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Two new combinations in *Adenostyles (Asteraceae, Senecioneae),* a conspectus of the genus and key to its species and subspecies

Abstract

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Based on a molecular phylogeny (using ITS, ETS and the *rpl32-trnL, psbA-trnH* and *ndhF-rpl32* plastid spacer sequences) of all species and subspecies of the European genus *Adenostyles* currently recognised, and supported by the morphology of the leaf margin, we transfer two subspecies of *A. alliariae* to *A. alpina* and provide the new combinations *A. alpina* subsp. *macrocephala* and *A. alpina* subsp. *pyrenaica*. A revised key to the species and subspecies and a conspectus of the genus are presented.

Additional key words: *Compositae,* Alps, European Alpine system, taxonomy, molecular phylogeny

Adenostyles Cass. of the tribe *Senecioneae* of the sunflower family *(Asteraceae)* is an endemic genus of Europe, where it is distributed in the Alps and in other high mountain ranges at montane to subalpine altitudes (for distribution maps see Meusel & Jäger 1992). Within *Senecioneae,* it is part of the 'Quadridentate group' (Jeffrey 1992; Nordenstam 2007; Pelser & al. 2007) together with the SW Asian *Caucasalia* B. Nord., *Dolichorrhiza* (Pojark.) Galushko, *Iranecio* B. Nord. and *Pojarkovia* Askerova.

In the only revision available of *Adenostyles,* three species with six subspecies and several varieties were recognised (Wagenitz 1983). These species and subspecies are: 1. *Adenostyles alliariae* (Gouan) A. Kern. with subsp. *alliariae,* subsp. *macrocephala* (Huter & al.) Wagenitz & I. Müll. and subsp. *pyrenaica* (Lange) P. Fourn.; 2. *A. alpina* (L.) Bluff & Fingerh. (= *A. glabra* (Mill.) DC.) with subsp. *alpina,* subsp. *briquetii* (Gamisans) Tutin and subsp. *nebrodensis* (Wagenitz & I. Müll.) Greuter; 3. *A. leucophylla* (Willd.) Rchb.

A molecular phylogenetic analysis of 46 samples of all species and subspecies of *Adenostyles* as recognised by Wagenitz (1983) and using nuclear ribosomal internal transcribed spacer (ITS) and external transcribed spacer (ETS) sequences as well as three different plastid (*rpl32-trnL* spacer, *psbA-trnH* spacer, *ndhF-rpl32* spacer) sequences (Dillenberger & Kadereit in prep.) resulted in phylogenetic relationships (Fig. 1) which are clearly incongruent with Wagenitz's (1983) classification: *A. alliariae* subsp. *alliariae* and *A. leucophylla* were found to be well-supported sister species, which in turn were well-supported sister to *A. alpina* with subsp. *alpina,* subsp. *briquetii* and subsp. *nebrodensis,* but also including *A. alliariae* subsp. *macrocephala* and *pyrenaica*.

Wagenitz (1983), as already earlier authors (back at least to Fiori 1903), distinguished *Adenostyles alpina* and *A. alliariae* by the absence *(A. alpina)* and presence *(A. alliariae)* of more or less distinctly auriculate upper leaves. The inclusion of subsp. *macrocephala* and *pyrenaica* in *A. alliariae* was based on this charac-

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ter. While auriculate upper leaves were explicitly described for subsp. *pyrenaica* by Wagenitz (1983), he omitted subsp. *macrocephala* from his key and did not describe the upper leaves of this taxon. However, the isotype of subsp. *macrocephala* illustrated in Wagenitz (1983) clearly shows upper leaves with auricles. This character thus supports the classification of subsp. *macrocephala* and subsp. *pyrenaica* in *A. alliariae* and is incongruent with our molecular results.

On the other hand, the placement of *Adenostyles alliariae* subsp. *macrocephala* and subsp. *pyrenaica* in *A. alpina* rather than in *A. alliariae,* as suggested by our molecular results, is supported by the structure of the leaf margin (Fig. 2). Whereas the leaf margin of *A. alliariae* is irregularly dentate with large and small teeth (Fig. 2g), leaf margin dentation in all subspecies of *A. alpina* and also in *A. alliariae* subsp. *macrocephala* and subsp. *pyrenaica* is much more regular and mostly teeth of only one size class are present (Fig. 2b–e). The regularly dentate leaf margin of subsp. *macrocephala* and subsp. *pyrenaica* had also been noted and described by Wagenitz (1983). On the basis of the molecular evidence supported by leaf margin morphology, we here transfer subsp. *macrocephala* and subsp. *pyrenaica* from *A. alliariae* to *A. alpina*. Subspecies *macrocephala* had been treated before as a variety of *A. alpina* by Fiori (1903).

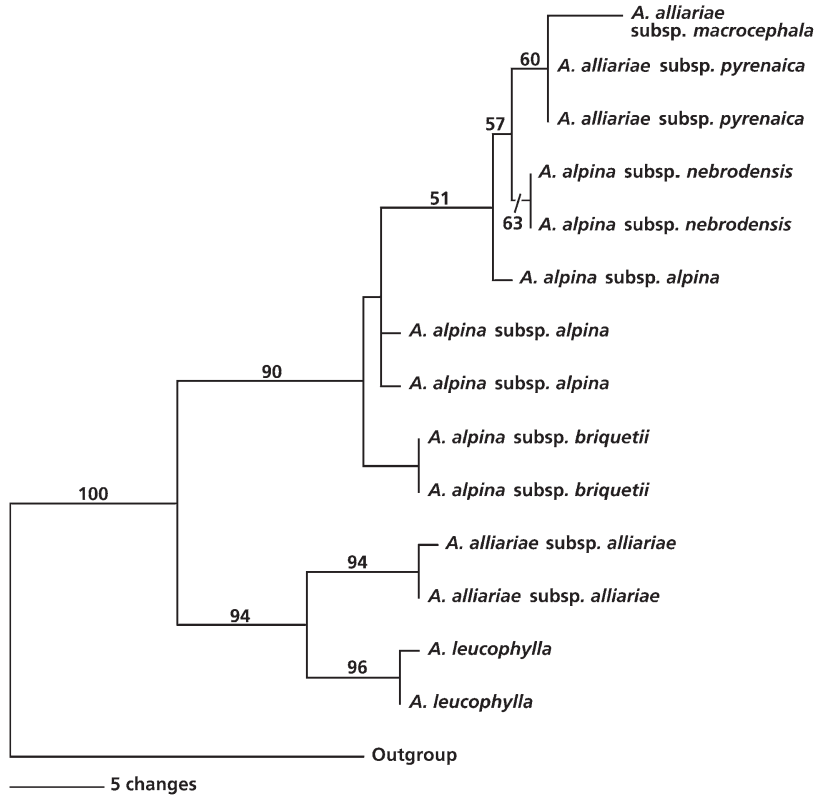


Fig. 1. Simplified Maximum Parsimony phylogram of *Adenostyles* (modified from Dillenberger & Kadereit in prep.). – Values above branches are bootstrap support values. *Adenostyles alliariae* subsp. *macrocephala* and subsp. *pyrenaica* are shown with their old names.

We here provide a key to the species and subspecies of *Adenostyles* and a conspectus of the genus in order to accommodate our results.

1. Involucral bracts tomentose; leaves usually densely hairy below and above . . . . . 2. *A. leucophylla*
– Involucral bracts glabrous to densely hairy; leaves at the most densely hairy below and sparsely hairy above 2
2. Leaf margin regularly dentate with teeth of one size class (Fig. 2a–e) 3
– Leaf margin irregularly dentate, with small and large teeth (Fig. 2g) . . . . . 1. *A. alliariae*
3. Upper leaves auriculate; capitula with 10–25 florets 4
– Upper leaves exauriculate; capitula with 3–12 florets 5
4. Capitula with 10–20 florets . . . . 3b. *A. alpina* subsp. *pyrenaica* (Spain, France)
– Capitula with 20–25 florets . . . . . 3d. *A. alpina* subsp. *macrocephala* (Aspromonte, Italy)
5. Plants completely glabrous; on siliceous rock . . . . . 3e. *A. alpina* subsp. *briquetii* (Corsica)
– Plants pubescent at least in inflorescence; on calcareous rock 6
6. Capitula with 3–6 florets; leaves chartaceous . . . . . 3c. *A. alpina* subsp. *nebrodensis* (Sicily)
– Capitula with 8–12 florets; leaves coriaceous . . . . . 3a. *A. alpina* subsp. *alpina*

1. *Adenostyles alliariae* (Gouan) A. Kern. in Österr. Bot. Z. 21: 12. 1871 ≡ *Cacalia alliariae* Gouan, Ill. Observ. Bot.: 65. 1773.

= *Adenostyles albida* Cass. in Cuvier, Dict. Sci. Nat. 1, Suppl. 60. 1816, nom. illeg.

Wagenitz (1983) recognised three varieties in *Adenostyles alliariae*. We here do not assess their justification: (1) *Adenostyles alliariae* var. *alliariae;* (2) *A. alliariae* var. *kerneri* (Simonkai) Malý in Glasn. Zemaljsk. Muz. Bosni Hercegovini 35: 123. 1923; (3) *A. alliariae* var. *orientalis* (Boiss.) Wagenitz in Phyton (Horn) 23: 153. 1983.

The species is found in the Alps, Carpathians, Dinarid Mountains, Apennines, Massif Central, eastern Pyrenees, the central Spanish Sierra de Gredos and several small-

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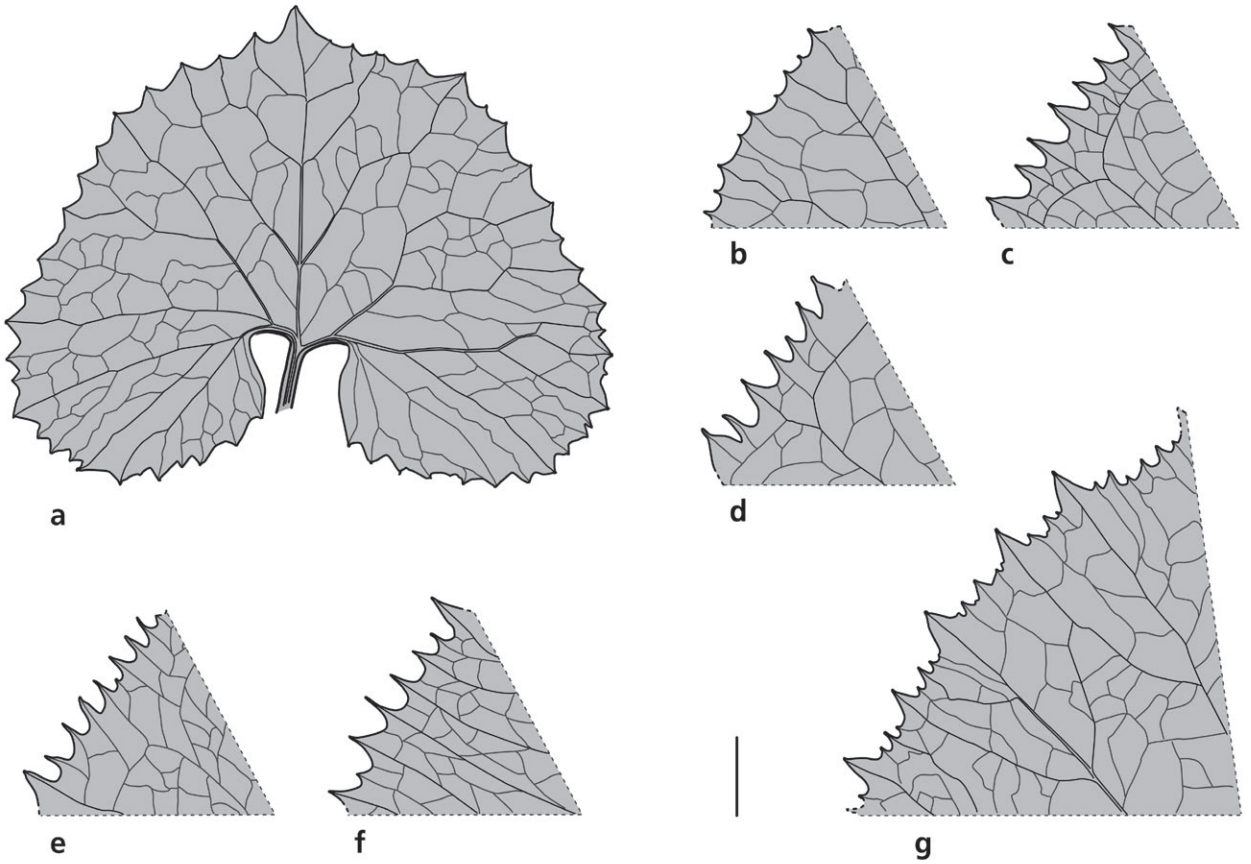


Fig. 2. a: Leaf shape and leaf margin of *Adenostyles alpina* subsp. *alpina;* b–g: leaf margins of *A. alpina* subsp. *pyrenaica* (b), subsp. *briquetii* (c), subsp. *macrocephala* (d), subsp. *nebrodensis* (e), *A. leucophylla* (f) and *A. alliariae* (g). – Scale bar = 1 cm.

er mountain ranges in Central Europe (Meusel & Jäger 1992).

2. *Adenostyles leucophylla* (Willd.) Rchb., Fl. Germ. Excurs.: 278. 1830 ≡ *Cacalia leucophylla* Willd., Sp. Pl. 3(3): 1736. 1803 ≡ *Adenostyles tomentosa* (Vill.) Schinz & Thell. in Bull. Herb. Boissier, ser. 2, 7: 578. 1907, nom. illeg.

This species is restricted to the western Alps.

3. *Adenostyles alpina* (L.) Bluff & Fingerh., Comp. Fl. German. 2: 329. 1825 ≡ *Cacalia alpina* L., Sp. Pl. 2: 836. 1753.
= *Adenostyles glabra* (Mill.) DC., Prodr. 5: 203. 1836.

In recent European Floras, this taxon is either called *Adenostyles glabra* (Fournier 1961; Heß & al. 1972; Pignatti 1982; Lauber & Wagner 1996; Wisskirchen & Haeupler 1998; Aeschimann & al. 2004; Eggenberg & Möhl 2009; Seybold 2009) or *A. alpina* (Tutin 1976; Rollán 1985; Rameau & al. 1993; Jeanmonod & Gamisans 2007; Fischer & al. 2008; Greuter 2008). These two names were extensively discussed by Wagenitz (1983) who argued for the preference of *A. glabra* over *A. alpina*. However, considering that the lectotype of *Cacalia alpina* L. (Herb. Burser X: 155, UPS!) chosen by Jeffrey (in Jarvis 1992) clearly belongs to the same taxon as *A. glabra, A. alpina* is the correct name to be used for this taxon.

3a. *Adenostyles alpina* subsp. ***alpina***
= *Adenostyles glabra* (Mill.) DC. subsp. *glabra*

Within *Adenostyles glabra* subsp. *glabra,* Wagenitz (1983) recognised three varieties. We here do not assess their justification: (1) *A. glabra* subsp. *glabra* var. *glabra;* (2) *A. glabra* subsp. *glabra* var. *calcarea* (Brügger) J. Braun & Thell. in Vierteljahrsschr. Naturf. Ges. Zürich 58: 93. 1913; (3) *A. glabra* subsp. *glabra* var. *australis* (Ten.) Wagenitz in Phyton (Horn) 23: 148. 1983.

The subspecies is distributed in the Alps, northern Dinarids, Jura and Apennines.

3b. *Adenostyles alpina* subsp. ***pyrenaica*** (Lange) M. Dillenberger & Kadereit, **comb. nov.**
≡ *Adenostyles pyrenaica* Lange in Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn, ser. 2, 3: 64. 1862 ≡ *Adenostyles alliariae* subsp. *pyrenaica* (Lange) P. Fourn., Quatre Fl. France: 994. 1940 ≡ *Adenostyles albida* subsp. *pyrenaica* (Lange) Rouy, Fl. France 8: 351. 1903.

This subspecies occurs in the western Pyrenees and the Cordillera Cantabrica.

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3c. ***Adenostyles alpina*** subsp. ***nebrodensis*** (Wagenitz & I. Müll.) Greuter in Willdenowia 37: 140. 2007 ≡ *Adenostyles hybrida* Guss., Fl. Sicul. Syn. 2: 449. 1844 ≡ *Adenostyles nebrodensis* Strobl in Flora 65: 196. 1882, nom. illeg. ≡ *Adenostyles glabra* subsp. *nebrodensis* Wagenitz & I. Müll. in Phyton (Horn) 23: 149. 1983.

Adenostyles alpina subsp. *nebrodensis* is only known from one population in the Madonie on Sicily.

3d. ***Adenostyles alpina*** subsp. ***macrocephala*** (Huter & al.) M. Dillenberger & Kadereit, **comb. nov.** ≡ *Adenostyles macrocephala* Huter & al. in Österr. Bot. Z. 56: 110. 1906 ≡ *Adenostyles alliariae* subsp. *macrocephala* (Huter & al.) Wagenitz & I. Müll. in Phyton (Horn) 23: 154. 1983 ≡ *Adenostyles alpina* var. *macrocephala* (Huter & al.) Fiori in Fiori & Béguinot, Fl. Italia 3: 205. 1903.

The subspecies is restricted to the Aspromonte in Calabria, southern Italy.

3e. ***Adenostyles alpina*** subsp. ***briquetii*** (Gamisans) Tutin in Bot. J. Linn. Soc. 70: 18. 1975 ≡ *Adenostyles briquetii* Gamisans in Candollea 28: 75. 1973 ≡ *Adenostyles glabra* subsp. *briquetii* (Gamisans) Wagenitz & I. Müll. in Phyton (Horn) 23: 150. 1983.

Adenostyles alpina subsp. *briquetii* is an endemic of Corsica.

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