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Typifications and taxonomic notes for *Veronica* subgen. *Pseudolysimachium* (Plantaginaceae) based on material from the Hungarian Natural History Museum Budapest (BP)

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Abstract

Veronica subgen. *Pseudolysimachium* is a group of 30 species ranging across northern Eurasia in various open habitats from dry steppe to swamps. It includes several horticulturally important species that have been crossed in the past. As such, it exemplifies a group with long taxonomic tradition, exemplified by more than 600 valid names, which also indicates its variability. In the process of identifying the evolutionary important units, molecular markers have started to help immensely. However, assigning names to identified significant groups of populations has been hindered by problems in typification. Here, we try to alleviate the problem for the taxa in southeastern Europe, which have been analyzed rigorously using AFLP fingerprints in the past, by lectotypifying 11 names and neotypifying four names, mostly based on specimens found in the Hungarian Natural History Museum Budapest (BP). This allowed revising *Veronica barrelieri* with its three subspecies and synonyms.

Introduction

Veronica subgen. *Pseudolysimachium* (Koch 1837: 527) Buchenau (1894: 447), sometimes segregated as genus *Pseudolysimachion* Opiz (1852: 80), is a group of about 30 species or more distributed across Northern Eurasia from Japan to the British Isles (Kosachev *et al.* 2016). It includes the horticulturally most important species of the genus *V. spicata* Linné (1753: 10) and *V. longifolia* Linné (1753: 10), which have been used as ornamentals for a long time and gave rise to a number of cultivars, often through hybridization with other species of the subgenus (Armitage 2008). In contrast, hybridization with species outside is not known and unlikely due to the synapomorphic chromosome base number of $x=17$ in *V.* subgen. *Pseudolysimachium*. The subgenus is characterized by a number of morphological characters (Albach *et al.* 2008) and dated to have originated between approximately 12 my (stem age) and 3 my ago (crown age) by Meudt *et al.* (2015). It is considered to be the fastest radiating subgenus of the genus in the Northern Hemisphere (Meudt *et al.* 2015). Until today, Albach & Fischer (2003) and Trávníček *et al.* (2004) took the most comprehensive studies on the European species of *V.* subgen. *Pseudolysimachium* based on morphological and ploidy level analyses and gave a detailed perspective on Central European members. They provided the taxonomic basis for the first detailed study in the group based on DNA sequence variation using AFLP and cpDNA, which supported the hypothesis that hybridization is widespread (Bardy *et al.* 2011). Focusing on *V. spicata*, *V. orchidea* Crantz (1769: 333) and *V. barrelieri* H.Schott ex Roemer & Schultes (1817: 94) it was shown that genetically pure individuals (i.e. individuals that did not experience introgression in their parents since the origin of the species) exist in geographically separate regions with many hybrids in between. Especially, the region of Transylvania and Banat are rich in hybrids between all three species. For example, plants identified as *V. crassifolia* Wierzbicki ex Heuffel (1835: 251, nom. illeg.; or in the legitimate name *V. barrelieri* subsp. *crassifolia* Hayek 1929: 157) from the Banat region were demonstrated to be genetically intermediate between *V. barrelieri* and *V. orchidea*. To verify the hypothesis that *V. crassifolia* sensu Wierzbicki is a hybrid one would need to investigate the type material. However, few names in the subgenus have been lectotypified, yet. Recently, hybridization was also shown to have major impact on the diversification of the subgenus through intraindividual variation in ribosomal DNA (Kosachev *et al.* 2016). Therefore, the lack of typification becomes a hindrance for further taxonomic studies in the subgenus. Typifications are necessary to allow the exact morphological and genetic circumscription of species, geographic variants and hybrid forms.

A recent investigation of material at the Natural History Museum in Budapest (BP) offered the possibility to significantly increase the number of names typified in the group and clarify the taxonomic meaning of these and several other names. The herbarium in Budapest houses approximately 1.8 million specimens of vascular plants including important collections from central and Eastern Europe, the formerly larger Hungary. These have been collected primarily in the second half of the 19th and the beginning of the 20th century. This time has been an important era for herbarium exchange leading to types of some taxa being widely distributed. Further, more in-depth analyses of the European flora led to the description of many infraspecific taxa. Budapest has been a central herbarium for many gatherings from Eastern Europe. The most important collections with respect to *V.* subgen. *Pseudolysimachium* are those by Heinrich Schott (father) and Johann (János) Heuffel, both of them housed/kept in BP.

We here aim at filling the identified gap in typification of taxa in *V.* subgen. *Pseudolysimachium* focusing on types present in Budapest (BP). Based on unpublished information by the first author (see below), there are approximately 840 names in the subgenus with about 600 of them being valid. More than 300 of them require a type but so far only 64 have a holotype and 27 a lectotype designated, which leaves more than 200 names to be typified. Even focusing on southeastern Europe (including Austria, Hungary and Romania), more than 70 names need to be typified, which has been done only for 14 of the names so far. It, therefore, is obvious that revising the group in a geographically limited area cannot be done easily in a single study. We here begin the revision by focusing on the collections of the especially type-rich herbarium in Budapest. We demonstrate the importance of the herbarium in Budapest to revise and typify species, clarify geographical variants from one specific region and highlight the importance of collections by a single botanist to understand the variation within such a horticulturally important group of plants. In more detail, first, we revise *V. barrelieri* including its intraspecific variation. Second, we typify *V. bachofenii* Heuffel (1835: 235). Third, we clarify names published from material of Vojvodina and Syrmia in the southern Pannonian plains. Fourth, we typify names based on plants grown by H. Schott in Vienna and names attributed to him. Fifth, we typify two other names important for recent investigations of diversification in the subgenus based on herbarium specimens in BP.

Materials and Methods

For the purpose of this study the whole collection of *Veronica* at the Natural History Museum in Budapest (BP) was studied and compared with material from other herbaria, such as B, HBG, K, M, PRC, W, WU, and protologue information. This includes information on more than 97% of all protologues for more than 4000 names in the genus and inspecting about 30 herbaria world-wide and plants.jstor.org.

Measurements of specimens in OLD and BP were recorded using a binocular microscope (Zoom stereo microscope SZX16, Olympus Corporation) and the software CellSens Dimensions (Olympus Corporation). Herbarium abbreviations follow Thiers (continuously updated). The symbol “!” was used for specimens seen by at least one of the authors. Names in the taxonomic section are ordered stating homotypic names first, within homo- and heterotypic names valid ones first and then according to date.

Results

1. Taxonomy of *Veronica barrelieri* H.Schott ex Roemer & Schultes (1817: 94)

Description

Veronica barrelieri has often been confused and regarded to be conspecific with *V. spicata* and *V. orchidea*. Diagnostic characters distinguishing it from these are, therefore, underlined.

Perennial herb, rhizome woody, prostrate, slender, 2–4 mm thick, 10 cm long, likely longer, much branched, roots arising from all along the rhizome. **Stems** ascending, (20)30–50 cm tall, glabrous (subsp. *nitens* and *andrasovszkyi*) or with hairs on the upper part of the stem patent (curved upwards in *V. orchidea*; patent to reflexed or flexuous and appressed in *V. spicata*), subrigid or ± crispate, 0.3–1 mm long, exclusively glandless hairs (mostly glandular in *V. spicata*). **Leaves** petiolate (petioles up to 15 mm) below, sessile above, ovate to oblanceolate, 40–80 mm × 10–20 mm, margin crenate, base attenuate, apex obtuse, surface glabrous (subsp. *nitens* and *andrasovszkyi*) or with indumentum on both sides similar as that of the stem, margins ciliate (subsp. *nitens*) or not, remaining greenish when dry (blackening in *V. orchidea*). **Inflorescence** solitary, rarely with two lateral inflorescences, 10–15 cm long, densely 80–150-flowered,

sparsely to densely eglandular pubescent, without unpleasant smell (as in *V. orchidea*), bracts subulate, 3–5 mm long. **Pedicels** 1 mm long, pubescent. **Flowers:** calyx 2–3 mm long, surface glabrous (sometimes pubescent in *V. orchidea* and *V. spicata*), margin glabrous or with glandless, stiff cilia, 0.1–0.5 mm long; corolla caducous (persistent in *V. orchidea* and *V. spicata*), 5–7 mm long, white to blue; all corolla lobes erecto-patent, 3–5 mm × 1.5–2 mm, narrowly triangular to narrowly ovate (upper lobe ovate with linear apex, other lobes sublinear in *V. orchidea*; narrowly ovate in *V. spicata*), not or only slightly twisted at the top (as in *V. orchidea*); stamens 7 mm long (4–5 mm in *V. orchidea* and *V. spicata*); style 8 mm long (2–5 mm long in *V. orchidea*). **Capsule** ovoid, 3 mm long, 3 mm wide, apex truncate, with a few, 0.2–0.7 mm long straight hairs, otherwise glabrous. **Seeds** 2–21 per capsule, 0.7–1.1 mm × 0.5–0.8 mm, 0.2–0.4 mm thick. $2n = 4x$, $8x = 34, 68$; published chromosome numbers deviating from this are considered misinterpretations due to the small size and sticky nature of chromosomes in the subgenus (Albach *et al.* 2008).

- 1 Stem in upper part (below inflorescence) pubescent..... *V. barrelieri* subsp. *barrelieri*
 - Stem in upper part (below inflorescence) glabrous or nearly so 2
 2 Leaf margins ciliate; cilia of calyx 0.3–0.5 mm long *V. barrelieri* subsp. *nitens*
 - Leaves completely glabrous; calyx completely glabrous or with cilia at most 0.15 mm long..... *V. barrelieri* subsp. *andrasovszkyi*

Distribution: Submediterranean (illyric-macedonic-thracic range): Italy, SLOVENIA, CROATIA, Bosnia and Herzegovina, Montenegro, Serbia, Kosovo, FYR Macedonia, Bulgaria (mainly S.), Albania, N. Greece, southern Romania (?).

Veronica barrelieri subsp. *nitens* is restricted to the northwestern range of the species (Slovenia, Italy), whereas *V. barrelieri* subsp. *andrasovszkyi* is a serpentinophyte restricted to northern Albania and Kosovo.

Specimens examined:

V. barrelieri subsp. *barrelieri*—ITALY. Trieste, Santa Croce: 15. September 2008, Bot. Gard. Trieste 61 (grown from seeds at Bot. Gard. Oldenburg), *Albach S261* (OLD 00152, OLD 00168, OLD 00907). SLOVENIA. Ajdovščina, Trnovski Gozd, Österr. Gartenbauges. Graz (grown from seeds at Bot. Gard. Oldenburg, *Albach S312* (OLD 00913). CROATIA. Primorje-Gorski, Rijeka-Prebuk: 10. April 2016, *Albach 1429* (OLD); Primorje-Gorski, north of Brsec: 10. April 2016, *Albach 1430* (OLD).

V. barrelieri subsp. *andrasovszkyi*—ALBANIA. Diber, Mt. Stragu: 24. June 2012, *Barina et al. 21604* (BP 757299); Puke, Mt. Terbosh: 23. June 2012, *Barina and Pifkó 22646* (BP 761126); Shkoder, south of Vau i Dejes Reservoir, *Barina et al. 23897* (BP)

A) *V. barrelieri* subsp. *barrelieri* H.Schott ex Roemer & Schultes (1817: 94).

≡ *V. squamosa* var. *barrelieri* ('barrelierii') (H.Schott ex Roemer & Schultes) Reichenbach (1833: 370); ≡ *V. spicata* var. *setulosa* Koch (1837: 528); ≡ *V. squamosa* f. *barrelieri* (H.Schott ex Roemer & Schultes) Voss & Siebert (1896: 779); ≡ *V. spicata* f. *barrelieri* (H.Schott ex Roemer & Schultes) Béguinot in Fiori, Béguinot & Paoletti (1902: 438); ≡ *V. spicata* f. *setulosa* (W.D.J. Koch) Hayek (1929: 157); ≡ *Pseudolysimachion barrelieri* (H.Schott ex Roemer & Schultes) Holub in Holub & Pouzar (1967: 424); ≡ *V. spicata* subsp. *barrelieri* (H.Schott ex Roemer & Schultes) Elenevsky (1971: 221); ≡ *V. spicata* subsp. *setulosa* (W.D.J. Koch) Peev in Kožuharov & Kuzmanov (1978: 78); ≡ *V. spicata* var. *barrelieri* (H.Schott ex Roemer & Schultes) Kittel (1853: 377); *nom. superfl.* (Art. 52.2; priority of homotypic *V. spicata* var. *setulosa* W.D.J. Koch); ≡ *V. spicata* f. (?) *barrelieri* (H.Schott ex Roemer & Schultes) Gortani in Gortani & Gortani (1906: 351); *nom. inval.* (Art. 37.1; no clear indication of rank); ≡ *V. setulosa* (W.D.J. Koch) Stroh (1942: 394); *nom. inval.* (Art. 36.1c; publ. in synonymy)

Lectotype (designated here):—ITALY. Vicenza: Alpi Grappa bey Bassano, *Gr. Sternberg* (BP! 349992; Fig. 1)

Roemer & Schultes (1817) referred to two pre-Linnean polynomials and one other binomial in their description, “*V. spicata* minor Vaill. t. 33 f. 7, *V. mas recta latifolia spica coerulea*, Barr. ic. t. 682 and *V. spicata* Decand. Fl. fr. n. 2408 β”. While the first and the latter refer to French material, Barrelier reported plants from Spain, France and Italy. This is important since *V. barrelieri* is currently not reported from France. Further, Roemer & Schultes (1817) gave as distribution southern France and mountains surrounding Bassani (=Bassano del Grappa) near Venice based on a specimen by Sternberg.

We have found two possible lectotypes for *V. barrelieri*. One is the illustration by Barrelier (1714) icon 682. The other is a specimen from the H. Schott collection at BP (Fig. 1), which is here preferred as lectotype against an uninformative icon. It is labelled in addition to the name *V. barrelieri* with the polynomial by Barrelier. It further states that the specimen is from “von Gr. [Graf?] Sternberg, alpi Grappa bey Bassano”. The specimen is clearly diagnosable as *V. barrelieri*.



FIGURE 1. Lectotype specimen of *Veronica barrelieri* H.Schott ex Roemer & Schultes.

=*V. spicata* var. *carnea* Degen (1938: 18)

Lectotype (designated here):—CROATIA. Gospic: On mount Velinac, „Simokos“ meadows, over Karlobag, 4. July 1905, *Degen* (BP! 219739 as *V. spicata* f. *carnea* on the label)

= *V. glabra* Sternberg (1804: 108); *nom. illeg.* (Art. 53.1; non *V. glabra* Ehrhart ex Schrader 1803: 25); ≡ *V. sternbergiana* Bernhardt (1806: 21); ≡ *V. spicata* var. *sternbergiana* (Bernh.) Fiori (1926: 347)

Type:—ITALY. Veneto: „linker Hand in dem Thal Valstagra [Valstagna], etwa eine Viertelstunde, ehe man an das Thal Val de Sassi kommt“ (whereabouts unknown).

= *V. spicata* var. *eglandulosa* Kümmerle; *nom. illeg.* (Art. 30.1; herbarium name)

CROATIA. Lika-Senje: Plantae Karstianae nr. 459, Comit. Lika Krbava. Velebit. In declivibus saxosis graminosis montis Bussero ad pagum Ostaria, alt ca. 1330 m, solo calcareo, 12. September 1908, *Kümmerle* (BP! 151222).

B) *V. barrelieri* subsp. *andrasovszkyi* (Jáv.) Albach (2008: 3)

≡ *V. andrasovszkyi* Jávorka (1920: 26) ≡ *Pseudolysimachion andrasovszkyi* (Jáv.) Holub in Holub & Pouzar (1967: 423) ≡ *Pseudolysimachion barrelieri* subsp. *andrasovszkyi* (Jáv.) Fischer (1974: 35)

Lectotype (designated by Pifkó 2004: 67):—ALBANIA/KOSOVO: Montes Albanieae borealis versus opp. Djakova extensi: in herbis et dumetis in jugo „Čafa Morins“ [Qafe Morine] inter opp. Djakova et pag. Tropoja ad versus montem Skelsen; solo serpentinico; alt. ca. 600 m, 9. September 1918, *Jávorka* (BP! 95790; isolectotype W! 1926-10223, K! 806846, HBG 512117).

C) *V. barrelieri* subsp. *nitens* (Rchb.) Albach (2008: 3)

≡ *V. nitens* Host (1827: 7); *nom. illeg.* (Art. 53.1); ≡ *V. squamosa* var. *nitens* Reichenbach (1833: 370); ≡ *V. spicata* var. *nitens* (Rchb.) Koch (1837: 528); ≡ *V. spicata* subsp. *nitens* (Rchb.) Nyman (1881: 544); ≡ *V. squamosa* f. *nitens* (Rchb.) Voss & Siebert (1896: 779); ≡ *V. spicata* f. *nitens* (Rchb.) Abromeit (1903: 621); ≡ *Pseudolysimachion barrelieri* subsp. *nitens* (Rchb.) Fischer (1974: 35); ≡ *Pseudolysimachion nitens* (Rchb.) Holub (1976: 82)

Lectotype (designated here):—SLOVENIA: “In Carniolia in pratis, et aliis locis ad Savum”, *Hladnik* (W! 1885–1951)

= *V. spicata* var. *nitida* Bolzon (1900: 279); ≡ *V. spicata* f. *nitida* (Bolzon) Gortani in Gortani & Gortani (1906: 352)

Type:—ITALY. Venetia: sul muricciuolo lungo la strada da Trichiana a S. Antonio nel Bellunese [along a low wall along the street from Trichiana to S. Antonio in Bellunese], 3. Sep. 1900, *Bolzon* (whereabouts unknown).

The name is based on *V. nitens* Host, which is illegitimate (Art. 53.1; non *V. nitens* Schultes 1822: 97), but Reichenbach includes a description to validate the name at subspecific level. Therefore, the subspecies described by Reichenbach is the first valid name with that epithet for the taxon discovered by Host and serves as basionym.

D) Types of dubious affinity to *V. barrelieri*, possibly hybrid and introgressant forms

There are a number of names that in the past have been affiliated with *V. barrelieri*. As indicated by Bardy *et al.* (2011), *V. barrelieri* hybridized with *V. orchidea* across the Central Balkan Peninsula and, therefore these authors suggested that a number of names may relate to such hybrids, among them *V. spicata* subsp. *prodanii* Degen (1916: 250) and *V. crassifolia* sensu Wierzbicki ex Heuffel (1835: 251). Plants resembling those two plants have been inferred to be admixed types of *V. barrelieri* and *V. orchidea*. Morphologically, these combine the upwards bent hairs of *V. orchidea* on the stem and the ciliate sepals of *V. barrelieri* with a variable habitus and leaf morphology. Albach & Fischer (2003) recognized (though not formally) these two taxa as subspecies under *V. barrelieri* since they are geographically separate and morphologically deviant types of affinity to *V. barrelieri*. However, one could similarly argue for recognition as subspecies or variety under *V. orchidea*. Another alternative would be to recognize these as hybrid taxa but this would require molecular analysis of the type material and experimental crossings of pure types of the putative parents. We, here, abstain from making new combinations in the absence of further data.

D1) “*crassifolia*”

V. crassifolia Wierzbicki ex Heuffel (1835: 251); *nom. illeg.* (Art. 53.1; non *V. crassifolia* Kitaibel ex Roemer & Schultes 1817: 96); ≡ *V. orchidea* subsp. *crassifolia* Nyman (1881: 544); ≡ *V. spicata* var. *crassifolia* (Wierzb. ex Heuff.) Stojanoff & Stefanoff (1925: 1004); ≡ *V. spicata* subsp. *crassifolia* Hayek (1929: 157); ≡ *V. spicata* subsp.

kitaibelii Elenevsky (1978: 114); *nom. superfl.* (Art. 52.2e; *V. crassifolia* Wierzbicki cited in synonymy, thus *V. spicata* subsp. *crassifolia* Hayek should have been adopted); \equiv *Pseudolysimachion banaticum* Holub in Holub & Pouzar (1967: 423); *nom. superfl.*; (Art. 52.2e; although Holub gave a new description and a type (Romania, Caras-Severin: "Hungary: in montibus ad oppidum Bazias Com. Temes", *Thaisz*, 22. Jun. 1905; PR (56796)), citation of *V. crassifolia* Wierzbicki ex Heuffel in synonymy makes this name isotypic with *V. crassifolia* Wierzbicki ex Heuffel).

Lectotype (designated here):—ROMANIA. Caras-Severin: Hab. in lapidosis rupestribus que calcareis (on calcareous rocks) montis Szimcon (Simion) ad Csiklovan in Banatu, *Wierzbicki* (BP! 149668; Fig. 2).



FIGURE 2. Lectotype specimen of *Veronica crassifolia* Wierzbicki.

The name *Veronica crassifolia* has been used at least three times on specific level. The first is the description by Kitaibel in Roemer & Schultes (1817), which based on the protologue (leaves ovate-lanceolate, lower crenate, upper entire, corolla orchid-like) slightly differs from *V. orchidea* Crantz (1769: 333) but is likely a synonym of that. Unfortunately, no type material is available. The second is the combination by Zeyher ex Schrank (1822), which is likely an isonym of the former combination based on the comment that the name is supposed to be derived from Kitaibel but the description is from Zeyher and differs slightly from the above. There is also no type material available. However, the most widely used combination is *V. crassifolia* Wierzbicki ex Heuffel, which was described based on material from Mount Szimcon (Mt. Simion) near Csiklova (Ciclova Montană) in Banat (today Caras-Severin County, Romania). Despite the fact that Kitaibel reported *V. crassifolia* from the type locality of *V. crassifolia* sensu Wierzb. years before in his diary (Gombocz 1945), Heuffel explicitly considered his *V. crassifolia* to be distinct from *V. crassifolia* Kit. and *V. orchidea* (Heuffel 1835). However, Wierzbicki and Heuffel did not refer to Kitaibel and without type material *V. crassifolia* Kitaibel remains a dubious name and should not be used.

Regarding *V. crassifolia* Wierzbicki, the name is commonly cited in floras of the region, while rank and relationship have varied considerably over the years. Combinations with *V. spicata* and *V. orchidea* exist and *V. spicata* subsp. *crassifolia* Hayek (1929: 157) is legitimate based on the validating description. Based on DNA-based and morphological evidence Bardy *et al.* (2011) concluded that it is genetically intermediate between *V. orchidea* and *V. barrelieri* with closer association to the former but morphologically is closer to *V. barrelieri* and may, thus, be likely some kind of introgressant from one into another. However, no material close to the type locality was used in that analysis. Johann Heuffel was in close contact to the botanists of his time with whom he shared letters and plants. Thus, herbarium material of his collections is scattered in several herbaria. However, most of these, we assume, have been collected after their original publication by Heuffel. Types are expected to be found in his own herbarium, which was bought by Lajos Haynald after his death (Skofitz 1863) and by this came to Budapest.

Typification of *V. crassifolia* sensu Wierzbicki ex Heuffel, therefore, requires material that was collected by Wierzbicki before 1835 and sent to Heuffel. Since the herbarium of Heuffel is mostly at BP, this is the prime location to look for the type. There are a number of specimens in BP that were collected by Wierzbicki at the type location but only BP (149668; Fig. 2) fits all requirements. It bears a handwritten label with identical locality to the protologue and states as year 1833. The sheet contains three stems that differ in the number of inflorescences (1–4), a character given as variable also in the protologue, while most other plants collected by Wierzbicki have just a single inflorescence. The specimens also fit perfectly to the other characters given by Heuffel.

D2) “prodanii”

V. spicata subsp. *prodanii* Degen (1916: 250); ≡ *V. spicata* var. *prodanii* (Degen) Hayek (1929: 157); ≡ *Pseudolysimachion barrelieri* subsp. *prodanii* (Degen) M. A. Fisch. in Fischer & Peev (1995: 202); ≡ *V. barrelieri* subsp. *prodanii* (Degen) Albach (2008: 3); ≡ *V. spicata* f. *prodanii* (Degen) Soó (1968: 168); *comb. inval.* (Art. 41.1; no complete citation of basionym given)

Type:—ROMANIA, Tulcea: in locis aridis ad promontorium Cap Dolejmen prope pagum Jurilovca, 15. July 1914, *Prodan*, (whereabouts unknown, BP (destroyed)?, also not found in CL (M. Puscas pers. comm.))

The other epithet “prodanii” is a bit more dubious since the type locality is from the Romanian Black Sea region, a region scarcely sampled by Bardy *et al.* (2011). However, morphologically similar specimens occur disjunctly in eastern Serbia and western Bulgaria (Albach & Fischer 2003), from where *V. prodanii* was analyzed by Bardy *et al.* (2011). The sample used by Bardy *et al.* (2011) showed clear signs of genetic contribution from *V. barrelieri* but in the absence of type material for comparison with material used by Bardy *et al.* (2011) no definite conclusion on its taxonomic status could be reached. Unfortunately, no type material was found in BP and was likely destroyed in the Second World War when remarkable type material of the Degen collection was lost from BP. Designation of type material will be critical for the correct taxonomic designation of this morphological variant and should definitely come from the same region.

= *V. spicata* subsp. *velutina* D. Peev in Kožuharov & Kuzmanov (1978: 202)

Holotype:—BULGARIA, Varna: “Inter fruticetis prope pag. Devnja”, 7. August 1970, *Peev* (SOM 127353).

D3) Other types from the Southwest Carpathians

The Southwestern Carpathians and the Banat form a region in which *V. spicata*, *V. orchidea* and *V. barrelieri* occur side-by-side and many admixed individuals were found by Bardy *et al.* (2011). Apart from *V. crassifolia* discussed above, Heuffel also described *Veronica spicata* var. *elegans* Heuffel (1858: 170) from the region. It has been synonymized with *V. crassifolia* sensu Wierzbicki in the herbarium of Heuffel in BP but differs clearly in several aspects such as the lax inflorescence, more elliptic leaves with more deeply serrate rather than shallow crenate leaves (Fig. 3). The only specimen bearing the name *V. spicata* var. *elegans* is BP (149695) from Domugled in 1835, a locality considered by Heuffel to be identical (see below) to that described in the protologue (“ad thermas Herculis (=Baile Herculane)”), which is designated here as lectotype.

It is noteworthy that from Domugled, Heuffel also collected specimens considered by him to be intermediate between *V. orchidea* and *V. crassifolia*. These are called “*V. spicata* var. *intermedia*” (BP 149696) or “*V. intermedia*” (“In rupestribus montis Domuglett ad th. Herculis Jun. Aug. 1835”; BP 228586), both names never validly published but indicative of the breadth of morphological variation in the area.

V. spicata var. *elegans* Heuffel (1858: 170)

Lectotype (designated here):—ROMANIA, Caras-Severin: ad Thermas Herculis [Baile Herculane], Heuffel (BP! 149695; Fig. 3)

D4) Southern Bulgarian types

Southern Bulgaria has not been studied by Bardy *et al.* (2011) but a few deviant forms of *V. barrelieri*, *V. orchidea* and/or *V. spicata* are found there, of which the following has been in our view correctly synonymized with *V. barrelieri* by Fischer & Peev (1995). The other name synonymized with *V. barrelieri* by Fischer & Peev (1995), *V. urumovii* Velenovsky (1901: 31), is in our opinion a form of *V. orchidea*.

V. spicata var. *austrobulgarica* Degen & Drenovsky (1934: 76); sometimes an earlier publication (Degen & Drenovsky 1933) “Vtori prinosa kum flora naalibotyw/ Vtori Prinossa Fl. Ali Botusch 6” is cited for the protologue but the description was not found in the publication (V. Vladimirov, pers. comm.); ≡ *V. spicata* f. *austrobulgarica* (Degen & Dren.) Stojanoff & Stefanov in Stojanov, Stefanov & Kitanov (1967: 969); *comb. inval.* (Art. 41.1; incorrect citation of basionym)

Type:—BULGARIA, Blagoewgrad: Hab. in Bulgaria meridionali. In monte Ali Botus [=Ali Botush; Slavyanka], alt. c. 1500 m, 18. July and 7. November 1933, Drenowski (whereabouts unknown, BP (destroyed)?)

2. *V. bachofenii* Heuffel (1835: 253)

Neotype (designated here):—ROMANIA, Hunedoara: Hab. in petrosis rupestribus que versus alpem Retezat in Transylvaniae Comitatu Hunyadiensi frequentissime; rarius similibus in locis ad Thermas Herculis versus alpes Banatus. July/August, Heuffel (BP! 149342).

Veronica bachofenii is a species with restricted distribution area in southern Romania. Knapp (1877) gave a detailed summary of the distribution but his circumscription of the species was too wide. Flora Europaea (Walters & Webb 1972) also reports it from Bulgaria and Serbia but the national floras either reject the occurrence there (Bulgaria, Fischer & Peev 1995) or did not mention it (Diklić 1974). Reports from the Ukrainian Carpathians (Walters & Webb 1972, Borissova 1955) are also wrong (Elenevsky 1978). The species is further commonly believed to have escaped from cultivation in North America (e.g. Fernald 1950), but these all seem to be variants of *V. longifolia* (Albach, in prep.).

Härle (1932) discussed possible affinities to *V. longifolia*, *V. spuria* Linne (1753: 10) and *V. grandis* Fisch. ex Sprengel (1821: 122; = *V. dahurica* Steven (1817: 339)) suggested in the past. However, phylogenetic analyses of DNA sequence data clearly demonstrated the distinctness of *V. bachofenii* from all three species (Kosachev *et al.* 2016).

Therefore, *V. bachofenii* is here considered in the narrow sense. Heuffel (1835) gave as original localities the Alp “Retezat” [=Retezat] and near “Thermas Herculis” [=Baile Herculane]. A number of specimen by Heuffel can be found in different herbaria (e.g. W! 1889-293284, HAL! 101778, HBG 512108). However, it seems as if most specimens by Heuffel in other herbaria have been collected after the first publication of the name. Thus, the Haynald herbarium in BP remains as the natural place for the type material of Heuffel. In BP, five specimens of *V. bachofenii* exist that seem to be collected by Heuffel but four of them bear different locality names. Only BP 149342 has a label with the locality “in rupestribus versus alpem Retezat. Jul.” and stamps “ex herbario L. Heuffel” and “herbarium Haynald”. However, there is no indication that it was collected prior to publication and it bears the same printed label

as specimens in HAL and W. However, the specimen in BP is more complete and bears flowers and fruits. In the absence of absolute evidence for being original material, it is here designated as neotype.



FIGURE 3. Lectotype specimen of *Veronica spicata* var. *elegans* Heuffel.

3. *Veronica* subgen. *Pseudolysimachium* in the Vojvodina and Syrmia (Serbia/Croatia)

Six taxa of *Veronica* subgen. *Pseudolysimachium* occur in the Vojvodina and Syrmia, the southeastern part of the Pannonian plain. These are *V. longifolia*, *V. spuria*, *V. barrelieri*, *V. spicata* subsp. *fischeri* (Trávn.) Albach (2008: 5), *V. spicata* subsp. *lanisepala* (Trávn.) Albach (2008: 5) and *V. orchidea* var. *glandulopilosa* (Peev & M. A. Fisch.) Albach (2008: 4). The area constitutes a southern distribution area for most of these species and an important area of contact for *V. barrelieri* from the west, *V. orchidea* from the east and *V. spicata* and *V. spuria* occurring more in the north. Bardy *et al.* (2011) sampled both subspecies of *V. spicata* and *V. orchidea* var. *glandulopilosa* from the area and demonstrated them to be genetically more or less pure representatives of their typical species, although the hypothesis of gene flow of *V. incana* Linne (1753: 10) into *V. spicata* subsp. *lanisepala* (Trávníček *et al.* 2004) could not be tested. Neither, hybridization between any of these taxa and *V. spuria* could be tested by Bardy *et al.* (2011) due to their sampling strategy. Two taxa in *V.* subgen. *Pseudolysimachium* were described from the region, both by Heuffel (1858), and can be typified with material from BP.

A) *V. spicata* var. *australis* Heuffel (1858: 170)

Lectotype (designated here):—CROATIA, Vukovar-Syrmia/SERBIA, West Bačka: In montibus graminosis apricis a Vukovár Syrmii, September 1846, *Heuffel* (BP! 151275).

Four specimens from Heuffel are found in the Haynald herbarium in BP. Specimen BP 151277 bears only the name “var. *australis* Heuffel”. BP 151275 is labeled “In montibus graminosis apricis a Vukovár Syrmii, Sept. 1846; *V. spicata* β) *australis* Heuff. ... Banat”. Both, BP 151276 and BP 151278 have been collected a year later with the label “*Veronica spicata* Linn. var. *australis* Heuff. In pratis collis ad Vukovár Syrmii. Sept. 1847”. The plants have long eglandular hairs on the stem, curved, mostly upwards. The indumentum on calyx and bracts is long, eglandular and seems to have scattered glandular hairs. Thus, the plant fits best to the description of *V. spicata* subsp. *fischeri* but may have experienced gene flow from *V. orchidea* in the past.

B) *V. spuria* var. *mollis* Heuff. (1858: 170)

Lectotype (designated here):—SERBIA, Vojvodina: *Veronica foliosa* W.&Kit. β.) *mollis* Heuffel, In dumetis collium arena mobile conflatorum ad Grebenacz leg. Teutoniiio-banaticae, July 1834, *Heuffel* (BP! 229035).

The description of the taxon differs from typical *V. spuria* only in having greyish-white pubescence. It is not clear whether this is an insignificant intraspecific variation or a sign of introgression from *V. spicata* occurring in the area. A single specimen bearing this name is in BP. The affiliation of this specimen with *V. foliosa* Waldstein & Kitaibel (1803–1805: 106) on the specimen is not surprising since *V. foliosa* and *V. spuria* are synonyms that have caused much confusion in the past (Rauschert 1967). More surprising is the difference in the month given in protologue and specimen and that the specimen came to Budapest by the herbarium “J. Dorner”. József Dorner (1809–1873) was a Hungarian grammar school teacher in Szarvas and Pest and communicated with many botanists in the country (Grundl 1874). However, it is not clear who collected the specimen in BP and whether Heuffel (1858) referred to his own collection or maybe a collection sent to him by Dorner in the protologue. Nevertheless, based on the correspondence in the description and the specimen and the locality names in the protologue and on the specimen, it is clear that the specimen in BP is original material for the name (Art. 9.3 (c)). No other original material is known. The BP specimen, therefore, serves here as lectotype.

4. Types of Heinrich Schott (father)

Heinrich Schott, father of the more famous Heinrich Wilhelm Schott, was gardener in Brno and Vienna from 1800 until 1819 (Bunke 1999). During that time he made considerable collections of Moravian and Austrian plants and culture trials in the gardens. Based on these, he introduced a number of names used in trade (Kotschy 1857), but formally published with descriptions by others. However, most names remained herbarium names or were otherwise published incorrectly. Many of his taxa are likely some kind of hybrid and with the exception of *V. barrelieri*, none is currently accepted. Nevertheless, typification of these names is important for determining their taxonomic relationships, since various authors in the last two centuries had different opinions. We are currently aware of seven names that have been taken up in the literature. One (*V. barrelieri*) has been discussed above. Taxonomic resolution of the other names is intended in the future based on type material. Potential type material has come with collections of Schott father

to BP by the herbarium of archbishop Lajos (Ludovicus) Haynald, the Hungarian priest that became archbishop of Kalocsa and cardinal but was a devoted botanist since early adulthood. He acquired the collections of Schott in 1868 (Anonymous 1868).

I. *Veronica waldsteiniana*

The name *Veronica waldsteiniana* H.Schott ex Schultes (1822: 117) was taken up in many other gardens for a particular form of *V. longifolia*. It was used by Schultes (1822) for plants close to the common *V. longifolia* but without description and not accepted by the author. The name occurs occasionally in the horticultural literature. There are two specimens of *V. waldsteiniana* in BP. The specimen 359334 is labeled “*Veronica waldsteiniana* mihi;—*incana* Waldst. et Kit. Pl. hung 3. Tab 244; *Veronica waldsteiniana* auf der Rabatt bey *V. spicata*; Fol. Oppositis oblongis crenatis villosis petiolis caule qua villosis ex Herbario Schott patris”. The specimen 359333 is labeled only „*Ver. waldsteiniana* Nro. 34 ex Herbario Schott Patris“. Based on these specimens, *V. waldsteiniana* is an especially densely pubescent *V. longifolia*, which differs from other *V. longifolia* also in long petioles in lower leaves but affinities to *V. spuria* are also present. BP 359334 may serve as type if the name ever gets validly published. However, a formal lectotypification cannot be made since the name is not validly published.

II. *Veronica clusii*

V. clusii H.Schott ex Roemer & Schultes (1817: 94); ≡ *V. spicata* var. *clusii* (H.Schott ex Roemer & Schultes) Uechtritz (1821: 37); ≡ *V. squamosa* var. *clusii* (published as *V. squamosa* var. *clusiana*) (H.Schott ex Roemer & Schultes) Reichenbach (1833: 370); ≡ *V. squamosa* f. *clusii* (published as *V. squamosa* f. *clusiana*) (H.Schott ex Roemer & Schultes) Voss & Siebert (1896: 779)

Lectotype (designated here):—[ICON] “*Veronica* ii. erectior angustifolia” in Carolus Clusius (1601) Rar. pl. hist.: 346, right plant

Veronica clusii was published by Roemer & Schultes (1817) with a rather wide distribution (Hungary, Bohemia, Austria (at the Rhine), Denmark). The epithet was rarely used and mostly mentioned as synonym of *V. spicata* (Mertens & Koch 1823; Römpf 1928), although the description with tomentose indumentum and lanceolate leaves does not fit typical *V. spicata*. Such specimens of *V. spicata* are, however, known from the distribution area mentioned by Roemer & Schultes (1817). The epithet was used as a variety by Uechtritz (1821), Fuss (1866) and others. Reichenbach (1833) introduced the orthographic variant *clusiana*. We have not come across any type material but Roemer & Schultes (1817) refer to a figure by Clusius, which serves as lectotype. Other illustrations referred to in the protologue either do not match the description (Bauhin 1651) or present typical *V. spicata* (Oeder 1761).

III. *Veronica azurea*

V. azurea H.Schott ex Link (1821: 22); ≡ *V. maritima* var. *azurea* (H.Schott ex Link) Reichenbach (1833: 372); ≡ *V. maritima* f. *azurea* (H.Schott ex Link) Voss & Siebert (1896: 781)

Neotype (designated here):—AUSTRIA, cultivated: Hoc nomine ex Horto Vindobon. [=Bot. Gard. Vienna] (BP! 349098).

Veronica azurea was described in Link (1821) as having long-lanceolate-linear leaves with sharply serrate margin. The name is commonly used in horticultural circumstances (e.g., seed catalogues) but its taxonomic status under *V. longifolia* / *V. maritima* is unclear. Link cites the name as “Hoc nomine ex horto Vindobon.” without a tribute to Schott. He mentions the name, however, in a later publication (Link 1829) as *V. azurea* Schott. Also, other horticultural publications refer this name to Schott (e.g., Steudel 1841, Voss & Siebert 1896), which makes it likely that the plant has been shared among Botanical Gardens under the name *V. azurea* Schott. Therefore, the name should be attributed to H. Schott. No material of *V. azurea* was found in Berlin. The only specimen of *V. azurea* in BP clearly matches the description, is labelled as belonging to the herbarium of H. Schott and still bears the location of the flowering bed. However, since Link (1821) likely did not see this particular specimen, it formally needs to be a neotype rather than a lectotype.

IV. *Veronica persicifolia*

V. persicifolia H.Schott ex Link (1821: 21); ≡ *V. spicata* var. *persicifolia* (H.Schott ex Link) Wallroth (1822: 4); ≡ *V. media* var. *persicifolia* (H.Schott ex Link) Reichenbach (1833: 371); ≡ *V. media* f. *persicifolia* (H.Schott ex Link) Voss & Siebert (1896: 781)

Neotype (designated here):—AUSTRIA, cultivated: Hort. Vind. [= Bot. Gard. Vienna] (BP! 349195).

Veronica persicifolia was published by Link (1821) based on material from H. Schott and the botanical garden Vienna.

Link (1821) considered it intermediate between *V. longifolia* and *V. maritima* L. (1753: 10), although differences to *V. maritima* are hardly discernible based on the description. No original material was found in Berlin. The specimen BP 349195 from the H. Schott herbarium has information from the flowering bed and clearly comes from the botanical garden Vienna. The description from the label, however, differs from the one by Link suggesting a different origin of the protologue. It states leaves opposite or in whorl of three (not whorl of three or four), leaves unequally serrate (not just serrate), apex entire (not acute), petiole short and similar to the stem, glabrous. We, therefore, consider this not to be original material. Nevertheless, since the description matches very closely and the specimen from BP and possible original material have the same origin from H. Schott in Vienna, we consider the specimen from BP suitable material for a neotype.

V. Veronica menthifolia

V. menthifolia (“*menthaefolia*”) H.Schott ex Roemer & Schultes (1817: 94); ≡ *V. spicata* var. *menthifolia* (H.Schott ex Roemer & Schultes) Uechtritz (1821: 37)

Neotype (designated here):—ORIGIN UNKNOWN: Hab. in Austria, ad littoral Wolgae, (BP! 348066)

Veronica menthifolia is another morphotype of dubious origin distributed among gardens. The origin is described as “Hab. In Austria. Ad littora Wolgae”, which in the beginning of the 19th century could point to a distribution area in nowadays western Ukraine to southern Russia. The material was sent by “Fischer Gorinkensis” (Roemer & Schultes 1817). Gorinka is a place in western Ukraine, which further supports a Ukrainian origin of the plant. Most authors considered it a synonym of *V. orchidea* (e.g. Uechtritz 1821), but it falls into the morphological spectrum of *V. barrelieri*, which is absent from that area. However, morphologically similar plants from eastern Ukraine and the Volga-region were formerly considered to belong to *V. barrelieri* but are nowadays called *V. steppacea* Kotov. The only specimen from the H. Schott collection at BP bears no indication of its exact origin. Material of *V. menthifolia* identified by Schott will need to be investigated in more detail in connection with a current DNA-based investigation of southern Russian and Ukrainian types by the first author to ascertain this synonymy, which would change the name for the East Ukrainian plants.

VI. Veronica ruthenica

Veronica ruthenica Roemer & Schultes (1817: 96)

Lectotype (designated here):—AUSTRIA, cultivated: Bot. Gard. Vienna (BP! 349679; isolectotype BP! 349678).

Veronica ruthenica was first published by Roemer & Schultes (1817) based on material from the botanical gardens in Vienna and Montpellier. The name was again used by Schrank (1822) in a discussion of some rare plants in the Botanical Garden Munich but with reference to “Prof. Sprengel”, director of the botanical garden Halle. While Roemer & Schultes (1817) gave no indication of its natural occurrence, the plant is supposed to come from Russia but based on the epithet it came from Ruthenia, the now western part of Ukraine. A few years later, Reichenbach (1833) published the name *V. ruthenica* as a synonym of *V. spuria* but attributed the name to Fischer. Steudel (1841) followed Reichenbach with the consequence that subsequently *V. ruthenica* Roemer & Schultes was considered a synonym of *V. longifolia* and *V. ruthenica* Fischer ex Reichenbach a synonym of *V. spuria* (e.g., Borissova 1955). The origin of this confusion may be Schultes (1822) who subsumed *V. grandis* Fischer ex Sprengel (1821: 122) under *V. ruthenica*. Original material of *V. ruthenica* was thus looked after under material from the botanical gardens Vienna, Montpellier or Munich from that time. No original material was found in Montpellier (C. Loup, pers. comm.) and Munich but in Vienna (W 1889-208953) and Budapest (BP 349678, 349679). Both specimens from BP bear handwritten notes “specimen originali *V. ruthenica* R. et Sch.”. While specimen BP 349679 only has the information “cult.”, 349678 has more extensive information on the flowering bed. Nevertheless, specimen 349678 is in poorer condition. The two specimens in BP fit nicely the original description and are clearly *V. longifolia* with eglandular indumentum, glabrescent lower stems and short pedicels but approach *V. spuria* in leaf shape and branched inflorescence. The specimen from the herbarium Vienna differs morphologically markedly from the specimen in BP by leaf shape being more lanceolate (ovate-lanceolate in protologue) and the serration being larger and more regular than in the BP specimen. Also, the affinity to *V. arguta* J. F. Wolff ex Schrader (1803: 22) mentioned by Roemer & Schultes (1817) is more pronounced in the specimens from BP. Furthermore, the label of the specimens in BP are clearly written in Schott’s handwriting while the specimen in Vienna is not. We, therefore, consider only the specimens in Budapest to be type material.

5. Further typifications

A) *V. mauksii* = *V. ×mauksii* Hulják (1929: 36)

≡ *Pseudolysimachion × mauksii* (Hulják) Soó (1977: 383)

Lectotype (designated here):—HUNGARY, Borsod-Abauj-Zemplén: habitat in pascuis argillosis ad viam ferream ad pagum Diósgyőr-Perecesbánya com. Borsod, 25 July 1928, *Hulják* (BP! 159314; isolectotype BP! 233219)

Veronica mauksii was described as the hybrid of *V. maritima* (= *V. longifolia*) and *V. orchidea* differing from the latter in habit, lanceolate, long acuminate leaves with narrow base with unequal sharply serrate margin, short and sparse pubescence in the inflorescence and short-acuminate corolla lobes. It is stated to differ from *V. maritima* by stem simple and unbranched above, inflorescence dense, subdense glandular puberulent and flowers often almost sessile. Hulják (1929) gave as type locality “Borsod on railway track at Diósgyőr-Perecesbánya” (today Miskolc, Hungary). Two specimens are found in BP. Both specimens are collected by Hulják and labeled to be from Borsod-Perecesbánya from 25 July 1928. Specimen 159314 is labeled “*Veronica maritima × orchidea*” and is in better condition. The other (233219) is labeled “*Veronica ×mauksii*” and publication information in a separate handwriting than the locality information and is from the Degen herbarium. We, therefore, assume that it was distributed by Hulják before publication to Degen. The better preserved specimen, likely from the original Hulják herbarium is here considered the better type specimen.

B) *V. spicata* f. *falz-feiniana* Tuzson (1913: 199)

Lectotype (designated here):—UKRAINE, Cherson: Habitat in steppibus Tauricis prope Ascania-Nova, 13./14. July 1912, *Tuzson* (BP! 115960; isolectotype BP! 115958).

Veronica spicata f. *falz-feiniana* was described by János Tuzson based on material from southern Ukraine. The specimens differ strongly from other *V. spicata* in habit being large (>30 cm) and erect or sharply ascending from a rhizome. Thus, the habit more resembles *V. longifolia* but the indumentum is identical, though maybe denser on the leaves, to that of *V. spicata* by leaves and bracts being mixed glandular-eglandular pubescent, especially the margin. The stem is covered by long eglandular hairs. The protologue gives as locality “in steppibus prope Ascania-Nova”, which fits both specimens 115958 (collected on 14. Jul. 1912) and 115960 (collected on 13. Jul. 1912) but not specimen 115957 (“in herbosis prope Ascania-Nova”, collected on 14. Jul. 1912). Specimen 115960 is designated here as lectotype based on the better development and closer fit to the figure given by Tuzson. Specimen 115958 is isolectotype and specimen 115957 paratype.

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