

Towards a taxonomic revision of the genus *Trollius* (*Ranunculaceae*) in the Asian part of Russia. I. *Trollius chinensis*: taxonomic and geographical reconsiderations

К таксономической ревизии рода *Trollius* (*Ranunculaceae*) в азиатской части России. I. *Trollius chinensis*: критический анализ таксономии и географии

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Abstract. The present paper opens a series of publications by the author on taxonomy and geography of the genus *Trollius* L. in the Asian part of Russia. *Trollius chinensis* Bunge was chosen as a focus of the paper, since the current status of knowledge of taxonomy and geography of this species appeared to be inadequate. Results of the research prove a vast distribution range of *T. chinensis* in Russia within which there is a number of contact zones with other species of the genus, resulting in active interspecific hybridization. Detailed adjusted morphological description and list of synonyms are elaborated, *T. vitalii* Stepanov and *T. chinensis* subsp. *macropetalus* (Regel) Luferov are reduced to synonymy; combination *T. macropetalus* (Regel) F. Schmidt should be considered invalidly published and withdrawn from usage. Occurrence of *T. chinensis* in Mongolia (Harhira Mountain Area) is recorded for the first time.

Keywords: *Trollius*, *T. chinensis*, synonymy, distribution range, hybridization.

Аннотация. Настоящая работа открывает цикл публикаций автора по систематике и географии рода *Trollius* L. в азиатской части России. В качестве основного объекта этой статьи выбран *Trollius chinensis* Bunge — вид, современные представления о котором — от таксономических до географических — оказались не соответствующими действительности. Результаты исследований доказывают обширный ареал *T. chinensis* на территории России и наличие многочисленных зон контакта (и гибридизации) этого вида с другими купальницами. Уточнены диагноз и синонимика *T. chinensis*; *T. vitalii* Степанов и *T. chinensis* subsp. *macropetalus* (Regel) Луферов отнесены к синонимам *T. chinensis*; показано, что комбинация *T. macropetalus* (Regel) F. Schmidt недействительно обнародована; впервые доказано нахождение *T. chinensis* в Монголии (горный массив Хархираа).

Ключевые слова: *Trollius*, *T. chinensis*, синонимика, ареал, гибридизация.

Trollius L. is a genus of ca. 30 (Kadota, 1985, 2016), 31 (Doroszevska, 1974) to 35 species (Luferov et al., 2018) of perennial herbs distributed entirely in the temperate/extratropical zones of the North Hemisphere, often (even mainly) in mountain areas — within forest-steppe, forest, subalpine, alpine — up to tundra/goltsy — altitudinal belts. On flat terrain *Trollius* species occur in wetlands (including wet forests and meadows), often near water streams and on flood plains.

Main reasons of uncertainty in the number of species within the genus *Trollius* are:

- still incomplete understanding of distribution ranges of *Trollius* species occurring in Asia;
- still unsatisfactory knowledge of variation range within groups of critical species;

— unlimited capability of almost all the species to hybridize (also in natural plant communities);

— treating of *T. lilacinus* Bunge and sometimes *T. chartosepalus* Schipcz. (Khokhrjakov, 1977) within a separate genus *Hegemone* Bunge;

— absence of currently accepted monograph of the genus: the effort by Alina Doroszevska (1974) is obsolete and full of well-known discrepancies.

Thus, I must admit that V. N. Siplivinsky's eloquent phrase: "The genus *Trollius* belongs to those genera of our flora for which accumulation of material is far ahead of taxonomic development" (Siplivinsky, 1972: 163) — is still valid.

History of taxonomic study of the genus *Trollius* in Asian part of Russia dates back about a century. Primary accumulation of material was connected with big

names of Russian botany: K. J. Maximowicz, V. L. Komarov, E. L. Regel, A. A. Bunge and others. The first monograph of the genus and treatment of *Trollius* for Flora of USSR published by N. V. Schipczinsky (1924, 1937) became obsolete already up to beginning of 1960s; the works by V. V. Reverdatto (1943) and L. I. Malyshev (1965) contributed a few new taxa but did not contain in-depth taxonomic considerations. At the same time the genus *Trollius* in Japan and Korea was studied by Japanese botanists T. Nakai, K. Miyabe and others. Their efforts were summarized by Miyabe (1943). Siplivinsky (1972) published a paper “Genus *Trollius* L. in Asia boreali et orientali” which became a long-term extremely important source for the Asian species of the genus. Two years later another monograph of *Trollius* was published by Doroszevska (1974). It contained an original intrageneric classification (the genus was subdivided into 7 new sections) which is still in use by taxonomists. However, this monograph has not become a fundamental basis for further research, since it contains a number of serious drawbacks: the author did not study type material of almost all the species (clearly confirmed that in the monograph), did not critically revise species in the Asian part of Russia and did not compose satisfactory identification key to the species. Until *Trollius* treatment for Flora Sibiriae (Friesen, 1993) — which cannot be considered a value-add to the taxonomic knowledge of the genus — only a few articles were published, particularly those containing descriptions of new species: *T. bargusinensis* Sipliv. (Siplivinsky, 1973) and *T. aldanensis* Volot. (Volotovskiy, 1990). N. V. Stepanov (1994) described a new species from West Sayan — *T. vitalii* Stepanov (alongwith several infraspecific taxa), and another one — *T. kolonok* Stepanov — from Kuznestska Alatau (Stepanov, 2018).

After a number of contributions (Kadota, 1985, 1987) Y. Kadota (2016) published a revision of the genus *Trollius* in Japan — a very important research, in which — besides a description of three new species (*T. soyaensis* Kadota, *T. teshioensis* Kadota and *T. rebunensis* Kadota) and one new section (*Yezoinsulicola* Kadota) — substantiated a broad concept of *T. riederianus* Fisch. et C. A. Mey. and commented on usage of petals (nectaries) morphology as diagnostic (not just morphometric) characters. Unfortunately, in a revision of the genus *Trollius* in Far East of Russia (Luferov et al., 2018; nine species recognized for the region) the Kadota's paper was completely ignored. Another recent contribution on the genus *Trollius* in the flora of the Altai Mountain Country (Erst et al., 2018) comprises only three species — *T. asiaticus* L., *T. altaicus* C. A. Mey. and *T. dschungaricus* Regel. Despite the author's statement on a geographical delimitation of the

researched region (comprising a whole Altai Mountain Country, incl. Russian, Kazakh, Chinese and Mongolian territories) absence of *T. chinensis* Bunge on the list of species is doubtful.

Recently A. S. Erst et al. (2019) described a new species from South Siberia — *T. austrosibiricus* Erst et Luferov. The authors compared it with *T. chinensis* and *T. macropetalus* (here considered as comb. inval.), i. e. with *T. chinensis*. A “Key to identification species of the genus *Trollius* from Russia” comprising 16 species was given (again, the recent revision of the genus *Trollius* in Japan by Kadota (2016) is ignored).

Trollius chinensis was chosen as a focus of the present paper, since the current status of knowledge of taxonomy and geography of this species appeared to be inadequate, although its distribution range in the Asian part of Russia is vast, morphological variation range is significant and the number of contact zones with other *Trollius* species is high.

Materials and methods

I have been studying taxonomy and geography of the genus *Trollius* since 2013. All the authentic specimens of *Trollius* in LE (alongwith a several type specimens from P and K) have been thoroughly studied, as well as important herbarium collections (LE, MW, MHA, MWG and others). Field material was collected in 2019 in Tunkinskii District, Buryatia (S macroslope of East Sayan Mountains) and N macroslope of Khamar-Daban Mountain Ridge, Baikal State Nature Reserve, Kabansk District, Buryatia. Field observations of previous years (1981–1992) in different regions of Siberia (Altai, Kuznetsk Alatau, East Sayan, Khamar-Daban, etc.) were analyzed. All the collected herbarium specimens are deposited in MHA, living plants are cultivated in Tsitsin Main Botanical Garden of RAS. Molecular genetic studies of species (currently *T. chinensis* and *T. asiaticus*) and interspecific hybrids (plants from hybrid populations *T. chinensis* × *T. asiaticus*) of the genus *Trollius* have been started.

Habitat data are recorded including:

- inventory and mapping of *Trollius* species populations;
- geobotanic descriptions of the plant communities in which species of the genus *Trollius* occur.

Another important source of valuable information is represented by photographs from natural habitats in different parts of the species distribution range.

Taxonomic treatment

Trollius chinensis Bunge, 1833, Enum. Pl. China Bor.: 3; id. 1833, Mém. Prés. Acad. Imp. Sci. St. Pétersb. 2 [marked “1835” on front page], 1–2: 77; Luferov,



Fig. 1. Syntype of *Trollius ledebourii* var. *macropetalus* (P00194367, <https://science.mnhn.fr/institution/mnhn/collection/p/item/p00194367?listIndex=235&listCount=1193>).

2004, Turczaninowia, 7 (1): 8; Luferov et al. 2018, Turczaninowia, 21 (2): 112. $\equiv$ *T. asiaticus* L. var. *chinensis* (Bunge) Maxim. 1889, Enum. Pl. Mongolia, 1: 25; Finet et Gagnep. 1904, Bull. Soc. Bot. France, 4: 396; Craib, 1914, Curtis's Bot. Mag. 140: tab. 8565; Schipcz. 1924, Izv. Glavn. Bot. Sada RSFSR, 23: 69; id. 1937, Fl. URSS, 7: 47; Sipliv. 1972, Novosti Sist. Vyssh. Rast. 9: 169–170; Dorosz. 1974, Monogr. Bot. 41: 74.

Holotype (“lectotypus”, Grabovskaya-Borodina, 2010: 372): “China, 1831, d[ed]. Bunge”, fl. fragm. (LE: LE 01013585!).

Protologue: “Tr. sepalis 10–12 patulis, petalis 20 ligulatis sepala aequantibus, stamina plus duplo superantibus. Hab. in Chinae borealis provincia Schan-ssi, ubi flores in usum medicinale colliguntur. Flores tantum exsiccatos vidimus”.

= *T. ledebourii* Rchb. [var.] γ *macropetalus* Regel, 1861, Mém. Acad. Imp. Sci. Pétersb., sér. 7, 4, 4 (Tent. Fl. Ussur.): 8. $\equiv$ *T. chinensis* subsp. *macropetalus* (Regel) Luferov, 1991, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 96, 5: 74; id. 2004, Turczaninowia, 7 (1): 8; Luferov et al. 2018, Turczaninowia, 21 (2): 113. — *T. macropetalus* (Regel) F. Schmidt, 1868, Mém. Acad. Imp. Sci. Pétersb., sér. 7, 12, 2 (Reisen Amur-Lande): 88, comb. inval.; Vorosch. 1982, Opred. Rast. Sovet. Dalnego Vostoka: 260.

Syntypes: “Coast of Manchuria, lat. 44–45 N, 1859, C. Wilford” (K, P00194367!). — Fig. 1.

Protologue: “floribus circiter 6-sepalis, sepalis suborbicularibus quam petala brevioribus. P. [corr.: T.] *chinensis* Max. prim. pag. 22 et Wilf. pl. exsicc. [corr.: exsicc.] Am Tatarischen Golf (Kusnezoff). An der Küste der Mandschurei (Wilford)”.

= *T. vitalii* Stepanov, 1994, Florogenet. Analiz, 1: 101.

Holotype: [Krasnoyarsk Territory] Ермаковский р-н, Западный Саян, хр. Кулумыс, окр. Ойского озера, субальпийский луг [Yermakovskoye District, West Sayan, Kulums Ridge, Oiskoye Lake vicinity, subalpine meadow], 11 VI 1990, N. Stepanov (NS0000407!, labelled “Isotype”); isotypes — LE: LE 01038901!, KRAS (not seen).

Protologue: “Typus: Sajan Occidental[is], trajectus Bujbinskij, vallis fl. Bolschaja Oja, pratum subalpinum, 11 VI 1990, N. Stepanov (NS, isotypi — LE, KRAS)... Тип: Западный Саян, хр. Кулумыс, окр. Ойского оз., субальпийский луг [West Sayan, Kulums Ridge, Oiskoye Lake vicinity, subalpine meadow], 11 VI 1990, Н. В. Степанов [N. V. Stepanov] (NS, изотипы [isotypes] — LE, KRAS)”.

— *T. ledebourii* auct. non Rchb.: Kom. 1903, Acta Horti Petropol. 22, 1 (Fl. Manch. 2, 1): 230.

Perennial herbs with simple or branched (up from the middle part) erect stems (20)30–120 cm tall, with one or several (usually 2) flowers; stems smooth, striate, enclosed with fibrous remains of the previous year's petioles at the base. Rhizome short, with brownish black thread-like roots. Basal leaves long-petioled, (1–2)3–6(10), 3–5-divided into more or less rhombic lobes; those dissected, margins serrate-dentate, with ovate to ovate-elliptic teeth shortly apiculate at the apex. Petioles smooth, up to half of the stem length or slightly longer, without pronounced geniculum in upper part. Leaf blade thin coriaceous (to coriaceous in the plants growing at highest altitudes); upper surface bright to dark green, velvety, with deeply impressed veins, sometimes with purple spot at the centre; lower surface contrastively silvery green, glossy, veins prominent, pubescent with appressed hairs (the contrast pattern persists in herbarium). Cauline leaves 3–7, lower ones on petioles up to 13(15) cm long, similar to the basal in shape, upper sessile, smaller (reduced); peduncles 5–15 cm long, getting longer at frutescence (to 20 cm long). Flowers 4–6 cm in diam., shallow bowl-shaped to saucer-shaped. Sepals of different tones of orange, usually bright orange (often turning yellow in herbarium specimens), slightly concave, broadly ovate to broadly elliptic, sometimes erose at the apex (sepals of the lower circle sometimes with a few teeth of irregular shape at the apex, tinged green), (5)6–12(14); petals (nectaries) about 20, getting (significantly) longer in course of anthesis, (subequal or shorter than sepals at the early flowering stage) longer (up to 2 times) than sepals, linear, more or less long aculeate or acute towards the apex (in herbarium specimens — to sword-like), 1.7–3 mm wide, same colour or slightly darker than sepals (in herbarium specimens often brighter than sepals), throughout the length fleshy but not thickened; nectary pit in the shape of a flat pocket, 1.5–3 mm from the base. Stamens two times shorter than petals, 13–20 mm long, incl. the anther length (2.5–4 mm), pale yellow to yellowish. Anthers with short acumen at the apex. Ovary green, more or less arcuate or curved, 3–3.5 mm long, style shorter than ovary (or subequal), stigma yellow. Follicles 12–40, in a head 1–2 cm diam.; follicle up to 14 mm long, with a beak up to 4.5(5) cm long; beaks straight, sometimes bent outwards at the basis, slightly arcuate (in herbarium specimens more often), (1.5)2–3.5(4) mm long, purplish/tinged purple as well as the area around their bases. Seeds 3–7 per follicle, dark brown, matt, oval. Flowers in June — July; second flowering (mid — late August) recorded in Amur Region and Primorye Territory. $2n = 16$ (Doroszewska, 1974). — Figs. 2–4.



Fig. 2. *Trollius chinensis* at anthesis.

1–3 — Primorye Territory, Ussuriysk Municipal Region, Monakino vicinity, 2 VII 2008, photos by L. V. Kraynik; 4 — Kunashir Island, Kurilskii State Nature Reserve, Filatov's cordon vicinity, VII 2002, photo by Yu. V. Ovchinnikov; 5 — Khamar-Daban Mountain Range, Snezhnaya River valley, 25 VII 2016 (plant of hybrid origin — *T. chinensis* × *T. asiaticus*), photo by Yu. V. Ovchinnikov; 6 — plant from old horticultural collection at Botanical Garden of Irkutsk State University, photo by S. S. Kalyuzhny.



Fig. 3. *Trollius chinensis* at fruiting.

1, 2 — fruiting plant: Republic of Buryatia, Tunkinskii District, Tubota River valley, study plot 2019-Tubota_main, 24 VII 2019, photos by K. P. Savov; 3, 4 — fruiting heads: Primorye Territory, Shkotovskii District, Sukhodol River basin, Novonezhino vicinity, 6 VII 2014, photos by L. V. Kraynik.

Table. Key characters to differentiate *Trollius chinensis* and *T. ledebourii*

Diagnostic character	<i>Trollius chinensis</i>	<i>Trollius ledebourii</i>
Petals per flower	About 20	Up to 10–12
Petals/stamens length ratio	2	1.2–1.4
Petal apex	Long aculeate/acute	Rounded, often incised
Anther length and shape	Up to 4 mm, more or less cylindric	Up to 8 mm, elongate and flattened
Teeth of leaf blade margin	More or less equal in size, ovate to ovate-elliptic, shortly apiculate at the apex	Teeth of irregular size and shape, acute or aculeate at the apex
Leaf blade texture	Coriaceous, upper surface velvety	Thin to thin coriaceous (rarely and mostly in hybrid plants), upper surface smooth
Beak of the follicle, length	Up to 5 mm	Up to 2 mm

Comments to morphological description. All the leaves to illustrate intrapopulation variability of the basal leaf blades (Fig. 4) were collected within the study plot 2019-Tubota_main ($3.4 \times 7.5 \text{ m}^2$; $51.872618^\circ \text{ N } 102.802318^\circ \text{ E}$; $h = 1039 \text{ m a. s. l.}$).

Flowers with number of sepals around 14 could be observed mostly in cultivated plants, often of hybrid origin (Doroszevska, 1974). Forming follicles of *T. chinensis* $\times$ *T. asiaticus* are often characterized by rather big purple spots and red to purple sutures.

According to our observations, the beaks of mature follicles remain straight up to opening, while in herbarium specimens of the same plants the beaks could turn arcuate in course of pressing and drying.

Affinity

Morphologically, *T. ledebourii* should be considered the closest species to *T. chinensis*. Both species have shallow bowl-shaped or saucer-shaped flowers (almost obligatory flat saucer-shaped in *T. ledebourii*) and long linear and not thickened petals always longer than stamens. At a superficial glance the plants with small number of sepals from *T. chinensis* populations are particularly close to *T. ledebourii*. Some important diagnostic characters to differentiate these species are presented in the Table.

In the contact zones of *T. chinensis* and *T. ledebourii* distribution ranges (e. g., in Amur Region) these species often form spontaneous hybrid populations, that causes identification difficulties. Many horticultural hybrids of these species have been originated long ago and still are widely cultivated.

Taxonomic and nomenclatural notes

The history of Bunge’s publication “Enumeratio plantarum, quas in China boreali collegit” (Bunge, 1833) which caused so many errors in nomenclature citations of the species, described by the author from his collections in China (1830–1831), is analyzed in detail by A. E. Borodina-Grabovskaya (2007). It appears, though, it is 1833 that should be considered a year of

the actual publication of issues 1–2 of the second volume of “Mémoires de l’Académie Impériale des Sciences de St.-Pétersbourg... Tome second, 1re & 2me livraison”. Besides that, I am supporting and following her decision to cite the both preprint and the publication of 1833 at all those taxa.

The only known to the date original specimen of *T. chinensis*, cited as the lectotype by Grabovskaya-Borodina (2010), contains 8 flowers in different safe state, stored in an envelope. No other authentic specimens have been found so far (P, TU). Bunge notices in the protologue: “Flores tantum exsiccatos vidimus [I have seen dried flowers only]” (Bunge, 1833: 3), therefore the cited specimen is most probably the only element of the original material, i. e. holotype (Turland et al., 2018: Art. 9.1(b)). According to Bunge (1833) flowers of *T. chinensis* were used in traditional local medicine.

The history of the name *T. macropetalus* (Regel) F. Schmidt is curious and paradoxical. Authors of many taxonomic papers referred to the work by F. Schmidt (1868: 88) as a place of valid publication of this combination. As a matter of fact, one can find on that page the only mention of the name *T. macropetalus* in a more than 220-pages paper. It says: “An Kräutern in dieser Region wüsste ich im Süden nur wenig Neues zu nennen, so *Trollius macropetalus* und *Lilium Glehni* [I have not known a lot about herbs in south of this region, such as *Trollius macropetalus* and *Lilium glehnii*]”. In contrary, neither of the researchers referred to the nomenclature citation, diagnosis and taxonomic comment for *T. ledebourii* var. *macropetalus* given by Schmidt on pages 105–106 of the publication (within a Synopsis – section Specieller Theil):

“18) *Trollius Ledebourii* var. *macropetala* Rgl. et Maak fl. ussur. n. 24. *T. chinensis* Max. n. 38.

T. 1–2 pedalis, foliis supra glaucescentibus, sepalis 5–7 rotundatis patulis, petalis c. 20–25 erectis lineari-lanceolatis aurantiacis sepala superantibus, quam stamina duplo longioribus stylis rectis $\frac{1}{4}$ carpellorum non superantibus.

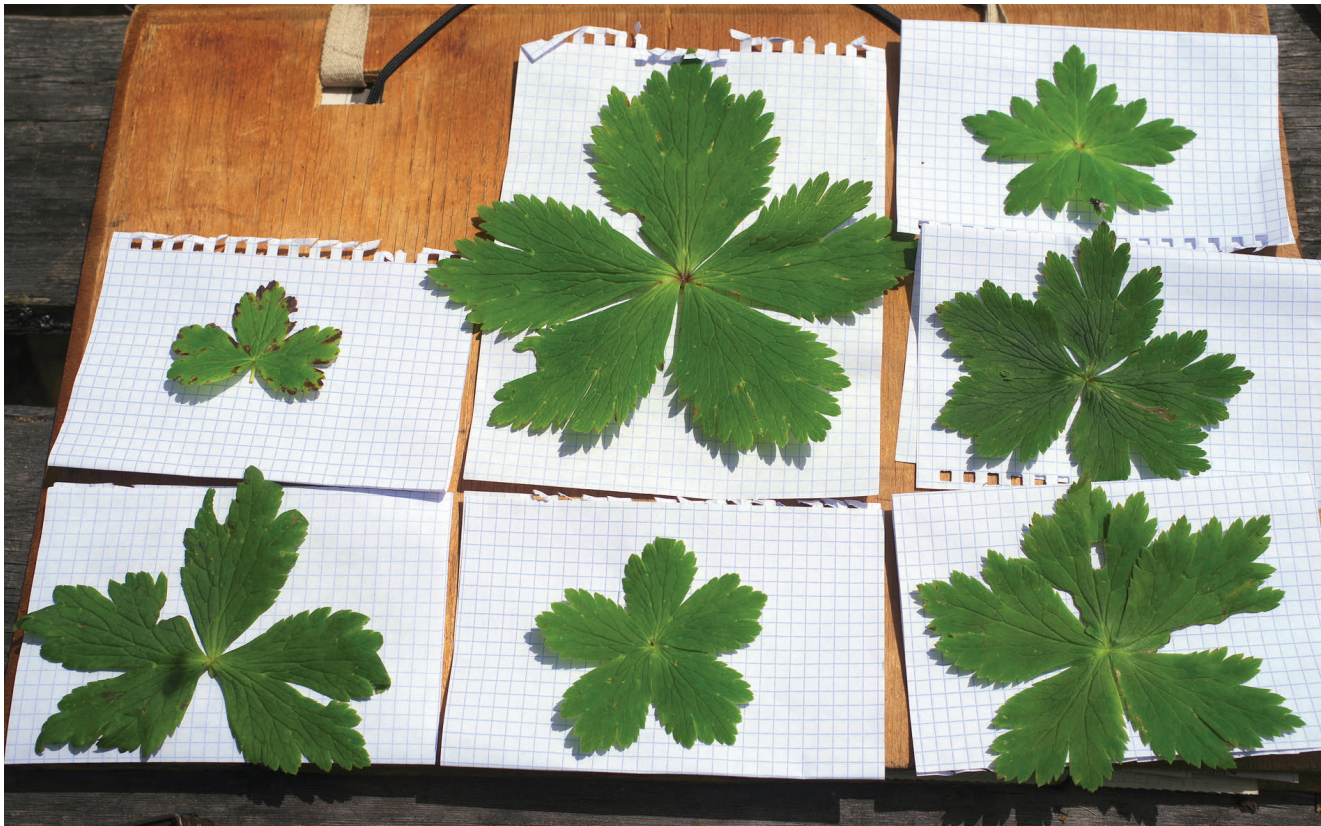


Fig. 4. Intra-population variability of basal leaves in *Trollius chinensis*: Republic of Buryatia, Tunkinskii District, Tubota River valley, study plot 2019-Tubota_main, 24 VII 2019, photo by K. P. Savov.

Differt a. *T. Ledebourii* genuino petalis longioribus stylisque rectis brevioribus; a. *T. chinensi* Bge. sepalis paucioribus patulis.

T. japonicus Miq. l. c. III, p. 6 petalis stamina aequantibus nec illa sub duplo superantibus differe videtur”.

V. N. Siplivinsky (1972) followed by A. N. Luferov (1991) additionally referred to page 218 of the Schmidt’s publication where one can find the following paragraph: “Ich bin mehrfach in das bekannte Dilemma von guten und schlechten Arten gerathen, und es finden sich noch jetzt unter meinen neuen Species einige, die vielleicht mit mehr Recht als Varietäten bei schon bekannten Arten untergebracht werden könnten, während manche Varietäten wiederum von Anderen als gute Species hingestellt werden moechten. Ich will hier gleich auf diejenigen Species hinweisen, deren Artrechte ich für zweifelhaft halte, wie auch diejenigen Varietäten, die vielleicht wieder zu Species erhoben werden duerften: *Trollius Ledebourii* var. *macropetala*, die ich früher als eigene Species hingestellt hatte, kann doch vielleicht eine gute Art sein. [I have repeatedly fallen into the well-known dilemma of good and bad species, and among my new species there are still some

which perhaps may be better treated as good varieties, and some varieties, in turn, considered by others to be good species I would rather like to discard. I will immediately point out the species which I consider doubtful, as well as the varieties which perhaps may be raised to species level: *Trollius Ledebourii* var. *macropetala* which I had considered earlier to be a separate species may appear to be a good species.]” (Schmidt, 1868: 218).

Trollius ledebourii var. *macropetala* opens a list of doubtful taxa with no final taxonomic decision taken, so it is the only accepted name for the taxon in this publication. Occasional usage of combination *T. macropetalus* on p. 88 of the publication is most probably a lapse and/or trace of the author’s reminiscences about evaluating the status of this taxon. The construction “I had considered earlier” on p. 218 refers to the time when F. Schmidt had started to evaluate this taxon, not to the previous episode in the publication. Page 105 should be the only correct reference in the respective nomenclature citation.

Thus, the combination “*Trollius macropetalus*” was not explicitly accepted by Schmidt, therefore it was not

validly published (Turland et al., 2018: Art. 36.1) and should be withdrawn from usage.

Treating of plants with a small number of strongly deflexed sepals (6 according to the protologue; 5–7 according to Schmidt (1868)) and petals up to 35 mm long gradually tapering at the top as a separate subspecies *T. chinensis* subsp. *macropetalus* (Regel) Luferov (Luferov, 1991, 1995) appears to be an unsatisfactory decision due to the following reasons:

- number of sepals within a single population varies significantly; the plants at the first anthesis are often characterized by a small number (5–7) of sepals;
- a long-lasting growth of petals often results in changing the shape of apex (gradual tapering/sharp narrowing) during anthesis;
- sepals deflection angle also changes significantly in course of anthesis.

Luferov (1991) suggested that there are graceful transitions between type subspecies and *T. chinensis* subsp. *macropetalus* in a form of clinal characters change (from West to East): e. g., number of sepals reduction, petal length increase, petal shape change. That is not corroborated by our data from different parts of *T. chinensis* distribution range: e. g., in the Far East populations plants with 7–10 sepals per flower were recorded many times while within the western sector of the distribution range plants with 5–7 sepals per flower are not rare.

Siplivinsky (1972) considered *T. macropetalus* as a synonym of *T. chinensis*. He commented on intraspecific variability of the species as follows: “Growing in such a vast mountain territory *T. chinensis* does not remain stable in its morphological characters. E. g., in the South, in Changbai Mountains, the most robust plants with big flowers and leaves, petals 1.5–2 times longer than sepals (5–8 per flower) could be observed. In the North and East (e. g. Primorye) – in contrary, plants with 5 sepals and shorter petals predominate. In the West number of sepals varies from 8 to 12 and petals are only slightly longer than sepals or subequal to them” (Siplivinsky, 1972: 169–170, translated from Russian). Taking into consideration lack of data from a significant part of *T. chinensis* distribution range, a big number of wrongly identified herbarium specimens and lack of in-depth knowledge of variation within hybrid populations of the species I consider it premature and inaccurate to argue the clinal characters change in *T. chinensis*.

A broad concept of *T. chinensis* is adequate and instrumental. However, a correct identification of herbarium specimens imposes a simultaneous presence of petals, basal leaves and anthers on the voucher, since the labels almost never contain detailed information on phenology/population patterns in the locality. For ex-

ample, plants of hybrid origin (*T. chinensis* × *T. ledebourii*) are often characterized by 5–6 sepals and very long petals gradually tapering to the apex, but petal shape (rounded, often incised at the apex) and long anthers on short and weak filaments) indicate “blood” of *T. ledebourii* in the plant.

N. V. Stepanov (1994) published one new species, two its varieties and one form from West Sayan: *T. vitalii* Stepanov, *T. vitalii* var. *forficuloides* Stepanov, *T. vitalii* var. *nadezhdae* Stepanov, and *T. vitalii* f. *asiaticifolius* Stepanov. As diagnostic characters of *T. vitalii* the author mentioned long straight beaks of follicles (up to 3–3.5 mm long), petals shorter than sepals, curved ovaries, style as long as ovary. All those characters agree with *T. chinensis* diagnosis and variation range, which is completely corroborated by authentic specimens. It is worth mentioning that the author stated in diagnosis/description of *T. vitalii* that the number of its sepals varies from 16 to 25. The number of sepals in the original specimens (KRAS, LE and NSK) does not, however, exceed 12. Comparatively short petals in flowers of the original specimens indicate early flowering phase.

It is possible that the author did not consider *T. chinensis* to be (at least) an affinity of *T. vitalii*, since none of the available bibliographic sources contained information on *T. chinensis* distribution in Siberia.

On the website of the Plantarium project (<https://www.plantarium.ru/>), there is a gallery of *T. vitalii* images (*Trollius vitalii* Stepanov, 2007–2019), where all the depicted plants are identified by N. V. Stepanov and several ones are published by him. One of them (Stepanov, 2009) is taken in locus classicus of *T. vitalii*, and illustrates a plant with a flower of 14 sepals. Some other photographs (e. g., Dragan, 2016; Pool, 2018) represent plants of a hybrid origin (*T. chinensis* × *T. asiaticus*).

Hybrid genesis of the illustrated plants is corroborated by petals morphology, flower shape and other characters. *T. chinensis* × *T. asiaticus* hybrids differ from *T. chinensis* s. str. by broadly lanceolate multiveined petals (similar to *T. asiaticus*) rarely exceeding sepals, globose (not shallow bowl-shaped) flower of many sepals arranged in circles (similar to *T. asiaticus*).

In my opinion, *T. vitalii* should be placed in a synonymy of *T. chinensis*; the infraspecific taxa described by Stepanov should not be treated taxonomically but taken into consideration from the perspective of studying variation range, particularly in hybrid populations, since they are, in fact, interspecific hybrids *T. chinensis* × *T. asiaticus*.

Recently described *Trollius austrosibiricus* Erst et Luferov (Erst et al., 2019) is most likely an interspecific hybrid *T. asiaticus* × *T. chinensis*: morphological comparison between *T. austrosibiricus* and related species,

presented by the authors, does not contain diagnostic differences, e. g. one can find lots of plants with simple rhizomes within a single *T. chinensis* population; all the morphometric differences mentioned are not in fact diagnostic. However, the shape of petals is very typical of *T. asiaticus* × *T. chinensis* hybrids: it is very close to that of *T. asiaticus* (broad and multiveined), except for the apex which is not rounded but clearly acute. For the time being (and until a thorough study of all the authentic specimens of *T. austrosibiricus* — holotype and six paratypes are cited) I will keep considering this taxon as another *T. asiaticus* × *T. chinensis* hybrid. It is weird, that the authors do not comment on *T. vitalii* although one of *T. austrosibiricus* paratypes was collected near locus classicus of the former species.

Distribution

General distribution range. Asian part of Russia, 700–2100 m alt.; Mongolia (Uvs Province, Harhiraа, ca. 2700 m alt.; North and North-East China (Hebei, N Henan, W Jilin, W Liaoning, E Nei Mongol, Shanxi provinces), 1000–2200 m alt. (“on grassy slopes” — Li, Tamura, 2001); north of Korean Peninsula.

Distribution in Asian part of Russia.
Krasnoyarsk Territory. Yermakovskoye District: West Sayan (Kulumys Ridge, Oiskoye Lake vicinity, Bolshoi Kebezh River upstream). **Republic of Buryatia.** Tunkinskii and Okinskii Districts: East Sayan (Orlik vicinity, Mondy vicinity, Arshan vicinity, Tubota River

valley); Zakamensk District: Jida uplands (Tsakirka River upstream, Malyi Subutui River fountain); Kabansk District: Khamar-Daban Mountain Range (Snezhnaya River valley, 4 km upstream from Monomakh Hat peak; Baikal Nature Reserve); Barguzin District, near Bolshoi Chivyrkui River mouth; Bauntovskii Evenkiiskii District. **Trans-Baikal Territory.** **Amur Region** (south). **Sakhalin Region.** Sakhalin (south-west, Holmsk vicinity), Kunashir Island (Kurilskii State Nature Reserve, Filatov’s cordon vicinity). **Khabarovsk Territory** (near Grossevichi Bay). **Primorye Territory** (Fig. 5).

The herbarium specimen from Mongolia (Harhiraа Ridge, Tsagan-Dygl Mt., Ogureyeva (MWG!)) not only proves the Mongolian locality but also marks the highest elevation (2700 m alt.) *T. chinensis* reaches within its distribution range (Fig. 6). Occurrence of *T. chinensis* in Mongolian Altai seems to be highly probable.

Previous views on *T. chinensis* distribution range in the Asian part of Russia (Schipczinsky, 1937; Siplivinsky, 1972; Voroschilov, 1982; Luferov, 2004; Luferov et al., 2018) should be radically changed. The material studied during this research project (herbarium specimens, living plants collected in the wild, photographs from different parts of distribution range, etc.) proves a vast distribution range of *T. chinensis* in the Asian part of Russia (from West Sayan in the west to Kunashir Island in the east). Moreover, it is the second-third in area within the genus after *T. asiaticus* and *T. sibiricus* Schipcz.

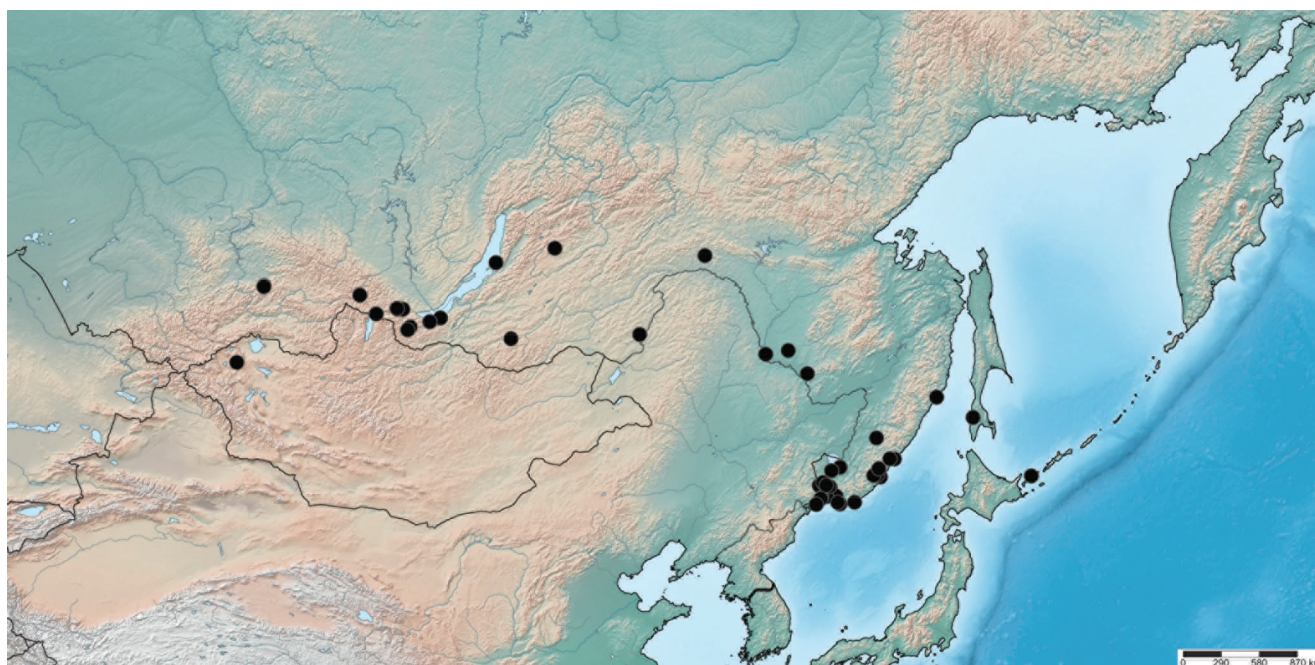


Fig. 5. Distribution of *Trollius chinensis* in the Asian part of Russia and Mongolia.



Fig. 6. Herbarium specimen of *Trollius chinensis* from Mongolia (MWG).

The distribution ranges of *T. chinensis*, *T. asiaticus*, *T. sibiricus*, *T. ledebourii* and *T. riederianus* s. l. within the Asian part of Russia overlap on a large area and extent, forming numerous contact zones and hybrid populations. Further studies should be focused on improving the knowledge of the distribution ranges, revealing and describing the hybrid populations and carrying out the necessary molecular genetic research.

Habitat and ecology

Forest and forest-steppe altitudinal zones: swamp coniferous forests — swamp larch open forest with dwarf bog birch (tree and shrub strata dominants: *Larix gmelini* (Rupr.) Kuzen., *Betula pendula* Roth, *Salix bebbiana* Sarg. — *Betula fruticosa* Pall.) on a flat summit of the coniform hill, h = 1090 m alt. (Selyutina, 2018, pers. comm.); wet meadows on fertile soils, forest edges, riversides and towpaths, open/thin forests at the upper forest boundaries. Subalpine altitudinal zone: subalpine meadows, often near water streams. Alpine (goltsy) altitudinal zone: meadows near headstreams, subnival small meadows, 1600 m a. s. l. (Khamar-Daban) — 2700 m a. s. l. (Harhiraa Ridge).

According to our observations in Tunkinskii District, Tubota River valley (July 2019) the populations of *T. chinensis* were recorded within the higher part of the forest altitudinal zone — in forest edges, riversides and roadsides. One population was described in details (results to be published elsewhere): Republic of Buryatia, Tunkinskii District, Tubota River valley, study plot 2019-Tubota_main (3.4 × 7.5 m²); 51.872618° N 102.802318° E, h = 1039 m a. s. l. It comprised 47 plants: 15 fertile mature, 14 immature, 18 juvenile.

Cultivation

T. chinensis — one of the most attractive species of the genus *Trollius* — was introduced in European horticultural collections at the end of 19th century along with several other species of Globe Flower (*Trollius*). A mess with names of cultivated plants existing at that time resulted in another introduction (re-introduction) of this species in the beginning of 20th century in the UK by the company J. Veitch & Sons. The company distributed the plants of the clone collected in China by W. Purdom. Thus, *T. chinensis* gained a broad popularity and won the praise of publication (and colour plate) in Curtis's Botanical Magazine (Craib, 1914).

Practically from the very beginning of the initial introduction numerous horticultural cultivars were originated on the basis of *T. chinensis* and/or via its hybridization with other species. Few species were used for hybridization: *T. europaeus* L. and *T. ledebourii* among them (Doroszewska, 1965, 1970). As a result of the

both targeted and spontaneous hybridization in garden collections many forms carrying labels *T. chinensis* (being very different from the species morphologically) became widespread across Europe. One of the consequences of that tendency was a misconception of the species which is still existing among horticulturalists.

Selection of the horticultural forms was aimed to create tall, multi-flowered plants with big bright flowers (of many sepals) and maximally long petals (Fig. 2: 6). That is why horticultural forms with extremely long petals (often incised at the apex) are very popular.

Geographically representative selection of collections studied

Herbarium specimens: Appendix 1 (see the journal's website: www.binran.ru/journals/novitates/).

Photographs from natural habitats: Appendix 2 (see the journal's website: www.binran.ru/journals/novitates/).

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Supplementary materials (Appendices 1, 2) to the article are available on the journal's website (www.binran.ru/journals/novitates/).

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