NOMENCLATURAL NOTES ON NORTH AMERICAN TAXA OF ANEMONASTRUM AND PULSATILLA (RANUNCULACEAE), WITH COMMENTS ON THE CIRCUMSCRIPTION OF ANEMONE AND RELATED GENERA

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ABSTRACT

A pragmatic circumscription of Anemone L. and related genera of Ranunculaceae is discussed based on recent molecular phylogenetic results and traditional taxonomy. It is concluded that the monophyletic taxonomy of Anemone sensu lato can be achieved only by inclusion in Anemone of such readily recognized and morphologically distinguishable genera as Clematis L., Hepatica Mill., Pulsatilla Mill., and some others, which is hardly a practical approach. An alternative option, which is preferred here, is the recognition of several genera segregated from Anemone sensu lato. The taxa placed in Anemone in the Flora of North America North of Mexico should be now placed in at least four genera: Anemone sect. Anemonidium (Spach) Mosyakin, comb. nov., Anemonastrum [sect. Anemonidium] subsect. Anemonidium (Ulbr.) Mosyakin, comb. nov., Anemonastrum [sect. Anemonidium] subsect. Richardsonia (Ulbr.) Mosyakin, comb. nov. (Anemone ser. Richardsoniae Ulbr.), Anemonastrum canadense (L.) Mosyakin, comb. nov. (Anemone canadensis L.; Anemonidium canadense (L.) Á. Löve & D. Löve), Anemonastrum dichotomum (L.) Mosyakin, comb. nov. (Anemone dichotoma L., Anemonidium dichotomum (L.) Holub), and Anemonastrum richardsonii (Hook.) Mosyakin, comb. nov. (Anemone richardsonii Hook., Anemonidium richardsonii (Hook.) Starod., Jurtsevia richardsonii (Hook.) Á. Löve & D. Löve). Three varieties of Anemone narcissiflora recognized in the Flora of North America North of Mexico are better accepted as three species: Anemonastrum sibiricum (L.) Holub, A. villosissimum (DC.) Holub, and A. zephyrum (A. Nelson) Holub. The North American taxon of the Pulsatilla patens (L.) Mill. group is recognized as a separate species P. nuttalliana (DC.) Bercht. & J. Presl; its nomenclature and synonymy are discussed and updated.

The phylogenetically natural and taxonomically rational circumscription of the genus Anemone L. and related taxa of Ranunculaceae Juss. tribe Anemoneae DC. is a long-debated issue. In particular, the genera Hepatica Mill., Pulsatilla Mill., Knowltonia Salisb., Barneoudia Gay, Oreithales Schltdl. (= Capethia Britton) and some others were readily recognized in many earlier and some recent taxonomic treatments (Britton 1892; Juzepczuk 1937; Steyermark & Steyermark 1960; Rasmussen 1979; Duncan & Keener 1991; Starodubtsev 1991; Tamura 1993; 1995; Tzvelev 2001, 2012; Malyshev 2005 etc.). In addition to those taxa, several other genus-level segregates of Anemone were proposed and/or recognized, such as Anemonastrum Holub, Anemonidium (Spach) Holub, Anemonoides Mill., Arsenjewia Starod., Eriocapitella Nakai, Jurtsevia Á. Löve & D. Löve, Pulsatilloides (DC.) Starod., Tamuria Starod. (Holub 1973, 1974; Starodubtsev 1991, 1995; Czerepanov 1995, Uotila 2001; Tzvelev 2001, 2012; Malyshev 2012 etc.), but their acceptance was more limited.

However, other molecular phylogenetic results and morphological data allow alternative phylogenetic patterns and different taxonomic solutions (Pfosser & al. 2011). The most important issue unresolved until recently was the proper phylogenetic placement of the large (ca. 250–300 species) and diverse genus Clematis L., position of which in some phylogenetic studies was controversial, either as sister to Anemone sensu lato or rooted in it. The new molecular phylogenetic results (Lehtonen & al. 2016) convincingly indicate that the clade of Clematis (incl. Atragene L.) and Anemoclema (Franch.) W.T. Wang (Wang 1964; Zhang & al. 2015; often treated earlier as Anemone subgen. Anemoclema (Franch.) Tamura or sect. Anemoclema Franch.; see Tamura 1995; Ziman & al. 2008, etc.) is in fact rooted in the grade of Anemone sensu lato (in the circumscription proposed by Hoot & al. 2012). In particular, Lehtonen & al. (2016) concluded that "Anemone s.l. is paraphyletic to Anemoclema + Clematis" and that "paraphyly of Anemone s.l. was strongly supported and evident under all studied parameter costs." They further commented that "an often assumed monophyly of a broadly defined Anemone s.l. apparently is an artefact caused by erroneous outgroup selection and poor sampling of non-focal groups." (Lehtonen & al. 2016: 840).

RATIONAL GENUS-LEVEL TAXONOMY OF ANEMONE SENSU LATO: A MODEST PROPOSAL

In view of new data it should be concluded that a monophyletic taxonomy of Anemone sensu lato can be achieved only by inclusion in Anemone of such readily recognized and morphologically distinguishable genera as Clematis, Hepatica, Pulsatilla and some others, which is hardly a practical approach, since the addition of Clematis to Anemone will require hundreds of new taxonomic combinations and possible new names. Moreover, both Anemone sensu lato and Clematis contain many important cultivated taxa and excessive changes in their nomenclature are not desirable.

An alternative option, which is strongly preferred here, is the recognition of several genera segregated from Anemone sensu lato. In my opinion, the following genera can be recognized, based on the clades revealed in Hoot & al. (2012) and in other molecular phylogenetic studies (Schuettpelz & al. 2002; Wang & al. 2009; Meyer & al. 2010; Zhang & al. 2015b etc.) as well as on some of the morphologically outlined groups (infrageneric taxa or segregate genera) recognized in recent taxonomic treatments (Starodubtsev 1991, 1995; Tamura 1993, 1995; Luferov 2001; Wang & al. 2001; Ziman & al. 2004, 2005, 2006a, 2006b, 2007, 2008, 2009, 2013; Ehrendorfer & al. 2009; Manning & al. 2009; Manning & Goldblatt 2013; Zhang & al. 2015b etc.).

1. Hepatica Mill.
3. *Knowltonia* Salisb. (most probably the earliest available generic name applicable to this group) in a greatly expanded circumscription, corresponding to *Anemone* subg. *Anemone* sect. *Pulsatilloides* sensu Hoot & al. (2012) (including the genera *Barneoudia*, *Oreithales*, and *Pulsatilloides*).


5. *Anemone* L. sensu stricto (including genera *Anemonoides*, *Anemonanthea* (DC.) Gray etc.).


In any case, *Anemonastrum* is phylogenetically more distant from *Anemone* sensu stricto than *Pulsatilla* and *Knowltonia*, among others. It also differs from *Anemone* karyologically: *Hepatica* and *Anemonastrum* (revealed in most of molecular studies as sister groups) have the base chromosome number $x=7$, while the other genera have $x=8$.

It is not an unusual situation now when a widely recognized "traditional" genus is revealed, in view of new phylogenetic information, as a polyphyletic or paraphyletic group, which is exactly what happened to *Anemone*. Taxonomic solutions aimed at achieving monophyly of recognized genera in such cases vary widely — from submerging of several genera into one genus sensu lato to splitting of "traditional" genera into monophyletic segregates, and/or to dramatic re-circumscriptions of genera. A relevant example is *Aloe* L. (Asphodelaceae subfam. Alloideae or Xanthorrhoeaceae subfam. Asphodeloideae) and its relatives. Recent phylogenetic studies of that group clearly demonstrated that both *Aloe* and *Haworthia* Duval, as traditionally circumscribed, are widely polyphyletic (Treutlein & al. 2003; Daru & al. 2013; Grace & al. 2013; Manning & al. 2014 etc.). Several taxonomic options were discussed, but finally a solution with recognition of several "narrow" genera corresponding to major clades has been proposed (Grace & al. 2013; Manning & al. 2014). Another relevant example is *Chenopodium* L. sensu lato (see overviews in: Fuentes & al. 2012; Hernández-Ledesma & al. 2015). Numerous additional examples of taxonomic handling of similar cases from the European flora are discussed in Kadereit & al. (2016).

In many cases, such large-scale taxonomic and especially nomenclatural changes are psychologically disturbing, at least for some plant taxonomists and mainly for non-taxonomists using the taxonomic information. However, gradually such changes are becoming widely accepted, especially if they are supported by solid phylogenetic evidence. I expect, for example, that the proposal to re-circumscribe the genus *Knowltonia* (the name that was traditionally applied only to a morphologically rather distinct group of southern African taxa characterized by fleshy fruits and much-branched inflorescences — see Rasmussen 1979; Manning & al. 2009) to accommodate also the South American taxa earlier placed in genera *Barneoudia* and *Oreithales* plus some other taxa usually treated in several infrageneric groups of *Anemone* may cause some resistance or opposition, as happened with our earlier proposal to expand the limits of *Dysphania* R. Br. (the name earlier applied only to Australian taxa) to include all glandular-pubescent species of *Chenopodium* sensu lato occurring on almost all continents (Mosyakin & Clemants 2002, 2008; Clemants & Mosyakin 2003). However, at present the new concept of *Dysphania* is almost universally accepted, with some necessary minor adjustments (Fuentes & al. 2012; Uotila 2013; Hernández-Ledesma & al. 2015 etc.). Hopefully, the same will happen to the new concept of *Knowltonia* provisionally proposed here and to other re-circumscribed segregates of *Anemone*.

2008, 2009, 2013; Ehrendorfer & al. 2009; Ren & al. 2009; Manning & al. 2009; Manning & Goldblatt 2013 etc.). New nomenclatural combinations and a more detailed morphological justification of the accepted genera and infrageneric taxa will be possible in parallel with the progress of an updated taxonomic revision of *Anemone* and related taxa now being prepared by Svetlana Ziman with several collaborators; they, however, at present prefer to keep *Anemonastrum* in *Anemone*, at the same time recognizing *Hepatica* and *Pulsatilla* as separate genera.

Meanwhile, I decided to propose here just a brief nomenclatural and taxonomic update to the treatment of *Anemone* in the *Flora of North America North of Mexico* (Dutton & al. 1997). The taxa placed in *Anemone* in that treatment should be now placed in at least four genera: *Anemone* sensu stricto, *Hepatica*, *Pulsatilla*, and *Anemonastrum*. *Hepatica* and *Pulsatilla* are accepted here in their traditional circumscription. I prefer an expanded circumscription of *Anemonastrum* as compared to the concept of this genus originally proposed by Holub (1973). The three groups corresponding to the clades recognized by Hoot & al. (2012) as sections of *Anemone* subg. *Anemonidium* can now be treated as sections of *Anemonastrum*. North American taxa belong to two sections, one of which can be further subdivided into subsections (see the new combinations below).

**VALIDATION OF NEW COMBINATIONS**


*Anemone dichotoma* was the only species originally included in this section by Spach (1839) and thus it is the type of the section.

Two North American species of *Anemonastrum* sect. *Anemonidium* can be placed in two subsections. The new combinations for these subsections and species are validated below.


It is widely accepted (Dutton & al. 1997; IPNI 2016 etc.) that *Anemone richardsonii* was described by Hooker in 1829 in the first issue of the first volume of his *Flora Boreali-Americana* (Hooker 1829). However, Hooker himself cited an earlier publication "Hook. in Frankl. 1st Journ. ed. 2. App. p. 21" (Hooker 1829: 6). Indeed, *A. richardsonii* was first validly described in a rare updated *Botanical Appendix* to the second edition of the *Narrative of a journey to the shores of the Polar Sea* (Richardson 1824). Petrovskiy (1971) cited the protologue of *A. richardsonii* as "Hook. in Franklin, Narr. J. Polar Sea, ed. 2, App. VII (1824) 749", but I was able to find only a separately paginated separate fascicle of the updated *Botanical Appendix*, which is available from the Biodiversity Heritage Library (see Literature Cited).

**Anemonastrum Holub sect. Anemonastrum**

This group is represented in North America by several taxa of the *Anemonastrum narcissiflorum* aggregate, which were treated in recent North American literature mainly as subspecies or varieties, or as separate species in many publications by Eurasian authors. Three varieties of *Anemone narcissiflora* were recognized in the *Flora of North America North of Mexico* (Dutton & al. 1997). In my opinion, these taxa are better treated as separate species, which are widely accepted in Eurasian literature (Juzepczuk 1931; Petrovskiy 1971; Starodubtsev 1991, 1995; Tzvelev, 2001, 2012; Malyshev 2005, 2012 etc.) and in the current online version of the *Annotated Checklist of the Panarctic Flora* (Elven 2016). Their nomenclature is updated and summarized below. Those preferring a wide concept of *Anemonastrum narcissiflorum* and the subspecies status of these taxa can use the names subsp. *sibiricum*, subsp. *villosissimum*, and subsp. *zephyrum* (as included in synonymy below); however, their species status is accepted here.


**NORTH AMERICAN TAXA OF PULSATILLA: A NOMENCLATURAL UPDATE**

*Pulsatilla* is represented in North America by two native species, the well-outlined *P. occidentalis* (S. Watson) Freyn (*Anemone occidentalis* S. Watson) and a more problematic taxon of the *P. patens* (L.) Mill. group. Some other taxa of *Pulsatilla* native to Eurasia may be expected in North America as occasional and local garden escapes. Native North American plants of the *Pulsatilla patens* aggregate were recognized by Dutton & al. (1997) as *Anemone patens* var. *multifida* Pritzel, which was described from Siberia (Pritzel 1841). The North American taxon has a very complicated synonymy and it is definitely not identical with the typical European–Western Asian *P. patens* sensu stricto (subsp. *patens*). Its correct name as a species of *Pulsatilla* is *P. nuttalliana* (DC.) Bercht. & J. Presl, which in a wide sense is also applicable to Siberian and northeastern Asian plants also treated as *P. nuttalliana* subsp. *multifida* (Pritz.) Aichele & Schwegler (1957; see also Petrovskiy 1971; Starodubtsev 1995; Kricsfalussy 2015; Elven 2016). Alternatively, if a very wide circumscription of *P. patens* is preferred and North American and Asian plants of the group are treated as belonging to the same taxon, the name *Pulsatilla patens* subsp. *multifida* (Pritz.) Zämelis can be applied (see Wang & Bartholomew 2001). An updated nomenclatural citation of *P. nuttalliana* and its synonyms and misapplied names is provided below; necessary nomenclatural explanations are also provided.


**Heterotypic synonyms of Pulsatilla nuttalliana**


*Pulsatilla ludoviciana* A. Heller, Cat. N. Amer. Pl., ed. 2, 4. 1900, nom. illeg. (intended new combination based on illegitimate *Anemone ludoviciana* Nutt., but in fact a new name; type of *Clematis hirsutissima* Pursh excluded but *Anemone nuttalliana* DC. cited in synonymy).

**Misapplied names for Pulsatilla nuttalliana**


The authorship of the combination Pulsatilla nuttalliana has been often attributed to Sprengel (in Syst. Veg. ed. 16, 2: 663. 1825). However, Berchtold and J.S. Presl (1823) made this combination two years earlier. Their work O Prírozenosti Rostlin aneb Rostlinář was published in fascicles and later collected into three volumes. The first volume has a complicated pagination: it is not paged continuously but has 13 different groups of pages (Hunt Institute for Botanical Documentation 2016). Pulsatilla is treated in the fascicle Rostliny Pryskýrnjkowité (Ranunculaceae).

Dutton & al. (1997) commented that the "names Pulsatilla hirsutissima (Pursh) Britton and P. ludoviciana (Nuttall) A.Heller are illegitimate." It is certainly true for Anemone ludoviciana Nutt. because this name was proposed by Nuttall (1818) as an illegitimate new replacement name for Clematis hirsutissima, a species of a true Clematis, but the type of the replaced name has not been explicitly excluded (Art. 52.1 and 52.2 of ICN: McNeill & al. 2012). However, Heller (1900), when listing synonyms of his Pulsatilla ludoviciana, cited "Pulsatilla hirsutissima Britton, Ann. N.Y. Acad. Sci. 6: 217 1891; not Clematis hirsutissima Pursh". It means that he explicitly excluded the type of C. hirsutissima (which is also the type of the illegitimate name Anemone ludoviciana) and thus coined a new replacement name (not a new combination), but at the same time he cited as a synonym the name Anemone nuttalliana DC., thus anyway making his proposed new name illegitimate. In the Annotated Checklist of the Panarctic Flora (PAF). Vascular Plants (Elven 2016) the name P. hirsutissima is also considered "illegitimate because the given basionym is Clematis hirsutissima Pursh, Fl. Amer. Sept. 2: 385 (1813), a true Clematis." However, it is definitely not illegitimate: Britton in fact made a new combination (Art. 6.10 of ICN: McNeill & al. 2012) based on C. hirsutissima and thus his combination (as well as other combinations based on the same basionym) is just homotypic with its basionym (Art. 7.3 of ICN: McNeill & al. 2012) and thus is a legitimate nomenclatural synonym of C. hirsutissima, despite a long history of its (mis)application to a taxon of Pulsatilla.

Luferov (2004) listed the combination Pulsatilla patens subsp. multifida (Pritz.) Zämelis as an illegitimate name. However, I was unable to find any proof of its illegitimacy. When making his new combination, Zämelis (Zämels 1926) indeed listed in its synonymy the name Pulsatilla patens, but with the reference to Ledebour, which in modern terms should be understood as "Pulsatilla patens sensu Ledebour in Flora Altaica, not (L.) Mill. sensu stricto." Moreover, that name is a combination based on a legitimate basionym.

The use of the epithet "wolfgangiana" to North American and East Asian taxa of Pulsatilla is an evident misapplication. Anemone wolfgangiana was first validly described by Besser (1826) in the fourth volume of Reichenbach's Iconographia Botanica seu Plantae Criticae (not in Reichenbach's Iconographia Botanica Exotica, as erroneously stated in IPNI 2016, and not by "Besser ex W.D.J. Koch" in the fourth volume of the third edition of J.C. Röhling's Deutschlands Flora revised by W.D.J. Koch, as occasionally mentioned in some other sources). The syntypes (LE, KW, and probably in some other herbaria) are from Lithuania, near Vilnius (Besser's collections made "in Lithuania prope Vilnas", "bei Vilna in Liththauen": Besser 1826: 41). This taxon, which is often treated as a species of hybrid origin, is probably conspecific with P. teklae Zämelis [P. patens subsp. teklae (Zämelis) Zämelis]; it occurs in Central and Eastern Europe (Poland, Baltic states, Belarus, northern Ukraine, and northwestern European Russia) (Tzvelev 2001, 2012). The misapplication of names based on A. wolfgangiana for plants from northeastern Asia (and later from North America) was most probably initiated by Trautvetter and C.A. Meyer, who proposed the name "Pulsatilla..."
patens Mill. var. Wolfgangiana nob. — Anemone Wolfgangiana Bess. in litt." (Trautvetter & Meyer 1856: 7), which should be treated as a new combination made by indirect reference, and thus the name of this variety has the same type as A. wolgangiana Besser. In IPNI (2016) this combination is cited with the incorrect authorship ("Trautv. & E.Mey.") and inaccurate citation of the place of publication ("Fl. Ochot. Phaenog. 1 abt 2: 7. 1856 [Jan 1856]; alt. title: in Middend., Reise Sibir. 1 (abt 2): 7. Jan 1856"). The second author of Florula Ochotensis Phaenogama was Carl Anton (Karl Andreévich) von Meyer, not Ernst Heinrich Friedrich Meyer. This Florula … (which itself has no volumes or issues) was published in the separately paginated second issue or fascicle (Abtheilung) of the second part (Theil) of the first volume of Middendorff's Reise in den äussersten Norden und Osten Sibiriens, and the volume information should be cited accordingly.

ACKNOWLEDGEMENTS

I am grateful to Prof. Svetlana N. Ziman (Svitlana M. Zyman in Ukrainian transliteration; M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine, KW) for her valuable comments and long-term cooperation on Anemone sensu lato, to Elena V. Bulakh (KW) for providing copies of some publications, and to Guy Nesom for his editorial work on the manuscript.

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