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New distribution data on Altai endemic *Ranunculus schischkinii* in floras of Russia and Kazakhstan

As a result of revision of herbarium specimens of buttercups and data analysis of collected samples and field observations, the new data on distribution of the endemic plant of Altai Ranunculus schischkinii (Ranunculaceae Juss.) have been revealed. From the positions of the administrative boundaries, R. schischkinii, previously known from several habitats only within the Russian sector of the Altai Mountains, is now a new species for the flora of Kazakhstan. Information on all known locations of this species is given for the first time. Specific features of the environmental confinement of the species, original herbarium voucher labels indicating a place of storage, including new data, as well as the taxonomic position of the species and a reference to its original description are provided.

The paper contains 3 Figures and 18 References.

Keywords: *Ranunculus*; Ranunculaceae; space distribution; endemic; Altai; Kazakhstan; taxonomy.

Introduction

Ranunculus schischkinii Revushkin (Ranunculaceae Juss.) - Shishkin's Meadow buttercup (Fig. 1) is an endemic species, known only from few locations in humid highlands of the Altai Mountains, which grows exclusively on overly moistened nival meadows, in mossy and grassy tundra (Fig. 2). This is the only species within the Altai Mountain Country, confined to the alpine belt in its altitudinal distribution within the *Acres* Prantl subsection of the genus *Ranunculus* L., which includes predominantly forest species. On the list of endemic plants of the Altai [1], published on a full scale for the first time in 2008 within the framework of the Darwin Initiative's project "Cross-border conservation strategies in the Altai Mountains (Russia, Mongolia, Kazakhstan)", the species is listed as *Vulnerable* in the neo-endemic category only for Shebalinskiy and Ongudai districts of the Altai Republic, Russia.

Morphologically and ecologically, *R. schischkinii* is well separated from the widely distributed related mountain forest mesophytes such as *R. propinquus* C.A. Meyer and *R. grandifolius* C.A. Meyer. Studies of the karyotype in original description of *R. schischkinii* [2] revealed its diploidity (2n = 14), as well as significant morphological differences of chromosomes of this species compared

with *R. propinquus*. According to karyotaxonomy specialists, the feature of buttercups is the stability of morphology and the number of chromosomes [3]. The data summarizing the results of phylogeny and biogeography studies of the genus *Ranunculus* as a large cosmopolitan taxon confirm not only the hypothesis of congruence of karyotypes to the main clades of *Ranunculus* [4], but also a high probability of regional adaptive diversification of species [5], which is more clearly manifested in mountainous regions, and testify to the autochthonous origin of *R. schischkinii*.

Fig. 1. *Ranunculus schischkinii* Revushkin. Mt. Sarlyk, Seminskiy mountain range, Altai Mountain Country (Photo is made by AI Pyak, 05.07.2005)

Fig. 2. Typical habitat of *Ranunculus schischkinii* Revushkin
(Photo is made by AI Pyak, the same date and location)

Materials and methods of research

The study was based on the revision of the main herbarium collections (LE, MW, NK, NS, NSK, KUZ, KG, AA), the analysis of field survey data and published information [13, 14], collected samples in the territories of selected regions of Siberia, Kazakhstan and Mongolia during 2003-2017 [6-12]. The results of Cross-Classified Association Analysis of ecological data for the genus *Ranunculus* L. in the Altai-Sayan phytochorion [15] were used in order to reveal the degree and statistical importance of conjugation (non-random distribution) of ecological groups. Species were grouped in relation to the environmental factors most important for buttercups - soil moisture, thermal regime, salinization of habitats and the mechanical composition of the substrate. Also, the confinement to a certain type of ecotopes and certain morpho-physiological properties of species were taken into account.

Results of the research and discussion

The results of revision of herbarium materials and analysis of data on the collections and field observations in the Altai territory made it possible to discover new locations of *Ranunculus schischkinii*. Earlier the studied species was known only from few points on the territory of the Altai within the Russian Federation.

New findings allowed to define this plant as a new species for the flora of Kazakhstan.

The application of the conjugate ecological analysis by abovementioned factors in the study of the genus *Ranunculus* [15] helps to determine the ecological and biomorphological features of *R. schischkinii*. The results of the distribution of typological (ecological) groups, the degree and statistical significance of their association have shown that *R. schischkinii*, unlike the closely related typical forest and mountain forest species, is a hekistothermic hydromesophyte of the mesomorphic structure, namely, psychrophyte. This is a group of alpine plants that live in the nival belt, often in places with snow accumulation, developing in conditions of excessive cold moisture supply, especially in the first half of the growing season. The habitats of *R. schischkinii* are well drained, with high cooled supersurface layer of air due to thawed, subflow cold waters or nearby snowfields, waterlogged in the first half of the growing season, and dry in the second.

A comprehensive analysis of the genus *Ranunculus* in selected regions of Siberia and Kazakhstan lead to identification of ecological and geographical characteristics of both individual species and closely related groups [9, 10, 12, 15]. For some species, their position in the system of the genus has been determined [8, 16]. Comparison of the obtained results with molecular phylogeny and karyology data [5, 17] was a basis for a critical review of the taxonomic position of *R. schischkinii* and the close species, common in Southern Siberia and Kazakhstan:

Genus *Ranunculus* L.
Subgenus *Ranunculus*
Typus: *R. acris* L.
Sectio *Ranunculus*
Typus: *R. acris* L.
R. acris L.
R. grandifolius C.A. Meyer
R. karkaralensis Schegol.
R. propinquus C.A. Meyer
R. schischkinii Revushkin
R. smirnovii Ovcz.
R. subborealis Tzvel.
R. tajgaensis Timochina

R. schischkinii Revushkin 1992, Systematic notes on the materials of P.N. Krylov Herbarium of Tomsk State University, 89: 16. - Shishkin's Meadow buttercup. Described from the Altai. According to the protologue: «Typus: Altai, jugum Seminski, mons Sarlyk, partum alpinum. 5 VII 1983. A. Revushkin, S. Vydrina, N. Gordeeva, V. Maltzev» (TK!). The holotype is lost due to damage by pests.

Lectotypus et isotypus: «Altai. Vicinities of settl. Shebalino. Mt. Kurata, alpine stony tundra. 6 VII 1927. B. Shishkin» (TK!) [18].

Paratypus: «Altai. Vicinities of settl. Shebalino. Upper reaches of the Kumalir river, alpine meadow. 7 VII 1927. B. Shishkin» (TK!).

Habitats: alpine meadows, high-mountain tundra.

Distribution: the Seminskiy ridge (Mt. Kurata in upper reaches of the Kumalir river, Mt. Sarlyk), the Holzun ridge (upper reaches of the Bannaya river), the Narymskiy ridge (valley of the Burlybai river). Endemic. 2n = 14 [2].

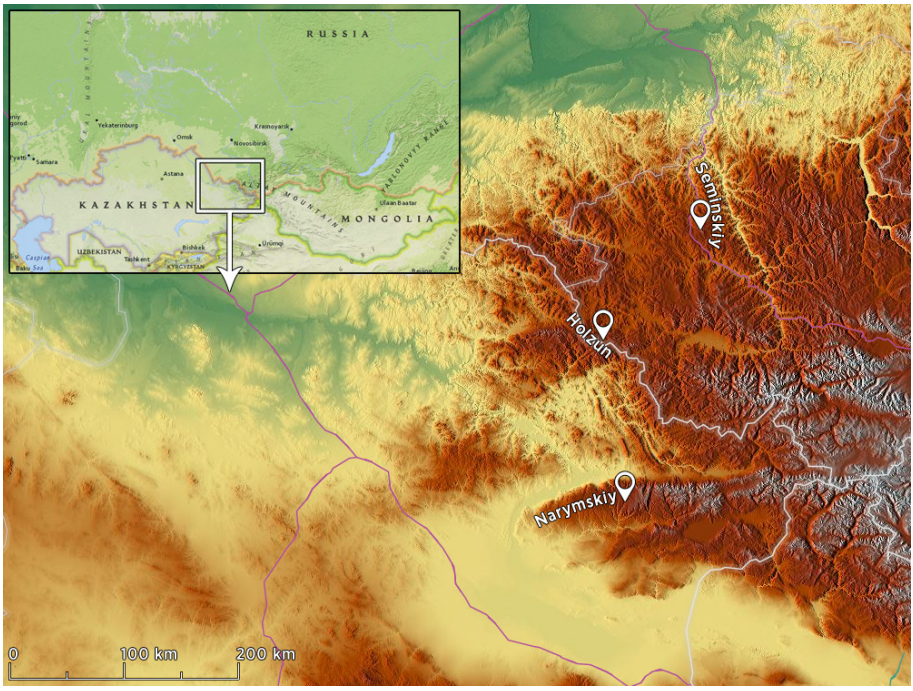

Fig. 3. The main known locations of *Ranunculus schischkinii* Revushkin

The following specimens have been examined:

«Vicinities of settl. Shebalino. Mt. Kurata, alpine stony tundra. 6 VII 1927. B. Shishkin» (TK!);

«Altai, vicinities of settl. Shebalino, upper reaches of the Kumalir river, alpine meadow. 7 VII 1927. B. Shishkin» (TK!);

«Gorno-Altai autonomous oblast, Ust-Koksinskiy distr., upper reaches of the Bannaya river, the Holzun ridge, high-mountain tundra. 06.07.1953. A. Kuminova» (NS!);

«Altai, the Seminskiy ridge, Mt. Sarlyk, alpine meadow. 5 VIII 1983. A. Revushkin, S. Vydrina, N. Gordeeva, V. Maltsev»;

«Altai, the Seminskiy ridge, Mt. Sarlyk, 57°03'N 85°50'E. Alpine lawn. 2.08.1984. M. Lomonosova» (NS!);

«Central Altai, the Holzun ridge, sources of the Bannaya river. In subalpine belt, on nival meadow. 7.08.1984. L. Malyshev» (NS!);

«Gorno-Altai autonomous oblast. Ongudayskiy distr., Mt. Sarlyk, nival meadow. 10-13.07.1986. A.S. Revushkin, S.N. Vydrina, A.V. Rakitin, N.M. Sergeeva, S.A. Przeworskaya, S.A. Pulkina» (TK!);

«East-Kazakhstan oblast, the Narymskiy ridge, valley of the Burlybai river, meadows with shrubs. 19.07.1986. Budulaeva, Utebekov» (AA!);

«Gorno-Altai oblast, sources of the Sarlyk river, alpine meadow. 21.07.1988. Alexander Revushkin» (TK!);

«Altai Republic. Shebalinskiy distr. The Seminskiy ridge, Mt. Sarlyk, along watercourse. 05.07.2005. Pyak A.I.» (TK!).

At present, it can be stated that all the known localities of *R. schischkinii* are found within the boundaries of the Altai Mountain Country on the Seminskiy, Holzun and Narymskiy ranges (Fig. 3).

Conclusion

Information about the localities of *R. schischkinii* on the Holzun and Narymskiy ridges have been published for the first time. According to administrative borders, the localities of *R. schischkinii* are currently known in two main locations (Seminskiy ridge, Holzun ridge) on the territory of the Altai Republic (Russia) and from one point (Narymskiy ridge) in East-Kazakhstan oblast (Kazakhstan). Thus, *R. schischkinii* is a subendemic species for both Russia and Kazakhstan. The distribution of this species is more extensive than previously studied, but not significantly. Therefore, strict ecological and high-altitude confinement of *R. schischkinii* is useful for predicting its subsequent locations. However, it is obvious that available information on known localities of this buttercup is not enough for robust modeling of distribution prediction maps using such algorithms as GARP or Maxent, and, probably, the expert evaluation is more optimal.

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