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RESEARCH ARTICLE

Flora of the Ushkurmynker ridge and adjacent territories (East Kazakhstan), Report 1

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Abstract

For the first time, a list of higher vascular plants of the natural flora of the Ushkurmynker ridge is presented. The list is based on literature data and materials collected during our field surveys and includes 127 species belonging to 94 genera and 37 families. 21 species are rare and endemic for the Altai mountainous country and the Southern Altai. In addition, the following species are registered in the Southern Altai for the first time: *Smelowskia calycina* (Steph.) C. A. Mey., *Draba ochroleuca* Bge., *Ribes glabrum* (Hedl.) Sennikov., *Thymus schischkinii* Serg., *Doronicum oblongifolium* DC., *Saussurea leucophylla* Schrenk., *Saussurea krylovii* Schischk. et Serg. The most numerous is the Asteraceae family, which includes 20 species. *Potentilla* is the genera largest of the presented and includes 5 species. We also registered many families that were represented by 1–2 species.

Keywords

Plants, flora, Ushkurmynker ridge, Altai, taxonomy, Asteraceae

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Introduction

The Ushkurmynker ridge belongs to the Southern Altai ridge system. It is part of the southern branch of the uplift of flat-topped mountain ranges extending from the middle part of the Kurchum Range to the east (Mikhailov et al, 1992) (Fig. 1).

The ridge is oriented from the northwest to the Southeast. From the north-east it is bounded by the Bugymuiz River and from the west by the Kopyrtas River, which separates the Ushkurmynker Ridge from the Kamenisty (Kamenny) Ridge and the Molku Mountains. In the south, it is separated by the State Border of the Republic of Kazakhstan and the Xinjiang Uygur Autonomous Region of the People's Republic of China. An important feature of the location is the proximity of vast sandy deserts on the territory of China, which has a significant impact on the climatic conditions of the area (Fig. 2).

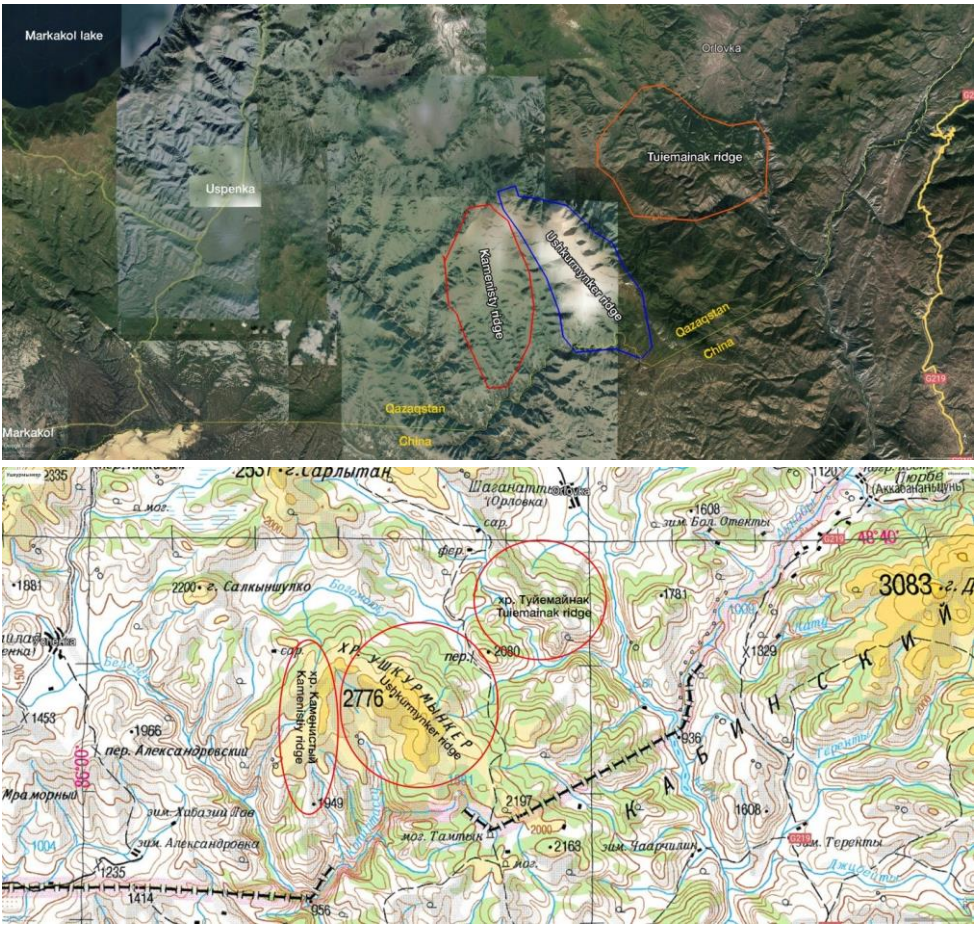

Figure 1. Map of the Ushkurmynker, Kamenisty and Tuyemaynak Ridges.

The Ushkurmynker ridge is characterized by isolation, relatively gently sparse slopes with single and sparse groups of Siberian larch (*Larix sibirica*) (Figs 2–4), the predominance of alpine meadows up to an altitude of 2500 m a.s.l. Starting from this elevation, the bald belt is sharply distinguished. The tundra zone is missing.

The bald belt up to 2776 m a.s.l. has an almost continuous coating of blocky material. Areas with patches of characteristic alpine herbaceous vegetation in the bald belt are found in open, predominantly loess plots, or in the beds of streams that come to the surface in places where "sheepback" appear.

Figure 2. Sand dunes in China, view from the Ushkurmynker Ridge, photo by Bolbotov G.A.

Figure 3. Ushkurmynker Ridge, view from the northern part of the Kamenisty (Kamenny) Ridge, photo by Bolbotov G.A.

Figure 4. Ushkurmynker Ridge, Northwestern spurs of Ushkurmynker mountain, photo by Bolbotov G.A.

Material and methods

Field observations and collection of herbarium material were carried out during July 7–9, 2021 from the Kamenisty (Kamenny), Ushkurmynker, and Tuiemainak ridges in the border zone and the border strip of the Republic of Kazakhstan.

The collected herbarium is presented in the collections of the Department of Science, Ecological Monitoring, and Information of the Katon-Karagay State National Natural Park, as well as in the Herbarium of the South Siberian Botanical Garden of the Altai State University.

Materials from the "Flora of Western Siberia" (Krylov 1927), the abstract of the 'High mountain flora of Altai" (Revushkin 1988) and the 'Flora of Altai" (Kamelin 2005) were used to determine the collected herbarium samples. The area considered was visited by V.V. Sapozhnikov (1895-1911) as part of his expeditions in the Southern Altai. This was noted in his works; however, the Ushkurmynker ridge was mentioned in the reports only and presented without descriptions and floristic essays (Kruger 1927).

The distribution of species is presented according to our proposed zoning scheme:

K – Kamenisty (Kamenny);

U – Ushkurmynker;

T – Tuiemainak.

Results

The annotated list:

Cystopteridaceae (Payer) Schmakov

Cystopteris dickieana R. Sim. On rocks, screes, and rocky slopes. Distr.: **U**.

Pinaceae Lindl.

Larix sibirica Ledeb. Distr.: **U**.
Pinus sibirica Du Tour. Distr.: **U**, **T**.

Cupressaceae Rich. ex Bartl.

Juniperus pseudosabina Fisch. et. Mey. Rocky slopes and cliffs. Distr.: **U**.
J. sibirica Burgsd. Rocky and gravelly slopes, placers of the high-mountain belt, and the upper forest boundary. Distr.: **K**.

Juncaceae Juss.

Luzula sibirica V.I. Krecz. Alpine meadows, swamps. Distr.: **U**, **K**.

Ephedraceae Dumort.

Ephedra monosperma C. A. Mey. Cracks in the rocks. Distr.: **U**.

Poaceae Barnhart.

Anthoxanthum alpinum A. et D. Löve. Alpine and subalpine meadows. Distr.: **U**, **K**.
Festuca altaica Trin. Alpine meadows. Distr.: **U**.

Cyperaceae Juss.

Carex aterrima Hoppe. Alpine and subalpine meadows. Distr.: **U**.

Melanthiaceae Batsch ex Borkh.

Veratrum lobelianum Bernh. Wet meadows, forests. Distr.: **U**, **T**, **K**.

Alliaceae J. Agardh.

Allium amblyophyllum Kar. et Kir. Alpine meadows. Distr.: **K**.

A. hymenorrhizum Ledeb. Cracks in the rocks. Distr.: **U**.
A. ledebourianum Schult. et Schult. f. Raw floodplain meadows, swamps. Distr.: **K**.
A. schoenoprasum L. Alpine meadows, swamps. Distr.: **U**, **K**.

Liliaceae Juss.

Erythronium sibiricum (Fisch. et C.A. Mey.) Kryl. The woods, near snowfields in the mountains. Distr.: **U**, **T**, **K**.
Lilium pilosiusculum (Freyn) Miscz. Edges, among bushes, and on mountain slopes. Distr.: **K**.

Salicaceae Mirb.

Salix rectijulis Ledeb. ex Trautv. Stream banks and rivers in the alpine belt. Distr.: **K**.

Polygonaceae Juss.

Aconogonon alpinum (All.) Schur. Meadow and gravelly slopes, banks of rivers and streams. Distr.: **U**.
Bistorta elliptica (Willd. ex Spreng.) Kom. Alpine meadows. Distr.: **U**, **K**.
B. officinalis Delarbre. Alpine meadows, rocky slopes. Distr.: **U**, **T**, **K**.
Oxyria digyna (L.) Hill. Rocky slopes. Distr.: **U**.
Rumex acetosa L. Alpine meadows. Distr.: **U**, **K**.

Caryophyllaceae Juss.

Dianthus superbus L. Subalpine meadows, forest edges. Distr.: **U**, **T**, **K**.
Dichodon cerastioides (L.) Rchb. By the patches of snow, the stream banks. Distr.: **U**, **K**.
Minuartia biflora (L.) Schinz et Thell. Rocky slopes near snowfields. Distr.: **U**.
M. verna (L.) Hiern. Alpine meadows, talus. Distr.: **U**, **K**.
Silene graminifolia Otth. Rocks, rocky and gravel slopes. Distr.: **U**.
S. turgida M. B. Rocky slopes. Distr.: **U**.
S. wolgensis (Willd.) Bess. Meadows at the foot of the mountains. Distr.: **T**.

Paeoniaceae Rudolphi

Paeonia anomala L. Alpine meadows, thin forests. Distr.: **T**, **K**.

Ranunculaceae Juss.

Aquilegia glandulosa Fisch. ex Link. Alpine meadows. Distr.: **U**.
Callianthemum sajanense (Regel) Witasek. Alpine meadows, moraines. Distr.: **U**.

Caltha palustris L. Swamps and damp places. Distr.: **U**, **T**, **K**.
Pulsatilla multifida (G. Pritz.) Juz. Open meadow slopes. Distr.: **U**.
Ranunculus acris L. Damp places. Distr.: **T**, **K**.
R. altaicus Laxm. Alpine meadows. Distr.: **U**.
Thalictrum alpinum L. Alpine meadows, pebbles. Distr.: **U**, **K**.
Trollius altaicus C.A. Mey. Alpine and subalpine meadows, stream banks. Distr.: **U**, **K**.

Berberidaceae Juss.

Gymnospermium altaicum (Pall.) Spach. Rocky slopes, thickets of shrubs, light forests. Distr.: **U**, **T**, **K**.

Papaveraceae Juss.

Papaver pseudocanescens Popov. Alpine meadows, rocky slopes. Distr.: **U**, **K**.

Brassicaceae Burnett.

Draba ochroleuca Bge. Subalpine meadows, stream banks. Distr.: **U**.
Macropodium nivale (Pall.) R. Br. Subalpine meadows, stream banks. Distr.: **U**, **K**.
Smelowskia calycina (Steph.) C. A. Mey. Rocky and gravel slopes. Distr.: **U**.

Crassulaceae DC.

Orostachys spinosa (L.) C.A. Mey. Open rocky slopes and cliffs. Distr.: **U**.
Rhodiola coccinea (Royle) Boriss. Rocky and gravel slopes. Distr.: **U**. (Fig. 5)
Rh. rosea L. Alpine and subalpine meadows, stream banks. Distr.: **U**, **T**, **K**.
Sedum hybridum L. Gravel and rocky slopes, rocks. Distr.: **T**.

Saxifragaceae Juss.

Bergenia crassifolia (L.) Fritsch. Rocks, rocky slopes. Distr.: **U**, **T**, **K**.
Micranthes aestivalis Fisch. et Mey. Stream banks. Distr.: **U**, **K**.
Saxifraga cernua L. Rocky and gravel slopes. Distr.: **U**, **K**.

Grossulariaceae *DC.*

Ribes glabrum (Hedl.) Sennikov. Rocks, rocky slopes. Distr.: **U**.
R. rubrum L. Stream banks. Distr.: **T**.

Figure 5. *Rhodiola coccinea*.

Rosaceae Juss.

Alchemilla sibirica Zämelis. Floodplains of streams, meadows, and forest edges. Distr.: **U**, **K**.
Cotoneaster uniflorus Bunge. Rocks and stony placers, stone run. Distr.: **U**.
Dasiphora fruticosa (L.) Rydb. Floodplains of streams, meadows, and gravel. Distr.: **U**, **T**, **K**.
Dryas oxyodonta Juz. Alpine meadows, banks of streams. Distr.: **K**.
Potentilla bifurca L. Steppe meadows. Distr.: **T**.
P. crebridens Juz. Rocks, rocky slopes. Distr.: **U**.
P. gelida C.A. Meyer. Alpine meadows, near snow fields and moraines. Distr.: **U**.
P. pensylvanica L. Stony and gravelly slopes. Distr.: **K**.
P. sericea L. Rocks, rocky slopes. Distr.: **K**.
Sanguisorba officinalis L. Subalpine meadows, sparse larch forests. Distr.: **U**, **K**.
Sibbaldia procumbens L. Alpine meadows, near snow fields and moraines. Distr.: **U**, **K**.

Fabaceae Lindl.

Astragalus alpinus L. Subalpine meadows, sparse larch forests. Distr.: **U**, **K**.
Hedysarum austrosibiricum B. Fedtsch. Alpine and subalpine meadows. Distr.: **U**, **K**.
Lathyrus gmelinii Fritsch. Forests, subalpine meadows. Distr.: **U**, **T**, **K**.

Oxytropis altaica (Pall.) Pers. Stony, gravelly, and lichen slopes, alpine meadows. Distr.: **U**, **K**.
O. nivea Bunge. Rocky and gravelly slopes. Distr.: **T**.
O. sulphurea (Fisch. ex DC.) Ledeb. Rocky and gravel slopes. Distr.: **T**.
Onobrychis arenaria (Kit.) DC. Rocky slopes and steppe meadows. Distr.: **T**.
Trifolium lupinaster L. Stream banks. Distr.: **U**, **K**.

Geraniaceae Juss.

Geranium albiflorum Ledeb. Alpine and subalpine meadows, light forests. Distr.: **K**.
Linaceae DC. ex S. F. Gray.
Linum altaicum Ledeb. ex Juz. Alpine and subalpine meadows, light forests. Distr.: **K**.

Violaceae Batsch.

Viola altaica Ker Gawl. Alpine meadows. Distr.: **U**, **K**.

Onagraceae Juss.

Chamaenerium angustifolium (L.) Scop. Forests, forest edges, pebbly river banks, screes. Distr.: **U**, **T**, **K**.

Apiaceae Lindl.

Angelica sylvestris L. Alpine meadows, streams banks, sparse larch forests. Distr.: **U**, **K**.
Bupleurum aureum Fisch. ex Hoffm. Alpine and subalpine meadows, light forests. Distr.: **K**.
B. multinerve DC. Meadows, open slopes, larch sparse forests. Distr.: **T**, **K**.
Heracleum sibiricum L. Alpine meadows, stream banks, sparse larch forests. Distr.: **U**, **T**, **K**.
Schulzia crinita (Pall.) Spreng. Alpine meadows. Distr.: **U**, **K**.

Primulaceae Vent.

Androsace lactiflora Pall. Meadows, rocky slopes. Distr.: **T**.
A. maxima L. Meadows, rocky slopes. Distr.: **T**.

Gentianaceae Juss.

Comastoma tenellum (Rottb.) Toyok. Stone run. Distr.: **U**.
Gentiana uniflora Georgi. Alpine meadows. Distr.: **U**.
Swertia obtusa Ledeb. Meadows, stream banks. Distr.: **U**, **K**.

Boraginaceae Juss.

Eritrichium villosum (Ledeb.) Bunge. Rocky and gravelly areas, alpine meadows. Distr.: **U**.
Myosotis asiatica (Vestergren) Schischk. et Serg. Stone run. Distr.: **U**.

Lamiaceae Lindi.

Dracocephalum grandiflorum L. Alpine and subalpine meadows. Distr.: **U**.
D. imberbe Bunge. Rocky and gravel slopes. Distr.: **U**.
D. nutans L. Dry rocky slopes. Distr.: **U**, **T**.
D. ruyschiana L. Dry meadows, thickets of bushes, forests, and edges. Distr.: **T**.
Scutellaria altaica Fisch. ex Sweet. Rocky or gravelly slopes. Distr.: **U**.
Thymus altaicus Klok. et Schost. Dry rocky slopes. Distr.: **U**.
T. schischkinii Serg. Dry rocky slopes. Distr.: **U**. (Fig. 6)

Scrophulariaceae Juss.

Euphrasia syreitschikovii Govor. ex Pavlov. Alpine meadows. Distr.: **U**.
Lagotis integrifolia (Willd.) Schischk. Alpine meadows, banks of the streams. Distr.: **U**, **K**.
Pedicularis anthemifolia Fisch. ex Colla. Alpine meadows. Distr.: **U**.
P. compacta Steph. ex Willd. Alpine meadows. Distr.: **U**, **T**.
Veronica densiflora Ledeb. Alpine meadows, stream banks. Distr.: **U**.
V. longifolia L. Meadows, thickets of shrubs. Distr.: **T**.
V. porphyriana Pavlov. Subalpine meadows. Distr.: **U**.

Rubiaceae Juss.

Galium boreale L. Meadows, forests, shrub thickets. Distr.: **K**, **T**.
G. verum L. Subalpine meadows. Distr.: **U**.

Valerianaceae Batsch.

Patrinia sibirica (L.) Juss. Rocky and gravel slopes. Distr.: **U**, **K**.
Valeriana dubia Bunge. Rocky slopes, thickets of shrubs, steppes, subalpine, and alpine meadows. Distr.: **U**, **K**.

Campanulaceae Juss.

Campanula altaica Ledeb. Meadow slopes, river banks. Distr.: **T**.
C. glomerata L. Subalpine meadows. Distr.: **U**.

Figure 6. *Thymus schischkinii*.

Asteraceae Dumort.

Achillea asiatica Serg. Meadows, riverbanks. Distr.: **T**.
A. ledebourii Hiemerl. Alpine meadows. Distr.: **U**.
Antennaria dioica (L.) Gaertn. Rocky slopes, thickets of shrubs, steppe, subalpine, and alpine meadows. Distr.: **U**, **T**, **K**.
Artemisia altaiensis Krasch. Meadows. Distr.: **T**.
Aster alpinus L. Alpine meadows. Distr.: **U**.
Doronicum oblongifolium DC. Rocky and gravel slopes. Distr.: **U**. (Fig. 7)
Erigeron altaicus M. Pop. River terraces and alpine meadows. Distr.: **U**, **K**. (Fig. 8)
E. eriocalyx (Ledeb.) Vierh. Alpine meadows, rocky slopes. Distr.: **U**.
E. flaccidus (Bge.) Botsch. Alpine meadows. Distr.: **U**, **K**.
E. petiolaris Vierh. Alpine meadows, rocky slopes. Distr.: **U**.
Gnaphalium sylvaticum L. Alpine meadows. Distr.: **U**.
Leontopodium ochroleucum Beauv. Alpine meadows, rocky slopes. Distr.: **U**, **K.**
Rhaponticum carthamoides (Willd.) Iljin. Alpine meadows, larch sparse forests Distr.: **U**, **K**.
Saussurea frolowii Ledeb. Alpine meadows, larch sparse forests Distr.: **U**, **K**.
S. krylovii Schischk. et Serg. Rocky and gravelly slopes. Distr.: **U**.
S. leucophylla Schrenk. Rocky and gravel slopes. Distr.: **U**.
Senecio jacobaea L. Meadows. Distr.: **T**.
Solidago virgaurea L. Rocky slopes, thickets of shrubs, steppe, subalpine, and alpine meadows. Distr.: **U**, **K**.

Tripleurospermum ambiguum (Ledeb.) Fr. et Sav. Alpine meadows, stream banks. Distr.: **U**.
Trommsdorffia maculata (L.) Bernh. Meadows. Distr.: **K**.

Figure 7. *Doronicum oblongifolium*.

Figure 8. *Erigeron altaicus*.

Discussion

On average, there are 3.4 species per family in the flora. The leading role in the flora belongs to families containing species in a number exceeding the average. There are 11 such families (a quarter of the total number of families), and they include 86 species (67.72% of the total number of species) and 57 genera (60.64% of the total number of genera). The leading families are listed in Table 1.

The three dominant families of the ridge flora are Asteraceae (20 species; 15.75%), Rosaceae (11 species; 8.66%), and Fabaceae (8 species; 6.3%). These families occupy the same position in the flora of the Russian Altai (Revushkin 1988). A high percentage of Asteraceae characterizes the studied flora as boreal. The high rank of the Fabaceae family indicates similarity with the Middle and Central Asia. This similarity is mainly due to the diversity of species in the genus *Oxytropis*.

The ten dominant families of the discussed ridge flora include 67.72% of all plant species. A similar ratio is observed in floras that develop in difficult extreme climatic conditions.

Table 1. Conditions during the vegetative phase

Grade	Family	Species		Genus	
		Number	Percentage	Number	Percentage
1	Asteraceae	20	15.75	14	14.89
2	Rosaceae	11	8.66	7	7.45
3-4	Fabaceae	8	6.3	6	6.38
3-4	Ranunculaceae	8	6.3	7	7.45
5-6	Scrophulariaceae	7	5.5	4	4.26
5-6	Lamiaceae	7	5.5	3	3.19
5-6	Caryophyllaceae	7	5.5	4	4.26
7-8	Apiaceae	5	3.94	4	4.26
7-8	Polygonaceae	5	3.94	4	4.26
9-10	Alliaceae	4	3.15	1	1.06
9-10	Crassulaceae	4	3.15	3	3.19
Total		86	67.72	57	60.65

The average number of genera in a family in the flora is 3.4. The ranks of some families in the generic spectrum are significantly different from the species spectrum. For example, the rank of the family Fabaceae drops sharply, since most of the species in Fabaceae are contained in the two genera, *Astragalus* and *Oxytropis*. The family Alliaceae changes its position most sharply in the spectrum, because all 4 species of this family belong to the same genus *Allium*.

The ranking of the largest genera by the number of species is presented in Table 2. The table contains 4 genera, in which there are more than three species. These genera represent 19 species (13.39%) in total.

Table 2. Dominant genera spectrum

Grade	Genus	Species	
		Number	Percentage
1	*Potentilla*	5	3.94
2-3	*Allium*	4	3.15
2-3	*Dracocephalum*	4	3.15
2-3	*Erigeron*	4	3.15
Total		19	13.39

At the same time, a significant number of low-species families and genera emphasize the complexity of florogenetic processes and the significant role of migration in the formation of the modern composition of the flora of the study area.

The presence of the secondary center of the latest speciation in southern Siberia of the genus *Potentilla* determines the high rank of this genus in the flora of the territory under consideration (5 species; 1.57%). Species of the genus *Potentilla* are part of rocky, meadow, steppe, and forest communities.

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