genus *Rheum*, an inventory of herbarium material dated 1840–2020 was carried out. To compile a summary of species, materials stored in the main repositories were processed: Altai Botanical Garden (ABG) – 11 herbarium sheets, Institute of Botany and Phytointroduction (AA) – 101 herbarium sheets, as well as the digital herbarium of Moscow State University (MW) – 141 herbarium sheets.

Taxonomy and systematics of species of the genus *Rheum* L. is based on the summary of A.S. Lozina-Lozinskaya [20] and the digital platform «Life map» of the University of Lyon [21]. Plant species in sections are arranged alphabetically. Latin names of species are indicated according to the international POWO platform [22]. The names of floristic regions are based on the botanical zoning of the Kazakhstan flora.

3 Results and Discussion

As a result of the analysis of herbarium material of genus *Rheum*, the actual places of growth of 10 species on the territory of Kazakhstan were established. These species belong to 5 sections out of 7 existing ones: *Rhapontica* A. Los., *Deserticola* Maxim., *Orbicularia* A. Los., *Spiciformia* A. Los., *Ribesiformia* A. Los.

Below is a summary of 10 species of the genus *Rheum* L., identified during the analysis of 3 herbarium funds.

Family Polygonaceae Juss.
Subfamily: Polygonoideae
Tribe: Rumiceae
Genus: *Rheum* L., Sp. Pl.: 371 (1753)

Section: *Rhapontica* A. Los.

***Rheum altaicum* Losinsk.**, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 3: 87 (1937).

Mesophyte, heliophyte. The species grows in the rocky steppe, on crushed stone, on calcareous and hilly slopes. Nine places of growth were identified (Fig. 2).

***Rheum compactum* L.**, Sp. Pl. ed. 2.: 531 (1762).

Alpine mesophyte, heliophyte. The species grows along the banks of rivers and springs, in river valleys, in forests, on placers, and on slopes. Four places of growth were identified (Fig. 3).



Fig 2. Places of *Rheum altaicum* growth



Fig 3. Places of *R. compactum* growth

***Rheum wittrockii* Lundstr.**, Acta Horti Berg. 5(3): 23 (1914).

Mesophyte, heliophyte. The species grows on mountain grassy slopes and in mountain forests. Thirty-five places of growth were identified (Fig. 4).

Section: *Deserticola* Maxim.

Series: *Racemiferae* A. Los.

***Rheum nanum* Siev.**, Neueste Nord. Beitr. Phys. Geogr. Erd- Völkerbeschreib. 7: 264 (1796).

Xerophyte, heliophyte. The species grows on rocky and clayey soil in the foothills, on rocky slopes, in the steppe or desert. Eleven places of growth were identified (Fig. 5).



Fig. 4. Places of *R. wittrockii* growth



Fig. 5. Places of *R. nanum* growth

Section: *Orbicularia* A. Los.

***Rheum tataricum* L. fil.** Suppl. Pl.: 229 (1782).

Xerophyte, heliophyte. The species grows in the steppe, in the plain, on crushed stone, on clay, salt licks, on grassy slopes, and sandy hillocks. Twenty growing sites were identified (Fig. 6).

***Rheum turkestanicum* Janisch.**, Spisok Rast. Gerb. Russk. Fl. Bot. Muz. Rossiisk. Akad. Nauk 8: 92 (1922).

Psammophyte, Heliophyte. The species grows on hilly sands. One place of growth was identified (Fig. 7).



Fig. 6. Places of *R. tataricum* growth



Fig. 7. Places of *R. turkestanicum* growth

Section. *Spiciformia* A. Los.

***Rheum spiciforme* Royle**, Ill. Bot. Himal. Mts.: 318, t. 78 (1836).

Alpine mesophyte, heliophyte. The species grows along gorges on slopes. Three places of growth were identified (Fig. 8).

***Rheum reticulatum* Losinsk.**, Trudy Bot. Inst. Akad. Nauk S.S.S.R., Ser. 1, Fl. Sist. Vyssh. Rast. 3: 112 (1937).

Alpine petromesophyte, heliophyte. The species grows in the alpine zone on rocky soils, often on sand. Two places of growth were identified (Fig. 9).



Fig. 8. Places of *R. spiciforme* growth



Fig. 9. Places of *R. reticulatum* growth

Section: *Ribesiformia* A. Los.

***Rheum cordatum* Losinsk.**, Izv. Bot. Sada Akad. Nauk S.S.S.R. 30: 381 (1931 publ. 1932).

Petromesophyte, heliophyte. The species grows on mountain slopes, on limestone and rocky soil on the Karatau and Chu-Ili mountains. Thirteen places of growth were identified (Fig. 10).

***Rheum maximowiczii* Losinsk.**, Izv. Bot. Sada Akad. Nauk S.S.S.R. 30: 382 (1931 publ. 1932).

Mesoxerophyte, heliophyte. The species grows on grassy and gravelly slopes in the middle mountain zone. Fourteen places of growth were identified (Fig. 11).



Fig. 10. Places of *R. cordatum* growth



Fig. 11. Places of *R. maximowiczii* growth

As a result of the audit of the main herbarium funds, 253 places of growth were identified for 10 species of the genus *Rheum* in Kazakhstan.

It has been established that among all floristic regions, the Dzungarian Alatau (4 species), Altai (3 species), Tarbagatai (3 species) and Ile Kungei Alatau (3 species) have high species diversity of the genus *Rheum* (Fig. 12).

Thus, the main concentration of species of the genus *Rheum* is in the east and southeast of Kazakhstan.

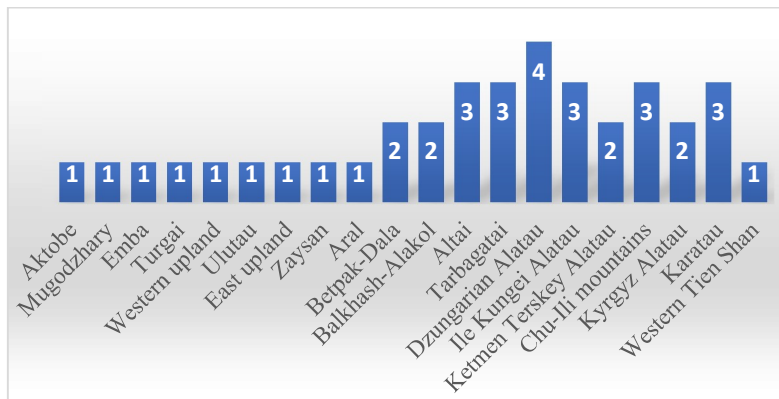


Fig. 12. Saturation of species of the genus *Rheum* in floristic regions of Kazakhstan

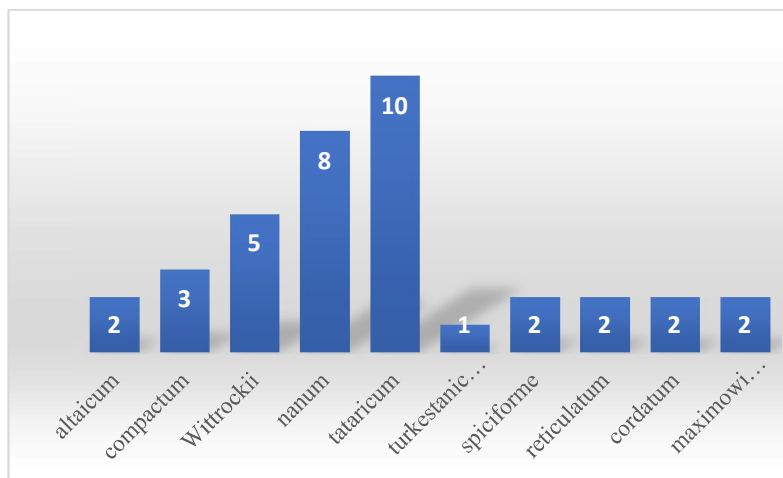


Fig. 13. Prevalence of species of the genus *Rheum* in floristic regions of Kazakhstan

When studying the geography of species of the genus *Rheum* in Kazakhstan, it was found that the greatest distribution is characterized by *R. tataricum*, growing in 10 floristic regions, *R. nanum* – 8, *R. wittrockii* – 5. The Red Book species *R. compactum* grows only in 3 floristic regions (Fig. 13).

In ecological terms, most *Rheum* species in Kazakhstan belong to mesophytes (4 species), less often to xerophytes (2) and petromesophytes (2). In relation to lighting, all species of the genus in Kazakhstan belong to heliophytes.

4 Conclusion

Studying the distribution of economically valuable and rare plant species in Kazakhstan is one of the most important methods for preserving the biological diversity of flora. Species of the genus rhubarb have a wide range throughout Kazakhstan and grow in various conditions: from semi-deserts to alpine meadows. An analysis of the actual species and population distribution of rhubarb in Kazakhstan was carried out based on a study of historical herbarium collections from three main herbarium collections: Altai Botanical Garden (ABG), Institute of Botany (AA), and the digital herbarium of Moscow State University (MW). As a result of the analysis of herbarium material for 10 species of the genus *Rheum* in the flora of Kazakhstan, 253 actual places of growth were established. Species belong to 5 sections out of 7 existing ones: *Rhapontica*, *Deserticola*, *Orbicularia*, *Spiciformia*, *Ribesiformia*. It was found that the Dzungarian Alatau, Altai, Tarbagatai and Ile Kungei Alatau have high species diversity of the genus *Rheum*. Thus, the main concentration is in the east and southeast of Kazakhstan. When studying the geography of species, it was found that the greatest distribution is characterized by *R. tataricum*, *R. nanum* and *R. wittrockii*. The Red Book species *R. compactum* grows only in 3 floristic regions. Ecologically, most species of the genus *Rheum* belong to mesophytes, less often to xerophytes and petromesophytes. In relation to lighting, all species of rhubarb are heliophytes. The conducted studies made it possible to systematize, clarify and supplement information on the presence and distribution of species of the genus *Rheum* L. in various floristic regions of Kazakhstan.

Authors' contribution

Conceptualization, A.S.; Methodology, M.A.; Formal Analysis, A.S.; Writing – Original Draft Preparation, Zh. A.; Writing – Review & Editing, Zh. A.; Supervision, A.S.; Project Administration, A.S.; Funding Acquisition, M.A.

Acknowledgments

Scientific research carried out as part of a scientific project: AP15473136 “Multi-vector study of a rare relict species *Rheum compactum* L. – scientific approach to species conservation of Kazakhstan Red Book” with the financial support of the Committee of Science (2022 – 2024).

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