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The genus *Rhaponticum* in East Asia

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Abstract

The genus *Rhaponticum* in East Asia has always been a taxon for discussion. *Rhaponticum carthamoides* from East Siberia comprises three subspecies: *carthamoides*, *chamarensis* and *orientale*. Even though they differ in morphology, they do not have isolated areas. *Rhaponticum satzyperovii* was recently described and its author pointed out its affinity with *Rh. uniflorum*. Plant height, stem indumentum, and radical and stem leaf dissection were signaled as the diagnostic characters. Our present study on living and herbarium specimens of *Rh. satzyperovii* shows that the diagnostic characters are not consistent. The species area was also claimed to be an argument for considering *Rh. satzyperovii* a distinct species. This area covers the south of the Primorye Province in the Far East of Russia with some locations in the adjacent Jewish Autonomous Region and in China. In our study, the area of *Rh. satzyperovii* is found to be within the area of *Rh. uniflorum* and thereafter they turned out to have no disjunction. In East Asia, *Rh. uniflorum* is characterized by a wide range of morphological variability. We suggest that *Rh. satzyperovii* should be included within *Rh. uniflorum* without any taxonomic rank.

Key words: East Asia; *Rhaponticum*; taxonomy.

Resumen

El género *Rhaponticum* en el Este de Asia.- El género *Rhaponticum* en el Este de Asia ha sido siempre un taxón discutido. *Rhaponticum carthamoides* del Este de Siberia incluye tres subespecies: *carthamoides*, *chamarensis* y *orientale*. Aunque difieren en su morfología, sus áreas no están aisladas. *Rhaponticum satzyperovii* fue descrito recientemente y su autor señaló su afinidad con *Rh. uniflorum*. Los caracteres diagnósticos fueron la altura de la planta, el indumento del tallo y las divisiones de las hojas basales y caulinares. Nuestro estudio de plantas vivas y muestras de herbario de *Rh. satzyperovii* muestra que los caracteres diagnósticos no son consistentes. El área de distribución también se argumentó para considerar *Rh. satzyperovii* una especie diferente. El área cubre el sur de la provincia de Primorye en el extremo Este de Russia con algunas localidades en la adyacente región Autónoma Judía y en China. En nuestro estudio hemos visto que el área de *Rh. satzyperovii* está dentro del área de *Rh. uniflorum* y por lo tanto no cabe hablar de disyunción. En el Este de Asia, *Rh. uniflorum* se caracteriza por un amplio rango de variabilidad morfológica. Proponemos que *Rh. satzyperovii* se incluya en *Rh. uniflorum* sin ningún rango taxonómico.

Palabras clave: Este de Asia; *Rhaponticum*; taxonomy.

INTRODUCTION

Up to the present, the names *Rhaponticum* Vaill., *Stemmacantha* Cass. and *Leuzea* DC. have been used in floristic reports and in literature covering the studies on chemical composition of the plant species of *Rhaponticum*. The authorship of the name *Rhaponticum* was usually ascribed to Adanson (1763) and more recently to Vaillant (1718) according to Susanna and Garcia-Jacas (2007). However, this name was used as early as Bock, Prosperus, Bauhin and other authors (Dittrich, 1973; Holub, 1973, 1974).

Many taxonomists developed the system of the genus *Rhaponticum*. In 1718 Vaillant used this name for a group of plants including species of the genera *Leuzea* and *Acroptilon* Cass., according to the contemporary conceptions. In 1742, Haller used the name *Rhaponticum* (Holub, 1973) for the association of four species of the *Asteraceae*. Ludwig (1747) published the genus name *Rhaponticum* and included 9 species into the genus. Linnaeus (1753) developed the classification of *Rhaponticum*, but he placed many species of *Centaurea* L. into this genus. Lamarck (1779) excluded *C. rhapontica* L. from *Centaurea* and transferred to the genus *Rhaponticum* as *Rh. scariosum* Lam. Later on, a number of authors clarified and changed the boundaries of the genus *Rhaponticum* (Jussieu, 1789; De Candolle, 1838; Ledebour, 1845; Bentham, 1876; Hoffmann, 1890). They even placed species of the genera *Cnicus* L., *Serratula* L., *Cirsium* Mill. and *Centaurea* into this genus. The genus name *Rhapontica* was suggested by Hill (1762) and the IAPT (International Association of Plant Taxonomy) resolved to consider this name to be homonym of *Rhaponticum* (Dittrich, 1984), which led to the generalized use of the genus name *Stemmacantha* Cass., described by Cassini (1818) with *Serratula cynaroides* DC. as the type species. Cassini (1818) considered the special structure of calyx bracts to be the distinguishing character of the genus. The classification of *Stemmacantha* proposed by Dittrich (1984) was adopted by Czerepanov (1995) and it included 20 species, 10 subspecies and 2 varieties. Finally, Greuter (2003) recovered Vaillant's names

and assigned, hopefully this time definitely, the name *Rhaponticum* to the genus.¹

In the literature on flora of Siberia, the Russian Far East (RFE), Mongolia, Korea and China and in publications on taxonomy of the *Asteraceae*, there is no agreement regarding the species composition of the genus *Rhaponticum*. In the check-list of Czerepanov (1995) there are three species of *Rhaponticum* (as *Stemmacantha*), namely *St. carthamoides* (Willd.) Dittrich, *St. uniflora* (L.) Dittrich and *St. satzyperovii* (Sosk.) Czer. reported for East Asia.

Rhaponticum satzyperovii was described in 1959 by Soskov based on the collections of 1913 from Primorsky Province. Dittrich (1984) included it into *Stemmacantha* as a subspecies, *St. uniflora* subsp. *satzyperovii* (Sosk.) Dittrich.

Rhaponticum carthamoides (Willd.) Iljin is distributed on subalpine meadows of Central and East Siberia, and outside Russia it grows only in two locations in the Mongolian Altai (Grubov, 1982; Zhironova, 1997; Doronkin, 2003) and is represented by three subspecies: *Rhaponticum carthamoides* subsp. *carthamoides*, *Rh. carthamoides* subsp. *orientale* (Serg.) Doronkin, and *Rh. carthamoides* subsp. *chamarensis* (Peschkova) Doronkin, that differ in morphological characters (shape of appendages of outer involucral leaflets), but do not have isolated areas. There are no other species related to *Rh. carthamoides* described from Siberia. In the south-eastern part of Siberia the area of *Rh. carthamoides* reaches the area of the southern lakeside of Baikal (Zhironova, 1997).

Rhaponticum carthamoides is used in Russia as a medicinal plant and as a source for ecdysteroid production. Mass harvesting of these species today accounts for working out measures on its conservation. The cited literature and synonyms are provided below.

Rhaponticum uniflorum (L.) DC. was reported in «Key-book of plants of Primorye and Primurye» by Vorobyev *et al.* (1966), who listed *Rh. satzyperovii* as a synonym. To the contrary, Voroschilov (1966) reported two species of *Rhaponticum* for the RFE, *Rh. uniflorum* and *Rh. satzyperovii*, and noted that in the territory of Primorye Province there are plants both similar to typical *Rh. uniflorum* and others with

¹ Note added in press: According to Brummitt (pers. comm.), German translation of Vaillant on which relied Greuter's validation of the name *Rhaponticum* Vaill. will be declared *opera utique oppressa* by the Nomenclature Committee. The name for the genus returns to *Stemmacantha* Cass.

characters transitional between *Rh. satzyperovii* and *Rh. uniflorum*. Later on, Voroschilov (1982, 1985) combined *Rh. satzyperovii* as *Rh. uniflorum* subsp. *satzyperovii* (Soskov) Vorosch.

In the survey «Vascular plants of the Soviet Far East», Barkalov (1992) recognized two independent species: *Rh. uniflorum* and *Rh. satzyperovii*.

In the floristic surveys on Siberia by Popov (1959), Peshkova (1979) and Zhironova (1997), two species were reported for the territory of East Asia, *Rh. carthamoides* and *Rh. uniflorum*. The «Key-book on vascular plants of Mongolia» the only accepted species was *Leuzea uniflora* (L.) Holub (Grubov, 1982).

Kitagawa (1979) reported *Rh. uniflorum* for Siberia, Mongolia, Amursky and Ussuriysky Regions, Korea and China. In the surveys on flora of Korea (Lee, 1993; Lee, 1996) only *Rh. uniflorum* was mentioned as well. *Stemmacantha carthamoides* and *S. uniflora* were reported for China (Chu, 1987), but *Rh. satzyperovii* was treated as synonym of *Rh. uniflorum*.

We carried out a study in order to ascertain whether *Rh. satzyperovii* is a different species from *Rh. uniflorum*.

MATERIALS AND METHODS

The paper is based on the study of living plants of *Rh. uniflorum* and *Rh. satzyperovii* collected during expeditions to nature populations in the Irkutskaya, Chitinskaya, Amurskaya and Jewish Autonomous Regions, Khabarovsk and Primorsky Provinces, and the study herbarium material in LE, MHA, MW, VLA, the Pacific Institute of Bioorganic Chemistry (Vladivostok), the Far-Eastern Branch of the Russian Academy of Sciences (FEB RAS), the Botanic Garden-Institute FEB RAS (Vladivostok), the Institute of aquatic and ecological problems FEB RAS (Khabarovsk), the Institute of Complex Analysis of Regional Problems FEB RAS (Birobidzhan), the Zabaikalsky State Pedagogical University of N.G. Chernyshevsky (Chita), the Blagoveschensk State Pedagogical University of M. I. Kalinin (Blagoveschensk), and literature data.

RESULTS AND DISCUSSION

Our study of living plants of *Rh. satzyperovii*, as well as observation of herbarium materials, has shown that the diagnostic characters indicated by

Soskov (1959, 1963) are not consistent. The species description (Soskov, 1959, 1963) details that *Rh. satzyperovii* is close to *Rh. uniflorum*, but «... it has isolated area and is well distinguished by its robust stem up to 1 m high, lyrate radical leaves and large superficially partite, often pinnatilobate, stem leaves and a number of other characters...». Having observed more than 300 plants of *Rh. satzyperovii* in “locus classicus” we were able to collect some specimens that corresponded to *Rh. uniflorum* in their morphological characters.

We registered high variability in plants of both species. The most variable are the shape and dissection of radical and lower stem leaves, i.e. the characters that were considered to be distinguishing in the description of *Rh. satzyperovii*. Within a single population of *Rh. satzyperovii* there are plants with lyrate radical leaves with a large terminal lobe and slightly partite lobed stem leaves, as well as individuals with pinnatipartite or pinnatifid leaf blades without a large terminal lobe. Often in the same leaf rosette there are leaves of two forms with all transitions between them. Such pattern is typical to both *Rh. satzyperovii* from “locus classicus” and the plants in the northernmost location of the area (by Soskov YU.D.) of *Rh. satzyperovii* in the Jewish Autonomous Region in the vicinities of Bidzhan Settlement. Such pattern in leaf variability is observed in plants of *Rh. uniflorum*. The species characters that describe *Rh. satzyperovii* easily fit into character variability of *Rh. uniflorum*. We have not found any differences between *Rh. uniflorum* and *Rh. satzyperovii* in morphological characters.

Within the species one can find plants with xeromorphic pattern: dwarfish, with small dissected (often as deep as to the central costa) leaf blades with up to 12 pairs of narrow-lanceolate lobes. Usually those are plants which grow in open southern steppe or stony hill slopes. Xeromesophytic plants are tall (up to 1 m high), with large, pinnatilobate or slightly partite into 3-8 pairs of wide ovate-oblong lobes, lyrate leaves – they often occur on elevated sites river valleys, sea shores, sometimes under forest canopy. Plants with xeromorphic pattern grow in the north-western part of the area in the regions with continental, arid climate (the Tuva and Buryatiya Republics, the Irkutskaya, Chitinskaya and the north of Amurskaya Regions, Mongolia, North and Central China). Plants with xeromesophytic pattern are restricted to the regions with

humid, warm, monsoon climate (the southern areas of the Amurskaya Region, the Jewish Autonomous Region, Primorsky Province, North-East China and Korea Peninsula).

The area of *Rh. satzyperovii* (Soskov, 1959) covers the territory of south Primorsky Province of the RFE, the Jewish Autonomous Region (Stolbovoye Village and Bidzhan Settlement) and North-East China (near Sochintsy, Matsyaokhe Station). In the area of *Rh. uniflorum*, Soskov (1963) reports a significant disjunction from the northern part of Zeya-Bureya floristic region (in the Amurskaya Reion) and «...as a carried plant on the Muraviov-Amursky Peninsula, Putyatin Island and in the vicinities of Ussuriysk city ...».

While specifying the growth locations of *Rh. uniflorum* in Russia, Mongolia, China and Korea we ascertained that this plant does not occur in the Russian Far East and Siberia as a carried plant and the area of the species turned out to be continuous (with no disjunction). The area continuity of *Rh. uniflorum* is provided by this species growing in North-Eastern China (Manchuria). *Rh. uniflorum*, which is characterized by a wide range of morphological variability, grows in East Siberia, Mongolia, Central, North and North-East China, Primorsky and south Amursky Provinces, and the Korean Peninsula. The area of *Rh. satzyperovii* is then within the area of *Rh. uniflorum*.

Morphometric studies on carpological character variability in *Rh. satzyperovii* and *Rh. uniflorum* (Basargin & Vorobyeva, 2004), morphology and anatomy of achenes, as well as stomatographic analyses, did not reveal any specific difference (Zaremba, 2000). For all these reasons, *Rh. satzyperovii* should be considered a synonym of *Rh. uniflorum*.

Nomenclature, citations and synonyms of *Rhaponticum carthamoides*

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centauroides Willd. ex Ledeb., Fl. Ross. 2(2,7): 753. 1846 ≡ *Serratula carthamoides* Poir., Encycl. (Lam.) 6(2): 561. 1805 ≡ *Serratula cynarifolia* Poir., Encycl. (Lam.) 6(2): 561. 1805 ≡ *Leuzea carthamoides* DC. in Ann. Mus. Paris 16: 205. 1810 and Prodr. 6: 666. 1837; Ledeb., Fl. Ross. 2(2): 753. 1845-1846; Turcz., Fl. Baic.-Dahur. 2(1): 135. 1856; Kryl., Fl. West. Sibiriae 11: 2943. 1949 ≡ *Leuzea altaica* Fisch. ex Schauer, Cat. Sem. Hort. Vrat. 1834 ≡ *Cirsium carthamoides* Link, Enum. pl. Hort. Berol. 2: 303. 1822 ≡ *Halocharis carthamoides* M. Bieb. ex DC., Prodr. 6: 666. 1837, pro syn. ≡ *Centaurea carthamoides* Benth., Gen. pl. 2: 479. 1873 ≡ *Stemmacantha carthamoides* (Willd.) Dittrich in Candollea, 39(1): 46. 1984; Chu, Fl. Reipubl. Popul. Sin. 78(1): 185. 1987; Czerep., Sosud. rast. Rossii i sopr. gosud.: 195. 1995; Doronkin, Fl. Sib. 14: 95. 2003.

Nomenclature, citations and synonyms of *Rhaponticum uniflorum*

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1935; Hu in Quart. Journ. Taiwan Mus. 19(1-2): 21. 1966 ≡ *Centaurea grandiflora* Pall., Reise 3: 237, 321. 1776; Kitag., Index Fl. Jehol.: 54. 1936 ≡ *Centaurea membranacea* Lam., Encycl. 1: 666. 1783; Hu in Quart. Journ. Taiwan Mus. 19(1-2): 20. 1966 ≡ *Serratula uniflora* (L.) Spreng., Syst. Veg. 3: 388. 1826 ≡ *Leuzea dahurica* Bunge, Enum. Pl. Chin. Bor. 37. 1833; Bunge id. in Mem. Acad. Sc. St. Petersburg. Sav. Etrang. 2: 111. 1835 ≡ *Leuzea satzyperovii* (Sosk.) Holub in Folia Geobot. Phytotax. (Praha) 8: 392. 1973 ≡ *Leuzea uniflora* (L.) Holub in Folia Geobot. Phytotax. (Praha) 8: 392. 1973; Grubov, Key-book of vascular plants of Mongolia: 262. 1982 ≡ *Rhapontica uniflora* (L.) DC., Diss. Comp.: 33. 1837; Maxim., Prim. Fl. Amur.: 176. 1859; Korsh. in Acta Hort. Petrop. 12: 361. 1892; Diels in Engler in Bot. Jahrb. Beibl.: 108. 1905; Kitam. in Mem. Coll. Sci. Kyoto Univ., ser. B., 13: 30. 1937; Kitag., Lineam. Fl. Mansh.: 461. 1939; Nakai in Bull. Nat. Sc. Mus. 31: 118. 1952; T. B. Lee, Illust. Fl. Korea: 77. 1993 ≡ *Rhaponticum dahuricum* (Bunge) Turcz. in Bull. Soc. Nat. Mosc. 11: 95. 1838 ≡ *Rhaponticum monanthos* (Georgi) Vorosch., Seed List State Bot. Gard. Acad. Sci. URSS viii. 28. 1953; cf. Botsch. in Not. Syst. Herb. Inst. Bot. Acad. Sci. URSS, xix. 642. 1959 ≡ *Rhaponticum satzyperovii* Soskov in Bot. mat. Gerb. Bot. In. AN SSSR 19: 400. 1959; Soskov, Fl. SSSR 28: 317. 1963; Vorosch., Fl. Sov. Far East: 436. 1966; Czerep., Vascular plants USSR: 92. 1981; Barkalov, Vascular plants Sov. Far East 6: 314. 1992 ≡ *Rh. uniflorum* subsp. *satzyperovii* (Soskov) Vorosch., Key-book of plants Sov. Far East: 583. 1982; Vorosch., Florist. issled. v raznykh raionakh SSSR: 198. 1985 ≡ *Stemmacantha uniflora* (L.) Dittrich in Candollea 39: 49. 1984; Chu, Fl. Reipubl. Popul. Sinicae 78, 1: 184. 1987; Czerep., Sosud. rast. Ross. sopred. gos.: 195. 1995; Doronkin, Fl. Sib. 14: 95. 2003 ≡ *Stemmacantha satzyperovii* (Sosk.) Czerep., Vascular plants USSR: 195. 1995 ≡ *Stemmacantha uniflora* subsp. *satzyperovii* (Sosk.) Dittrich in Candollea 39: 49. 1984.

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