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THE GENUS *RHAPONTICUM* VAIL. (ASTERACEAE: CARDUEAE – CENTAUREINAE)
IN SIBERIA AND FAR EAST

РОД *RHAPONTICUM* VAIL. (ASTERACEAE: CARDUEAE – CENTAUREINAE)
В СИБИРИ И НА ДАЛЬНЕМ ВОСТОКЕ

Summary. A taxonomy of the Asteraceae in Asia the genus *Rhaponticum* Vail. (*Leuzea* DC., *Stemmacantha* Cass.) is still a taxon for discussions. The species *Rh. carthamoides* (Willd.) Iljin in East Siberia unites 3 subspecies: *carthamoides*, *chamarensis* (Peschkova) Zhirova and *orientate* (Serg.) Soskov; although they differ in morphology, they do not have isolated areas. In 1959 Yu.D. Soskov described *Rhaponticum satzyperovii* and pointed to its affinity to *Rh. uniflorum* (L.) DC. The plant height, stem indumentum degree, radical and stem leaf dissection degree to be diagnostic characters. Studies on living plants of *Rh. satzyperovii* and herbarium (LE, MHA, MW, VLA) examination have shown that diagnostic characters are not consistent. Yu.D. Soskov claims the species area to be an argument of *Rh. satzyperovii* being a distinct species, whose area covers the south of the Primorye Province in the Far East of Russia with some locations in the Jewish Autonomous Region and in North-East China. He reported a disjunction in the area of *Rh. uniflora*. In the course of specification of growth locations of *Rh. uniflora* in Russia, Mongolia, China and Korea, the area turned out to have no disjunction. The area continuity takes place due to the species's growing in North-East China. The area of *Rh. satzyperovii* found itself «within» the area of *St. uniflora*. Thus, on the territory East Asia, *Rh. uniflora* occurs that is characterized with wide range of morphological variability and the area covering the territories of East Siberia, Mongolia, Central, North and North-East China, the Primorye Territory, the south of the Amur Region and Korean Peninsula. *Rh. satzyperovii* has been synonymized with *Rh. uniflora*.

Key words: *Rhaponticum*, Siberia, Far East, distribution.

Аннотация. Среди сложноцветных (Asteraceae) Азии, род *Rhaponticum* Vail. (*Leuzea* DC., *Stemmacantha* Cass.) остаётся одним из наиболее дискуссионных. Вид *Rh. carthamoides* (Willd.) Iljin в Восточной Сибири объединяет три подвида: *carthamoides*, *chamarensis* (Peschkova) Zhirova и *orientate* (Serg.) Soskov. Несмотря на некоторые морфологические различия, эти таксоны не являются полностью аллопатричными. В 1959 г. Ю.Д. Сосков описал *Rh. satzyperovii*, родственной *Rh. uniflorum* (L.) DC. и отличающийся от последнего размерами растений, интенсивностью опушения стебля, а также степенью рассечения прикорневых и стеблевых листьев. Изучение живых растений *Rh. satzyperovii* и гербарных коллекций (LE, MHA, MW, VLA) по данному таксону выявило непостоянство диагностических признаков. Одним из аргументов в пользу самостоятельности *Rh. satzyperovii*, по мнению Ю.Д. Соскова, является его ареал, охватывающий юг российского Дальнего Востока (юг Приморского края, несколько местонахождений также в Еврейской автономной области) и Северо-Восточный Китай, и не перекрывающийся с ареалом *Rh. uniflorum*. В процессе уточнения распространения *Rh. uniflorum* в России, Монголии, Китае и Корее, выяснилось, что ареал вида не является дизъюнктивным, а простирается сплошной полосой от Саян, Прибайкалья и Северной Монголии через Северо-Восточный Китай до Кореи и Дальнего Востока. Таким образом, ареал *Rh. satzyperovii* оказывается полностью включённым в область распространения *St. uniflorum*. Следовательно, на территории Восточной Азии произрастает один вид – *Rh. uniflorum*, характеризующийся значительным диапазоном морфологической изменчивости и встречающийся в Восточной Сибири, Монголии, Центральном, Северном и Северо-Восточном Китае, в Приморье, на юге Амурской области и на п-ве Корея. Название *Rh. satzyperovii* следует отнести к синонимам *Rh. uniflorum*.

Ключевые слова: *Rhaponticum*, Сибирь, Дальний Восток, распространение.

INTRODUCTION

The names *Rhaponticum* Vail. (*Rhaponticum* Hill, *Rhaponticum* Ludw.), *Leuzea* DC. and *Stemmacantha* Cass. are used in floristic reports and in

literature covering the studies on chemical composition of the plant species of this genus.

The authorship of the name *Rhaponticum* is ascribed to M. Adanson (1763). However, this name

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was used as early as H. Bock (1572), A. Prosperus (1612), G. Bauchin (1623) and other authors (Dittrich, 1973; Holub, 1973).

Many taxonomists developed the system of the genus *Rhaponticum*. In 1718, M. 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, A. Hauler used the name *Rhaponticum* (Holub, 1973) for the group of four species of the Asteraceae. Ludwig (1747) further expanded the concept of *Rhaponticum* (9 species) and later he (Ludwig, 1757) validated this generic name. K. Linneus (1763) developed the system of *Rhaponticum*, but he put many species of *Centaurea* L. into this genus. In 1779, J.B. Lamarck excluded *C. rhapontica* L. from the genus *Centaurea* and transferred it into the genus *Rhaponticum* as *Rh. scariosum* Lam. Later on, a number of authors clarified and changed the size of the genus *Rhaponticum* (Jussieu, 1789; De Candolle, 1837; Ledebour, 1845; Bentham, Hooker, 1876; Engler, Prantl, 1893), they put species of the genera *Cnicus* L., *Serratula* L., *Cirsium* Mill., and *Centaurea* into this genus. The genus name *Rhapontica* was suggested by J. Hill (1762) and the IAPT (International Association of Plant Taxonomy) resolved to consider this genus name to be the latest homonym of *Rhaponticum* (Dittrich, 1984). M.M. Ilyin (1933), Yu.D. Soskov (1959), M. Dittrich (1968, 1973, 1984), J. Holub (1973, 1974) studied the characters distinguishing *Rhaponticum* from closely related *Leuzea* and found out that these taxa differ in structure of achene surface, pappus structure and inflorescence form.

The genus *Stemmacantha* was described by H. Cassini in 1817 and *Serratula cynaroides* DC. was chosen to be the type species. H. Cassini considered special structure of calyx bracts to be the distinguishing character of the genus *Stemmacantha*. Later, A.P. De Candolle (1837) turned the genus *Stemmacantha* into the section of *Rhaponticum*. After the genera *Stemmacantha* and *Leuzea* were recognized as separate species in 1978, the IAPT made a decision to move species and subspecies from the *Rhaponticum* into the genus *Stemmacantha* (Dittrich, 1984). The system of the genus *Stemmacantha* proposed by M. Dittrich (1984) was adopted by S.K. Czerepanov in the check-list «Vascular plants of Russia and adjacent states» (1995) and it includes 20 species, 10 subspecies and 2 varieties. In the book «Systematics, evolution, and biogeography of Compositae» (Funk et al., 2009), the genus *Stemmacantha* is absent.

MATERIALS AND METHODS

The paper is based on the studies on living plants and herbarium specimens on *Rh. uniflorum* (L.) DC. and *Rh. satzyperovii* Sosk. collected during expeditions in nature populations in the Irkutskaya, Chitinskaya, Amurskaya and Jewish Autonomous Regions, Khabarovskiy and Primorsky Territories; herbarium material (LE, MHA, MW, VLA) and 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 (Blagoveschensk) and literature.

RESULTS AND DISCUSSION

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 limits of the genus *Rhaponticum* (*Stemmacantha*). In the check-list of S.K. Czerepanov (1995) there are three species of *Stemmacantha* – *St. carthamoides* (Willd.) Dittrich, *St. uniflora* (L.) Dittrich and *St. satzyperovii* (Sosk.) Czer. reported for East Asia. *Rhaponticum satzyperovii* described in 1959 by Yu.D. Soskov based on the collections of 1913 from Primorsky Territory, M. Dittrich (1984) includes into *Rhaponticum* 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 Mongolia (the Mongolian Altai) (Zhirova, 1997; Doronkin, 2003; Grubov, 1982) and is represented by the subspecies: *carthamoides*, *orientale* (Serg.) Soskov, *chamarensis* (Peschkova) Zhirova, that differ in morphological characters (shape of appendages of outer involucre leaflets), but do not have isolated areas. No more taxa of *Rh. carthamoides* affinity were described from Siberia. In the south-eastern part of Siberia the area of *Rh. carthamoides* reaches the area of the southern lakeside of Baikal (Zhirova, 1997). *Rhaponticum carthamoides* is used in Russia as a medicinal plant (*Leuzea* the strong root) and as a source for ecdysteroid production. Today mass harvesting of these species accounts for working out measures on its conservation. The cited literature and synonyms are provided below.

Rhaponticum carthamoides (Willd.) Iljin, 1933, Act. Inst. Bot. Acad. Sci. USSR, ser. 1, 1 :

204; Soskov, 1964, Fl. URSS, 28: 311; Zemlinsky, 1958, Med. plants USSR: 359; Polozhyi, Postnikov, Surov, 1980, Atlas areals a. resources med. pl. USSR: 185 (text, ic.), 103 (map); Zhirova, 1997, Fl. Sibiria, 13: 229, maps 162–164. – *Cnicus carthamoides* Willd. 1803, Sp. Pl. 3, 3: 1685. – *Stemmacantha carthamoides* (Willd.) M. Dittrich, 1984, Candollea, 39, 1: 46; Sh. Chu, 1987, Fl. Reipubl. Popul. Sinicae, 78, 1: 185; Czer. 1995, Sosud. rast. Rossii i sopr. gosud.: 195; Doronkin, 2003, Fl. Sibiria, 14: 95. – *C. centauroides* Willd. 1803, l. c. p. p. quoad pl. Sibir. – *C. uniformis* Sievers, 1796, in Pall. Neue nord. Beitr. 3: 346, nomen nudum. – *Serratula carthamoides* Poir. 1804, in Lam. Encycl. meth. 6: 561. – *S. cynarifolia* Poir. 1804, l. c., p. p. quoad pl. Sibir. – *Leuzea carthamoides* DC. 1810, Ann. Mus. Paris, 16: 205; id., 1837, Prodr. 6: 666; Ledeb. 1845–1846, Fl. Ross. 2, 2: 753; Turcz. 1856, Fl. Baic.-Dahur. 2, 1: 135; Kryl. 1949, Fl. West Sibiria, 11: 2943. – *L. altaica* Fisch. ex Schauer, 1834, Cat. Sem. hort. Vratisl.; id. 1835, Linnaea, 10: 117, non Link, 1822. – *Cirsium carthamoides* Link, 1822, Enum. Pl. Hort. Berol. 2: 303. – *Halocharis carthamoides* M. Bieb. ex DC. 1837, Prodr. 6: 666, pro syn. – *Centaurea carthamoides* Benth. 1873, in Benth. et Hook. f., Gen. pl. 2: 479.

Rhaponticum uniflorum (L.) DC. is reported in «Key-book of plants of Primorye and Priamurye» (Vorobyev et al., 1966) and *Rh. satzyperovii* is the synonym of this species. V.N. Woroschilow (1966) reported two species of *Rhaponticum* in the Russian Far East (FE): *Rh. uniflorum*, *Rh. satzyperovii* and noted that in the Primorye Territory there are plants both similar to typical specimens of *Rh. uniflorum* and with characters transitional between *Rh. satzyperovii* and *Rh. uniflorum*. Later, V.N. Woroschilow (1982, 1985) treated *Rh. satzyperovii* as *Rh. uniflorum* subsp. *satzyperovii* (Sosk.) Worosch. In the survey «Vascular plants of the Soviet Far East» (Barkalov, 1992) there are two independent species: *Rh. uniflorum* and *Rh. satzyperovii*.

In the floristic surveys on Siberia, M.G. Popov (1959), G.A. Peshkova (1979) and O.S. Zhirova (1997) report *Rh. carthamoides* and *Rh. uniflorum* for the territory of Sibiria. In the «Key-book on vascular plants of Mongolia» there is only *Leuzea uniflora* (L.) Holub (Grubov, 1982). M. Kitagawa (1979) reports *Rh. uniflorum* for Siberia, Mongolia, Amursky and Ussuriysky Regions, Korea and China. In the surveys on flora of Korea (T. Lee, 1993; Y. Lee, 1996) there is only *Rh. uniflorum* as well. *Rh. carthamoides* and *Rh. uniflorum* are reported

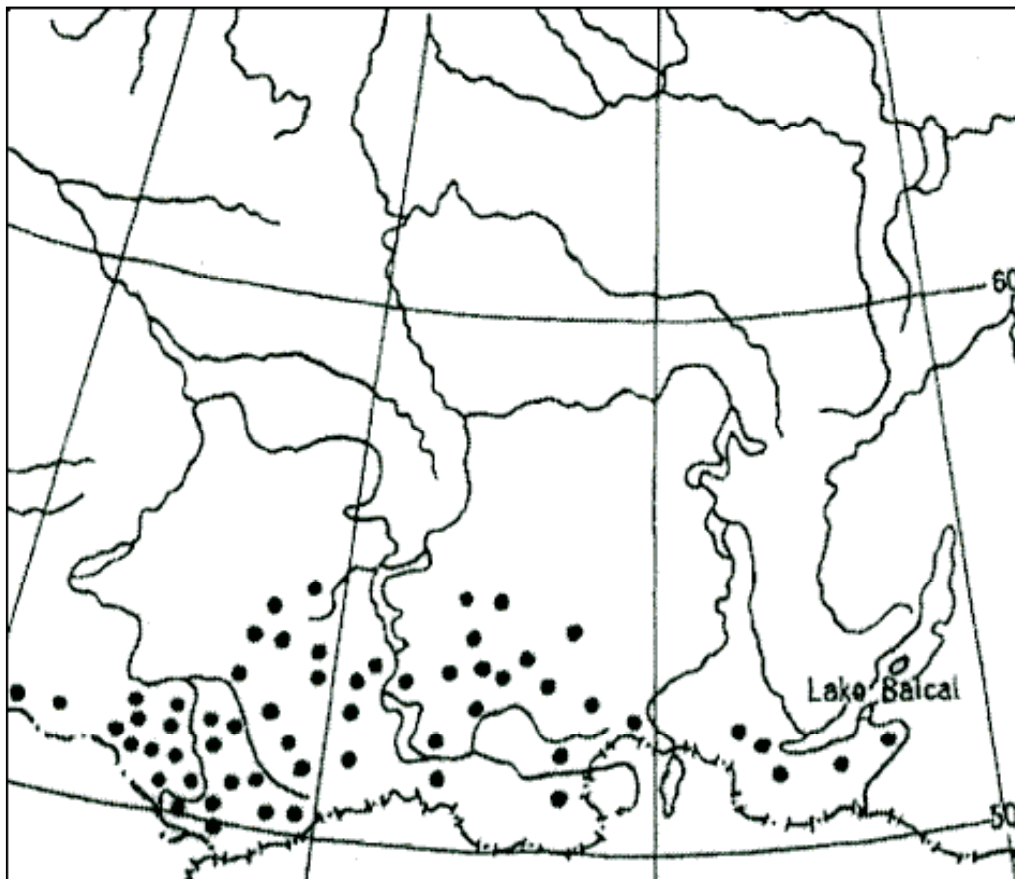


Fig. 1. Distribution of *Rhaponticum carthamoides*.

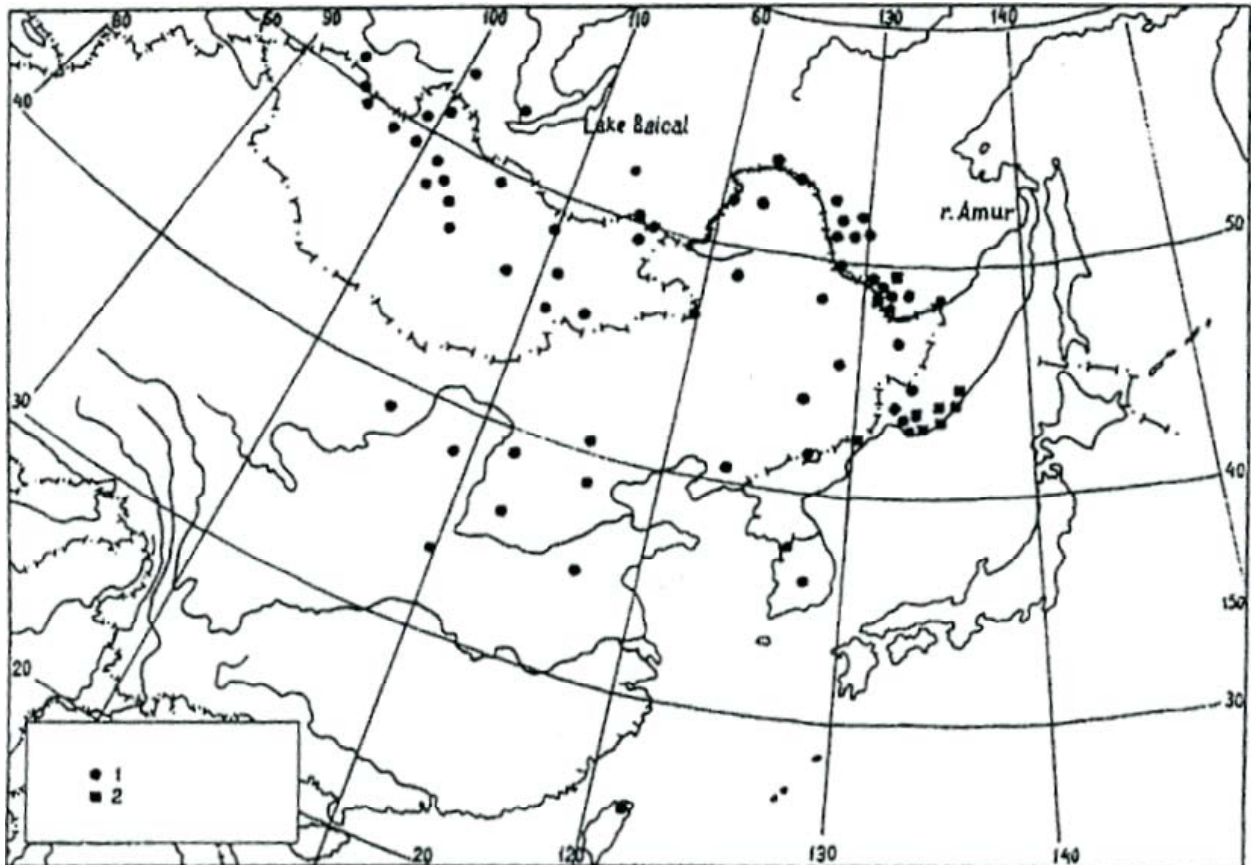


Fig. 2. Distribution of *Rhaponticum uniflorum*: ● – *Rh. uniflorum*, ■ – *Rh. satzyperovii* (synonym).

(Chu, 1987) for China, however *Rh. satzyperovii* is treated as synonym of *Rh. uniflorum*.

There is a special research in order to ascertain whether *Rh. satzyperovii* is an independent species. The species description (Soskov, 1959) in «The Flora of the USSR» (Soskov, 1963) says, 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...».

The studies on living plants of *Rh. satzyperovii*, as well as observation of herbarium materials have shown that the diagnostic characters, indicated by Yu.D. Soskov to be distinguishing, are not consistent. 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. There is 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 while describing *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 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 Territory in the vicinities of Bidzhan Settlement. Such pattern in leaf variability is observed in plants of *Rh. uniflorum*. The species characters describing *Rh. satzyperovii* are easily fit into a number of character variability of *Rh. uniflorum*. There are not any differences between *Rh. uniflorum* and *Rh. satzyperovii* in other 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 lobules. Usually those are plants of 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 lobules, lyrate leaves – they often occur on elevated sites of 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 restricted to the regions with humid, warm, monsoon climate (the southern areas of the Amurskaya Region, the Jewish Autonomous Region, Primorsky Territory, North-East China and Korea Peninsula). The area of *Rh. satzyperovii* (Soskov, 1956) covers the territory of south Primorsky Territory of the RFE, the Jewish Autonomous Region (Stolbovoye Village and Bidzhan Settlement) and North-East China (near Sochinty, Matsyaokhe Station). In the area of *Rh. uniflorum*, Yu.D. Soskov reports a significant disjunction from the northern part of Zeya-Bureya floristic region (in the Amurskaya Reion) and «...as an introduced 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 an introduced plant and the area of the species turned out to be continuous (with no disjunction). The area continuity of *Rh. uniflorum* provided by this species growing in North-East China (Manshuria). The area of *Rh. satzyperovii* found itself «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 research did not reveal any specific difference (Zarembo, 2000).

In East Siberia, Mongolia, Central, North and North-East China, in Primorsky and the south of Amursky Territories, in Korea Peninsula there is *Rh. uniflorum* that is characterized with a wide range of morphological variability, and therefore *Rh. satzyperovii* should be reduced to the synonyms of *Rh. uniflorum*. Detailed nomenclature of *Rh. uniflorum* is given below.

Rhaponticum uniflorum (L.) DC. 1810, Ann. Mus. Paris, 16 : 189; id., 1837, Prodr. 6 : 664; Ledeb. 1845–1846, Fl. Ross. 2 : 751; Turcz. 1856, Fl. Baic.-dahur. 2 : 133; Franch. 1883, Nouv. Arch. Mus. Hist. Nat. Paris, 6 : 62; id., 1884, Pl. David. 1 : 183; Popov, 1959, Fl. Mid. Sib. 2 : 866; Soskov, 1963, Fl. SSSR, 28 : 318; Woroschilow, 1966, Fl. Sov. Far East : 436; Vorobyev, 1966, Key-book of plants Prim. and Priamur. : 428; S.Y. Hu, 1967, 1. c. 20, 3–4 : 310; Peshkova, 1979, Fl. Central Sib., 2 : 890; Kitag. 1979, Neo-Lineam. Fl. Mansh. : 666; Czer. 1981, Vascular

plants USSR : 92; Woroschilow, 1982, Key-book of plants Sov. Far East : 583; H.Ch. Fu, 1982, Fl. Intramong. 6 : 211; Woroschilow, 1985, Florist. issled. v raznykh raionakh SSSR : 198; Barkalov, 1992, Vascular plants Sov. Far East, 6 : 314; Y.N. Lee, 1996, Fl. Korea : 858; Zhironova, 1997, Fl. Sibiria, 13 : 229. – *Cnicus uniflorus* L. 1771, Mant. Altera. : 572; Georgi, 1797, Reise, 3 : 1225; Willd. 1804, Car. Lin. Sp. Pl., 3 : 1685. – *Centaurea monanthos* Georgi, 1775, Reise, 1 : 231; Forbes et Hemsl. 1888, Journ. Linn. Soc. Bot. 23 : 470; Palib. 1898, Consp. Fl. Kor. : 120; Komarov, 1907, Fl. Manchuria, 3 : 761; Nakai, 1911, Fl. Korea, 2 : 48; id., 1923, Fl. Sylv. Koreana, 14 : 107; Komarov and Alisova, 1932, Key-book of plants of the Far-East. Province, 2 : 1086; Chen, 1934, Bull. Mem. Inst. Biol. Bot. 5 : 94; Ling, 1935, Contr. Inst. Bot. Nat. Acad. Peip. 3(4) : 178; S.Y. Hu, 1966, Quart. Journ. Taiwan Mus. 19, (1–2) : 21. – *C grandiflora* Pall. 1776, Reise, 3 : 237, 321; Kitag. 1936, Index Fl. Jehol. : 54. – *C. membranacea* Lam. 1783, Encycl. Meth. 1 : 666; S.Y. Hu, 1966, 1. c. : 20. – *Serratula uniflora* (L.) Spreng. 1826, Syst. Veg. 3 : 388. – *Leuzea daurica* Bunge, 1833, Enum. Pl. Chin. : 37; id., 1835, Mem. Acad. Sc. St. Petersburg. Sav. Etrag. 2 : 111. – *Leuzea uniflorum* (L.) Holub, 1973, Folia Geobot. Phylotax. (Praha), 8 : 392; Grubov, 1982, Key for vascular plants of Mongolia : 262. – *Leuzea satzyperovii* (Sosk.) Holub, 1973, 1. c. : 392. – *Rhapontica uniflora* DC. 1837, Diss. Comp. : 33; Maxim. 1859, Prim. Fl. Amur. : 176; Korsh. 1892, Acta Hort. Petrop. 12 : 361; Diels in Engler, 1905, Bot. Jahrb. Beibl. : 108; Kitam. 1937, Mem. Coll. Sci. Kyoto Univ., ser. B. 13 : 30; Kitag. 1939, Lineam. Fl. Mansh. : 461; Nakai, 1952, Bull. Nat. Sc. Mus. Tokyo, 31 : 118; T.B. Lee, 1993, Illust. Fl. Korea : 778. – *Stemmacantha uniflora* (L.) Dittrich, 1984, Candollea, 39, 1 : 49; Sh. Chu, 1987, Fl. Reipubl. Popul. Sinicae 78, 1 : 184; Czer. 1995, Sosud. rast. Rossii i sopr. gosud. : 195; Doronkin, 2003, Fl. Sibiria, 14 : 95. – *Rhaponticum dahuricum* (Bunge) Turcz. 1838, Bull. Soc. Nat. Mosc. 11 : 95. – *Rh. monanthum* (Georgi) Worosch. 1953, Seed list of Main Bot. Garden Acad. Sci. USSR : 8. – *Rh. satzyperovii* Sosk. 1959, Bot. mat. Gerb. Bot. In. AN SSSR, 19 : 400; 1. c. : 317; Worosch. 1966, 1. c. : 436; Czer. 1981, 1. c. : 92; Barkalov, 1992, 1. c. : 314. – *Rh. uniflorum* subsp. *satzyperovii* (Sosk.) Worosch. 1982, 1. c. : 583; 1985, 1. c. : 198. – *Stemmacantha satzyperovii* (Sosk.) Czer. 1995, 1. c. : 195. – *St. uniflora* subsp. *satzyperovii* (Sosk.) Dittrich, 1984, 1. c. : 49. – Icon.: Gmel. 1749, Fl. Sibirica, 2 : tab. 38.

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