BioOne DIGITAL LIBRARY

Re-evaluation of Senecio apenninus (Asteraceae, Senecioneae)

Authors: Conti, Fabio, Proietti, Elisa, Ogwu, Matthew Chidozie, Gubellini, Leonardo, and Bartolucci, Fabrizio

Source: Willdenowia, 49(3) : 329-341

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.49.49304

The BioOne Digital Library (https://bioone.org/) provides worldwide distribution for more than 580 journals and eBooks from BioOne's community of over 150 nonprofit societies, research institutions, and university presses in the biological, ecological, and environmental sciences. The BioOne Digital Library encompasses the flagship aggregation BioOne Complete (https://bioone.org/subscribe), the BioOne Complete Archive (https://bioone.org/archive), and the BioOne eBooks program offerings ESA eBook Collection (https://bioone.org/esa-ebooks) and CSIRO Publishing BioSelect Collection (https://bioone.org/csiro-ebooks).

Your use of this PDF, the BioOne Digital Library, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Digital Library content is strictly limited to personal, educational, and non-commmercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne is an innovative nonprofit that sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

Willdenowia
Annals of the Botanic Garden and Botanical Museum Berlin

FABIO CONTI[1], ELISA PROIETTI[1], MATTHEW CHIDOZIE OGWU[1,2], LEONARDO GUBELLINI[3] & FABRIZIO BARTOLUCCI[1*]

Re-evaluation of *Senecio apenninus* (*Asteraceae*, *Senecioneae*)

Version of record first published online on 26 November 2019 ahead of inclusion in December 2019 issue.

Abstract: A morphometric study on *Senecio apenninus* and *S. doronicum* subsp. *orientalis* belonging to *S.* sect. *Crociseris* was carried out with univariate and multivariate analyses. In order to correctly classify these taxa and clarify the taxonomic value of *S. apenninus*, we studied 38 qualitative and quantitative morphometric characters from 85 herbarium specimens. The results of our analyses allow the recognition of two clearly distinct and separate taxa, distinguished by number and diameter of their capitula, the ratio of involucral bracts and supplementary bracts and length of supplementary bracts. Furthermore, a neotype for the name *S. apenninus* is selected.

Key words: Apennines, *Asteraceae*, *Compositae*, endemic, Italy, morphometric analysis, *Senecio*, *Senecio apenninus*, taxonomy, typification

Article history: Received 3 May 2019; peer-review completed 20 June 2019; received in revised form 25 July and 2 August 2019; accepted for publication 2 August 2019.

Citation: Conti F., Proietti E., Ogwu M. C., Gubellini L. & Bartolucci F. 2019: Re-evaluation of *Senecio apenninus* (*Asteraceae*, *Senecioneae*). – Willdenowia 49: 329–341. doi: https://doi.org/10.3372/wi.49.49304

Introduction

The genus *Senecio* L. (*Asteraceae*, *Senecioneae*) is one of the largest genera of flowering plants and comprises c. 1250 species (Bremer 1994; Pelser 2007; Nordenstam 2007; Calvo & al. 2015). The origin of *Senecio* is hypothesized to be the SW parts of Africa around the Miocene from where its Palaearctic colonization began with different lineages (Kandziora & al. 2016). Today, it is almost cosmopolitan, although remarkable diversification occurs mainly in the Mediterranean climate zones, i.e. South Africa, Chile, and the Mediterranean Basin (Nordenstam & al. 2009; Calvo & al. 2015).

Senecio apenninus Tausch was first described generically from the Apennines (Tausch 1828). This taxon was treated at varietal rank by Fiori (1927) and Zangheri (1976) as *S. doronicum* var. *apenninus* (Tausch) Fiori distributed from Piceno Apennine to Cervialto. It was not recognized in *Flora europaea* (Chater & Walters 1976) and in *Flora d'Italia* as well (Pignatti 1982). *Senecio apenninus* gained again species validity in *An annotated checklist of the Italian vascular flora* (Conti & al. 2005), quoted in Marche, Umbria, Lazio, Abruzzo, and Molise. Greuter (in Greuter & Raab-Straube 2008) regarded *S. apenninus* as synonym of *S. provincialis* (L.) Druce. Recently, Pignatti (2018) listed it in note to

1 Scuola di Bioscienze e Medicina Veterinaria, Università di Camerino – Centro Ricerche Floristiche dell'Appennino, Parco Nazionale del Gran Sasso e Monti della Laga, San Colombo, 67021 Barisciano (L'Aquila), Italy; *e-mail: fabrizio.bartolucci@gmail.com (author for correspondence).
2 Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin, PMB 1154, Ugbowo, Benin City, Edo State, Nigeria.
3 Centro Ricerche Floristiche Marche, Provincia di Pesaro, Via Barsanti, Pesaro, Italy.

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

S. provincialis, and in the updated checklist of the vascular flora native to Italy (Bartolucci & al. 2018), it was regarded as a synonym of *S. doronicum* subsp. *orientalis* J. Calvo.

According to the recent systematic revision of *Senecio* sect. *Crociseris* (Rchb.) Boiss. (Calvo & al. 2015), *S. doronicum* (L.) L. occurs in SE Europe, from the Cantabrian Mountains to the N Dinaric Alps and it is characterized by 1–4(–9) capitula, which are relatively large, usually showing supplementary bracts as long as the involucral ones, and basal leaves lanceolate to oblanceolate, attenuate, ± concolorous. Within *S. doronicum* three subspecies are currently recognized: subsp. *doronicum*, subsp. *orientalis* and subsp. *longifolius* (Willk.) J. Calvo. *Senecio doronicum* subsp. *doronicum* is distributed in Austria, France, Germany, Switzerland and N Italy; *S. doronicum* subsp. *orientalis*, recently described based on a specimen collected in the C Apennines (Calvo & al. 2015), is an amphi-Adriatic taxon occurring also in the E Alps, and in some localities overlaps with *S. doronicum* subsp. *doronicum* (i.e. M. Baldo, Veneto and Trentino-Alto Adige, Italy); *S. doronicum* subsp. *longifolius* is distributed from Cantabrian Mountains and Pyrenees to SE France. *Senecio provincialis* is regarded by Calvo & al. (2015) as a good species distributed in France and Spain, differing from *S. doronicum* in supplementary bracts widened at the base, ± imbricate, usually a quarter to three quarters as long as involucral bracts, and basal leaves ovate to lanceolate, rounded to cuneate (rarely attenuate), ± discolorous. *Senecio provincialis* was also recently recorded from the W Alps in Italy (Bartolucci & al. 2018).

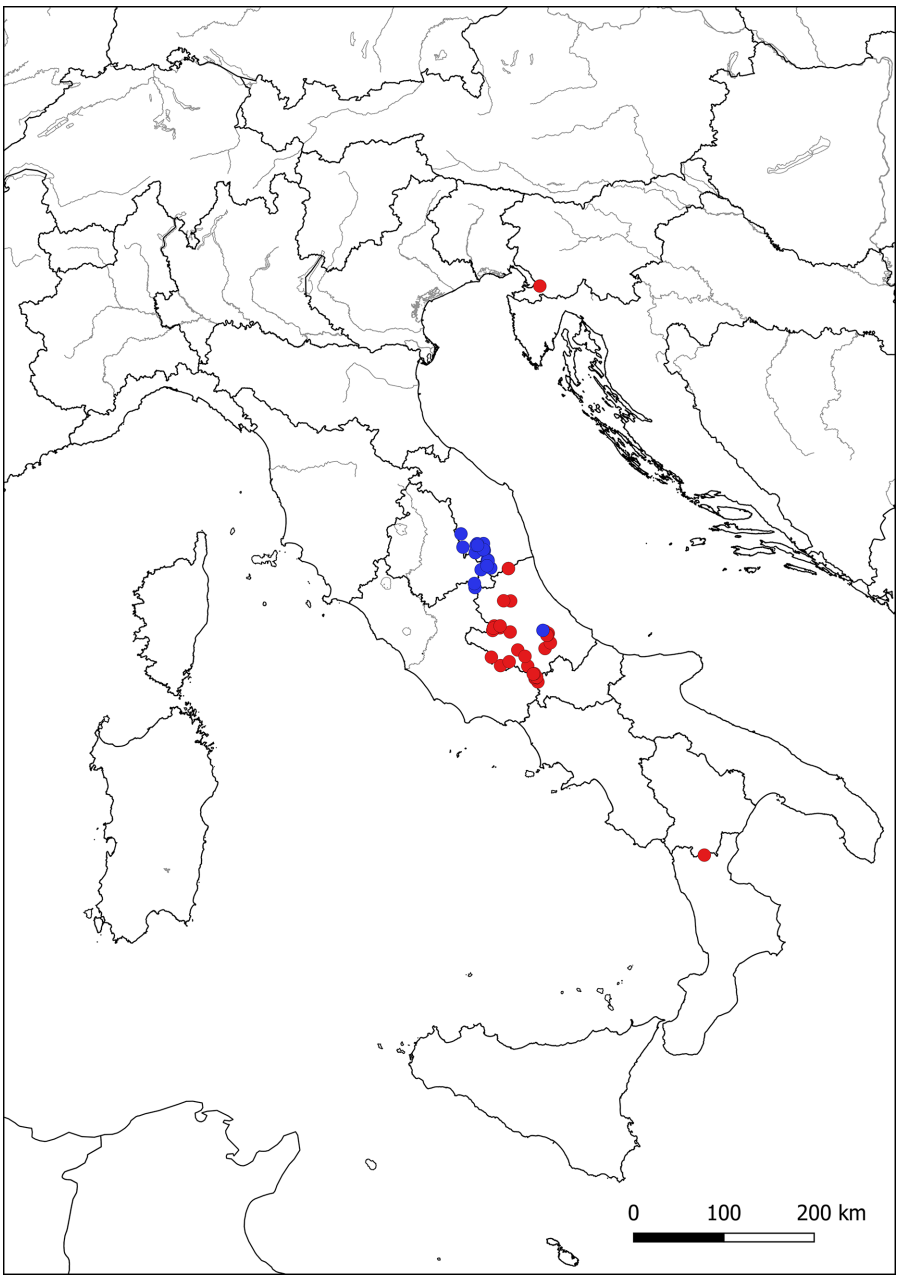

Fig. 1. Distribution map of *Senecio apenninus* (blue dots) and *S. doronicum* subsp. *orientalis* (red dots) according to herbarium specimens used for morphometric analysis.

Senecio apenninus is considered by Calvo & al. (2015) as likely similar to *S. doronicum* subsp. *orientalis*, but with remarkable morphological characters such as long peduncles, small capitula, and short supplementary bracts, a quarter to a half as long as the involucral ones. Even so, due to the few samples studied, Calvo & al. (2015) placed it under "Doubtful or excluded names".

According to our preliminary study on herbarium material (see Appendix 1, supplemental content online) matching Tausch's protologue and identifiable as *Senecio apenninus* from C Italy, it is evident that the latter species is morphologically homogeneous and clearly different from *S. doronicum* mainly for small capitula, 4–15 up to 50 capitula (vs 1–4(–9)), very short supplementary bracts, ± half as long as the involucral ones (vs two thirds to one and a half as long as the involucral ones) and from *S. provincialis* mainly for leaves lanceolate to oblanceolate, obtuse to acute, attenuate to cuneate, concolorous (vs ovate to lanceolate, rounded

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

Table 1. Morphological characters employed in the morphometric analyses.

	Abbreviations	Characters
1	PLH	plant height (mm)
2	LBL	length of largest basal leaf (mm)
3	WBL	width of largest basal leaf (mm)
4	LPBL	length of petiole of basal leaf (mm)
5	LCL	length of largest cauline leaf (mm)
6	WCL	width of largest cauline leaf (mm)
7	DoC	diameter of capitulum (mm)
8	LSB	length of supplementary bract (mm)
9	WSB	width of supplementary bract (mm)
10	LIB	length of involucral bract (mm)
11	WIB	width of involucral bract (mm)
12	RoIB/SB	involucral bract / supplementary bract ratio
13	LLF	length of ligulate floret (mm)
14	WLF	width of ligulate floret (mm)
15	LTLF	length of tube of ligulate floret (mm)
16	LTF	length of tubular floret (mm)
17	LTTF	length of tube of tubular floret (mm)
18	LPTF	length of free petal of tubular floret (mm)
19	LoF	length of filament (mm)
20	LoAT	length of anther (mm)
21	LoAC	length of achene (mm)
22	WoAC	width of achene (mm)
23	LoP	length of pappus (mm)
24	NLB	number of leaves and bracts
25	NoC	number of capitula
26	NSB	number of supplementary bracts
27	NIB	number of involucral bracts
28	TLPS	trichomes on lower part of stem (absent =0; present =1)
29	TMPS	trichomes on middle part of stem (absent =0; present =1)
30	TVSL	trichomes on ventral side of leaf (absent =0; present =1)
31	TDSL	trichomes on dorsal side of leaf (absent =0; present =1)
32	TSB	trichomes on supplementary bracts (absent =0; present =1)
33	TIB	trichomes on involucral bracts (absent =0; present =1)
34	TTSB	type of trichomes of supplementary bracts (straight =0; twisted =1)
35	TTIB	type of trichomes of involucral bracts (straight =0; twisted =1)
36	ToB	type of bracts (smooth =0; keeled =1)
37	CBA	colour of bract apex (pale =1; mildly black =2; black =3)
38	ToA	trichomes on achene (absent =0; present =1)

to cuneate, rarely attenuate, ± discolorous), involucral bracts lanceolate to ensiform (vs lanceolate to oblong), supplementary bracts subulate, without scarious margin, not imbricate (vs broadly lanceolate to triangular sometimes with scarious margin, ± imbricate), and 4–15 up to 50 capitula (vs 1(–4)).

In order to correctly classify *Senecio apenninus*, we carried out a morphometric analysis, that aims to clarify its taxonomic value and to examine its morphological variability. Considering the morphological traits discussed above and the distribution of the taxa cited, we compared *S. apenninus* with the related *S. doronicum* subsp. *orientalis*, the only taxon occurring in the same area (C Apennines, Italy).

Material and methods

This study is based on an extensive analysis of relevant literature, field surveys and detailed examination of herbarium specimens kept in APP, COI, FI, K, MPU, NAP, NY, P, PESA, PI and US (see Appendix 1, , supplemental content online). The original material for the name *Senecio apenninus* was searched in BUC, CGE, LE, PH, PR, PRC, REG, W and WU (herbarium codes follow Thiers 2019+). The morphometric analyses, based on measurements of both qualitative and quantitative characters, were carried out on 85 selected specimens (Fig. 1) including *S. apenninus* (42 specimens) and *S. doronicum* subsp. *orientalis* (43 specimens). The analyses were performed on 38 variables (Table 1), selected according to their common use for taxonomic identification of *Senecio* (Calvo & al. 2015).

Micromorphological analysis was carried out by stereo-microscope on stem, leaves, floral elements (petals, androecium and gynaecium) and fruits. For each specimen, ligulate florets, tubular florets, filaments, anthers, supplementary bracts and involucral bracts were soaked in water for a few seconds before measurements were taken. Parameters were measured, after scanning, using ImageJ software (Rasband 1997–2016) or simply with a ruler. Measurements refer to dried specimens.

For each quantitative character, Shapiro-Wilks normality test was first used to determine their distribution and then independent sample t-tests were used to analyse their differences and thereafter box plots were made in R studio version 1.1.463 (R Core Team 2019). To include the qualitative characters in the multivariate analysis, a matrix was developed based on individual character distribution (see Table 1). Several multivariate approaches were used to compare all the evaluated characters in both taxa including principal component analysis (PCA), Bray Curtis-based non-metric dimensional scaling (NMDS), unweighted pair group method with arithmetic mean (UPGMA) cluster analysis, and Pearson (linear) correlation in PAST [PAlaeontological STatistic] package version 3.24 (Hammer & al. 2019).

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

Table 2. Comparisons of morphological characters between *Senecio apenninus* and *S. doronicum* subsp. *orientalis*. Quantitative continuous characters are expressed in mm and are reported as mean ± standard deviation and 10–90 percentiles (extreme values in brackets). For quantitative discrete characters, 10–90 percentiles are given (extreme values in brackets).

		Senecio apenninus	***Senecio doronicum*** subsp. ***orientalis***
	Quantitative continuous characters (mm)		
PLH	plant height	645.33 ± 114.70 (420–)453–780(–930)	397.84 ± 92.44 (215–)286–535(–600)
LBL	length of largest basal leaf	102.54 ± 24.62 (60–)70–148.5(–155)	87.39 ± 23.65 (42–)55.45–118.05(–140)
WBL	width of largest basal leaf	38.40 ± 11.95 (15–)22.6–53(–75)	29.53 ± 8.45 (14.89–)18.96–43.19(–47.11)
LPBL	length of petiole of basal leaf	69.60 ± 38.97 (20–)30–110(–200)	56.36 ± 21.18 (17.78–)30.82–87.81(–108.98)
LCL	length of largest cauline leaf	142.40 ± 44.49 (43–)90–195.5(–270)	108.56 ± 32.87 (26.56–)67.08–155.49(–181.08)
WCL	width of largest cauline leaf	29.40 ± 12.62 (5–)14.6–43(–80)	21.08 ± 9.36 (7.3–)9.09–35.81(–45)
DoC	diameter of capitulum	32.85 ± 3.94 (24.66–)28.15–38.39(–42.59)	39.35 ± 7.17 (27.13–)30.58–48.19(–57.45)
LSB	length of supplementary bract	4.29 ± 0.79 (3.22–)3.34–5.29(–7.02)	10.99 ± 2.09 (7.19–)8.58–13.72(–17.06)
WSB	width of supplementary bract	0.65 ± 0.16 (0.39–)0.46–0.89(–0.99)	1.11 ± 0.19 (0.66–)0.89–1.38(–1.45)
LIB	length of involucral bract	7.82 ± 0.74 (6.58–)6.89–8.94(–9.52)	10.77 ± 1.52 (7.36–)9.01–12.86(–15.07)
WIB	width of involucral bract	1.30 ± 0.25 (0.95–)1.01–1.63(–1.94)	1.29 ± 0.03 (0.39–)0.88–1.72(–1.99)
LLF	length of ligulate floret	17.19 ± 2.35 (11.55–)13.17–20.08(–20.72)	19.62 ± 3.42 (11–)15.6–23.59(–29.31)
WLF	width of ligulate floret	3.88 ± 0.55 (2.79–)3.05–4.56(–5.08)	3.82 ± 0.91 (1.74–)2.77–5.14(–5.51)
LTLF	length of tube of ligulate floret	4.06 ± 0.59 (2.78–)2.99–4.72(–5.37)	4.70 ± 0.88 (2.42–)3.66–6.04(–6.55)
LTF	length of tubular floret	6.52 ± 0.77 (4.52–)5.63–7.53(–8.21)	7.74 ± 0.93 (5.68–)6.23–8.7(–10.03)
LTTF	length of tube of tubular floret	2.78 ± 0.52 (1.72–)2.06–3.49(–3.58)	3.15 ± 0.60 (1.97–)2.32–4.01(–4.32)
LPTF	length of free petal of tubular floret	0.76 ± 0.15 (0.47–)0.63–0.98(–1.15)	0.84 ± 0.19 (0.41–)0.64–1.05(–1.49)
LoF	length of filament	4.02 ± 0.79 (2.07–)2.96–5.09(–5.51)	4.69 ± 0.88 (2.1–)3.59–5.76(–6.19)
LoAT	length of anther	2.25 ± 0.28 (1.64–)1.84–2.59(–2.71)	2.76 ± 0.52 (1.82–)2.06–3.46(–4.08)
LoAC	length of achene	5.01 ± 0.21 4.69–5.19	5.36 ± 0.48 4.6–5.8
WoAC	width of achene	1.12 ± 0.15 1–1.38	1.12 ± 0.01 1–1.2
LoP	length of pappus	4.90 ± 0.62 (3.69–)3.98–5.81(–6.14)	6.05 ± 0.81 (4.35–)4.92–7.13(–7.68)
	Ratio		
RoIB/SB	involucral bract / supplementary bract ratio	1.87 ± 0.26 (1.32–)1.53–2.21(–2.49)	0.99 ± 0.16 (0.69–)0.75–1.21(–1.36)

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

Table 2 (continued from previous page)

		Senecio apenninus	*Senecio doronicum* subsp. *orientalis*
	Quantitative discrete characters		
NLB	number of leaves and bracts	(10–)13–31.7(–102)	(7–)9–21.2(–33)
NoC	number of capitula	(3–)4–15.7(–50)	1–5(–8)
NSB	number of supplementary bracts	(7–)8–16(–18)	(8–)10–20(–22)
NIB	number of involucral bracts	(18–)20–24(–28)	(20–)22–37.2(–40)
	Qualitative characters		
TLPS	trichomes on lower part of stem	present	present
TMPS	trichomes on middle part of stem	present	present
TVSL	trichomes on ventral side of leaf	present	present
TDSL	trichomes on dorsal side of leaf	present	present
TSB	trichomes on supplementary bracts	present	present
TIB	trichomes on involucral bracts	present	present
TTSB	type of trichomes of supplementary bracts	twisted	twisted
TTIB	type of trichomes of involucral bracts	twisted	twisted
ToB	type of bracts	keeled	keeled
CBA	colour of bract apex	black	pale
ToA	trichomes on achene	present	present

Table 3. T score and P value of quantitative characters evaluated (significant P values at $P < 0.05$ in **boldface**).

Characters	T score	P value
PLH	10.97	**2.2e–16**
NLB	4.06	**0.00**
LBL	2.90	**0.00**
WBL	3.84	**0.00**
LPBL	1.67	0.10
LCL	4.00	**0.00**
WCL	3.21	**0.00**
NoC	6.20	**2.07e–08**
DoC	–5.20	**1.42e–06**
NSB	–3.95	**0.00**
NIB	–8.91	**9.95e–14**
LSB	–19.57	**2.20e–16**
WSB	–12.35	**2.2e–16**
LIB	–11.39	**< 2.20e–16**
WIB	0.15	0.88
RoIB/SB	18.66	**< 2.20e–16**
LLF	–3.68	**0.00**
WLF	0.43	0.67
LTLF	–3.85	**0.00**
LTF	–6.53	**4.91e–09**
LTTF	–3.06	**0.00**
LPTF	–2.13	**0.04**
LoF	–3.67	**0.00**
LoAT	–5.57	**3.09e–07**
LoP	–7.01	**5.86e–10**

Prior to the analysis, all the characters were normalized using the software's correlation matrix as previously adopted and described by Wahlsteen & Tyler (2019). Pearson's correlation was used to show the relationship between the traits studied. The PCA was used to analyse matrices of several characters and species to get a general overview of the variation in the two groups. NMDS is a numerical technique with the capability to produce a dissimilarity-based index data matrix that places data points in a dimensional coordinate system so that relative distances between points reflect the relative dissimilarity between samples (Laflamme & al. 2011; Hammer & al. 2019). This technique can highlight the taxonomic significance of characters included in a study (Liu & al. 2013). UPGMA-based cluster analysis was performed with arithmetic mean, Michener & Sokal 1957) and Gower similarity index (Gower 1971).

Furthermore, the variability of the analysed morphological characters was described by standard statistical parameters (mean, standard deviation, minimum, maximum, 10th and 90th percentiles) (Table 2).

Results

Analysis of vegetative and reproductive morphological features (Table 2) of *Senecio apenninus* and *S. doronicum* subsp. *orientalis* allows the recognition of two clearly distinct and separate taxa. The most diagnostic features are the length of supplementary bracts and in particular

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

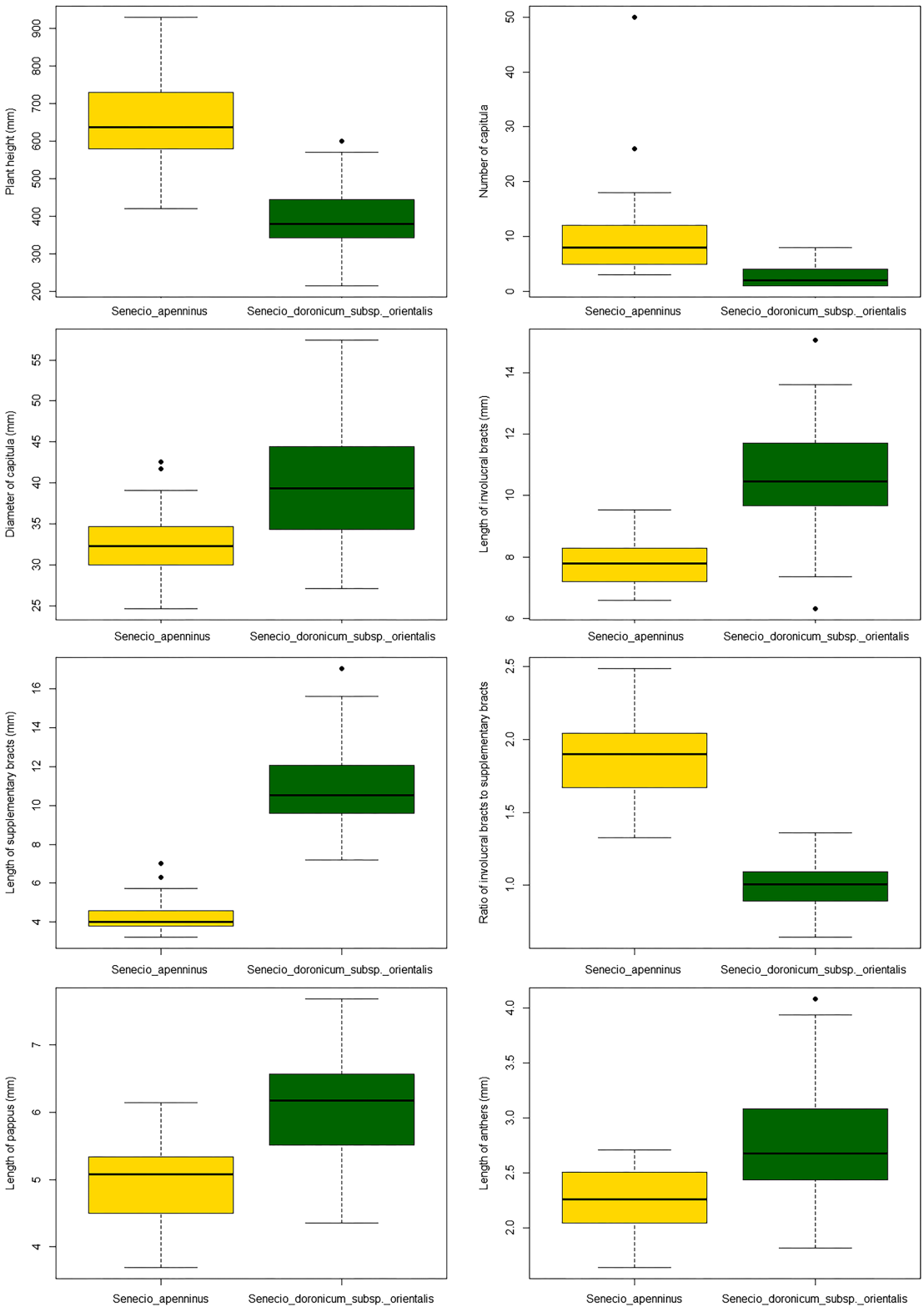

Fig. 2. Boxplots expressing morphological variation between *Senecio apenninus* and *S. doronicum* subsp. *orientalis*: plant height, number of capitula, diameter of capitula, length of involucral bracts, length of supplementary bracts, ratio length involucral bracts / supplementary bracts, length of pappus, length of anthers. Outlined central box depicts middle 50% of data, extending from 25th and 75th percentiles, and horizontal bar is the median. Ends of vertical lines (or "whiskers") indicate minimum and maximum data values, unless outliers are present, in which case whiskers extend to a maximum of 1.5 times inter-quartile range. Circles indicate outliers, unless extreme outliers are present, in which case circles extend to a maximum of three times inter-quartile range and extreme outliers are indicated as asterisks.

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

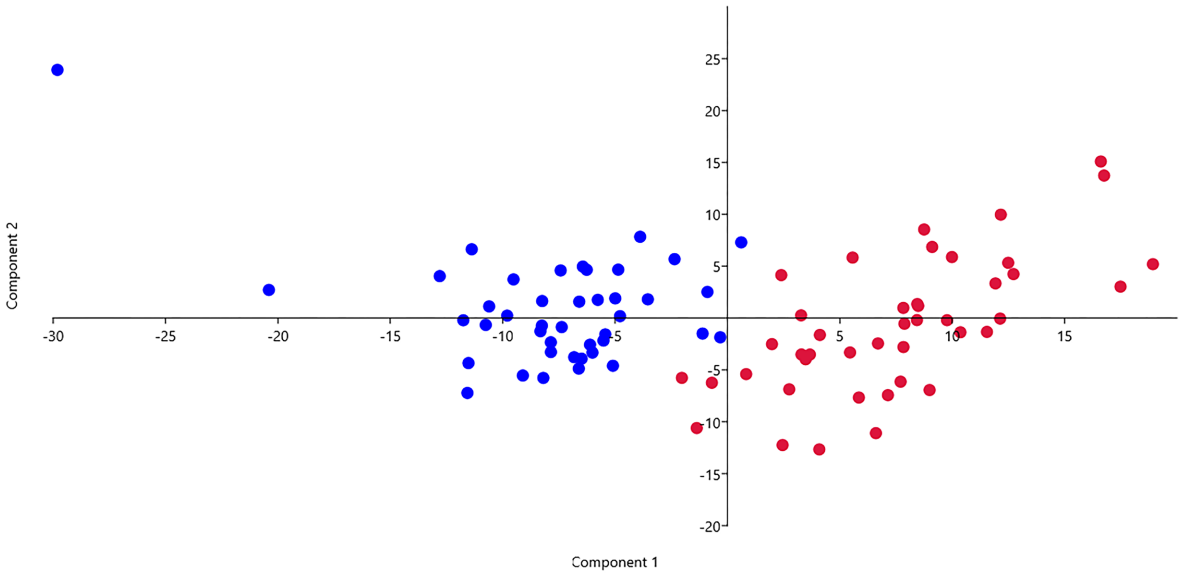

Fig. 3. PCA scatter plot revealing distinction between *Senecio apenninus* (blue dots) and *S. doronicum* subsp. *orientalis* (red dots).

the ratio of length between involucral bracts and supplementary bracts, the diameter of capitula and the number of capitula.

Most of the quantitative morphometric characters evaluated showed significant differences between the two *Senecio* taxa with the exception of LPBL, WIB and WLF (Table 3).

The means of each quantitative character were compared between the two taxa including PLH, NoC, DoC, LIB, LSB, RoIB/SB, LoP and LoAT (Fig. 2).

Overall, Pearson correlation coefficient reveals significant correlations between several characters. However, no character was excluded based on their correlation. The PCA produced eight components with eigenvalues greater than one (see Appendix 2, supplemental content online). The first and second component explained 47.61% and 20.11% of the variance, respectively. A scatterplot of the first two components (Fig. 3) shows a distinction between the two *Senecio* taxa. Character loadings of the eight components with eigenvalue greater than one reveal that DoC, NoC, NSB, NIB, LSB, LIB and LLF were the most influential characters in this analysis (see Appendix 3, supplemental content online).

The UPGMA dendrogram based on Gower similarity clearly separated *Senecio apenninus* (blue) and *S. doronicum* subsp. *orientalis* (red), suggesting more differences between the taxa and less within (Fig. 4). The two well-delimited clusters suggest they may be considered as independent taxa. This was further supported by the NMDS plot (Fig. 5), which grouped the individuals from the two taxa separately. The two clusters in the NMDS plot were exclusive for each group suggesting the possible separation of individuals from the two taxa.

Taxonomic treatment

Senecio apenninus Tausch in Syll. Pl. Nov. 2: 252. 1828. – **Neotype (designated here):** Italy, Lazio, M. S. Venanzio in loc. Selva Rotonda, Cittareale (Rieti), WGS84 33T: 345763 E, 4719023 N, pascoli secondari al margine della faggeta, 1616 m, 17 Jun 2016, *F. Conti, F. Bartolucci & R. Pennesi* (APP No. 57529; isoneotypes: APP Nos. 57499, 57528, 57530, 57531, 57532, 57533, 57534, 57535, 57536, 57537, 57538, 57539, 57540, 57541). – Fig. 6.

Description — Perennial herb. Stem (42–)45–78(–93) cm tall, erect, leafy, corrugated, solid, not branched, glabrescent to arachnoid, base usually without remnants of old leaves or tufts of hairs. Largest basal leaves (6–)7–14.8(–15.5) × (1.5–)2.2–5.3(–7.5) cm, persistent, occasionally withering early, lanceolate to oblanceolate, obtuse to acute, attenuate to cuneate, with a petiole (2–)3–11(–20) cm, dentate to slightly dentate, sometimes subentire, glabrescent to covered with scattered arachnoid trichomes above, arachnoid beneath, concolorous. Cauline leaves 3–7; largest cauline leaves (4.3–)9–19.5(–27) × (0.5–)1.4–4.3(–8) cm, alternate, lanceolate to oblanceolate, acute, rarely obtuse, sessile to semi-amplexicaul auriculate, rarely attenuated into a petiole, dentate to slightly dentate, rarely subentire, glabrescent above, arachnoid beneath, tertiary venation inconspicuous. Synflorescence corymbose, with linear bracts. Capitula (3 or)4–15(–50), (25–)28–38(–42) mm in diam., on long peduncles (to 23 cm); involucre cupuliform; involucral bracts (18–)20–24(–28), (6.6–)6.9–8.9(–9.5) × (0.9–)1–1.6(–1.9) mm, with

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

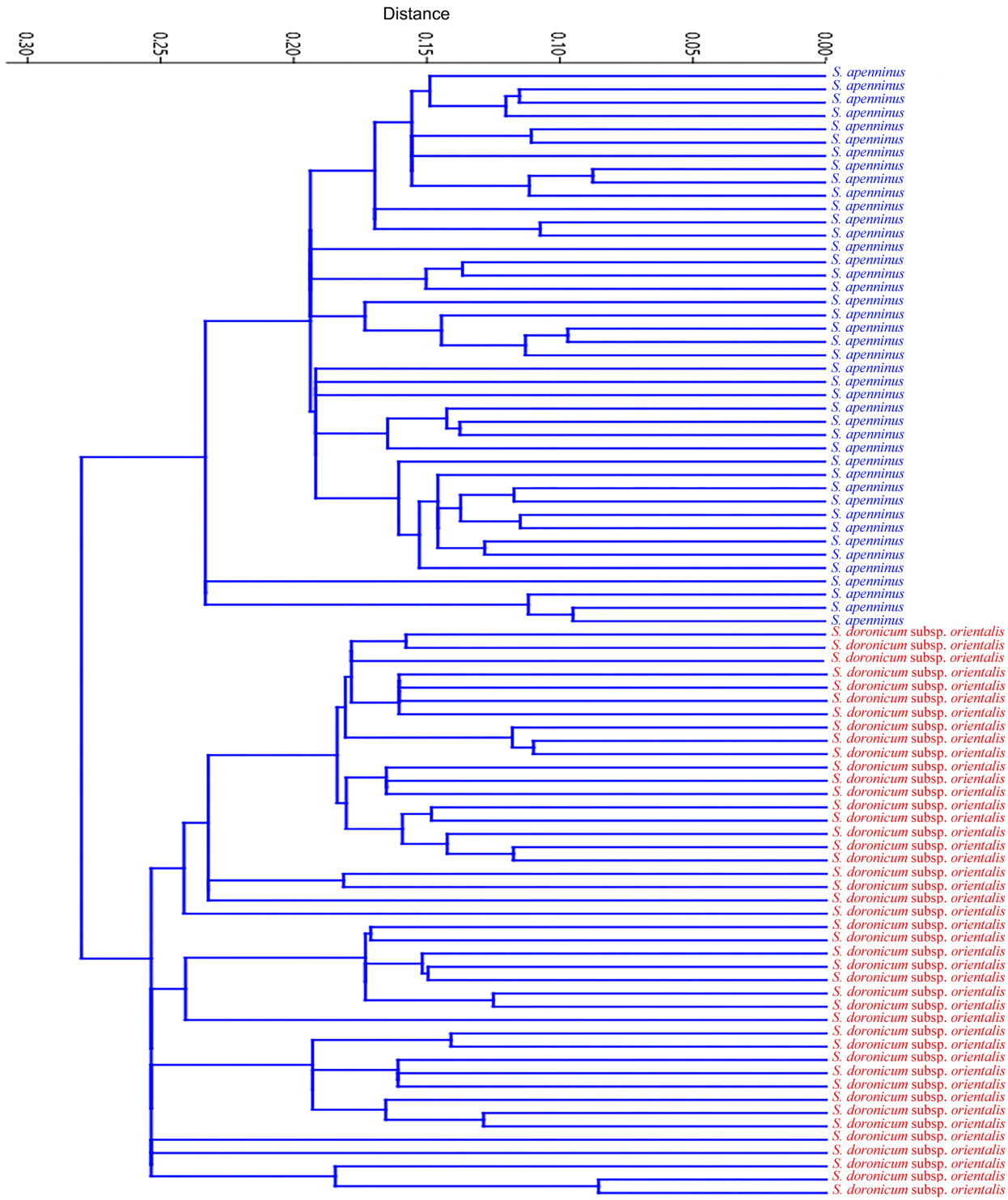

Fig. 4. Hierarchical clustering of 85 specimens of *Senecio apenninus* (blue) and *S. doronicum* subsp. *orientalis* (red) based on all evaluated characters using a paired group algorithm (UPGMA) and Gower similarity index.

scarious margin 0.05–0.35 mm wide, lanceolate to ensiform, acute, 0–2-keeled, apex usually with a blackish spot, glabrescent to weakly arachnoid; supplementary bracts (7 or)8–16(–18), (3.2–)3.3–5.3(–7) × (0.4–)0.5–0.9(–1) mm subulate, without scarious margin, apex usually with a blackish spot, [ratio length involucral bracts / supplementary bracts = (1.3–)1.5–2.2(–2.5)], arachnoid, not imbricate. Ligulate florets yellow, (11.5–)13.2–20.1(–20.7) × (2.8–)3.1–4.6(–5.1) mm, with tube (2.8–)3–4.7(–5.4 mm; t (2.1–)3–5.1(–5.5) mm. Achenes 4.7–5.2 × 1–1.4 mm subcylindric, shorter than pappus, with 9–11 ribs, glabrous, with scattered scales near base c. 0.06 mm; pappus (3.7–)4–5.8(–6.1) mm, whitish.

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

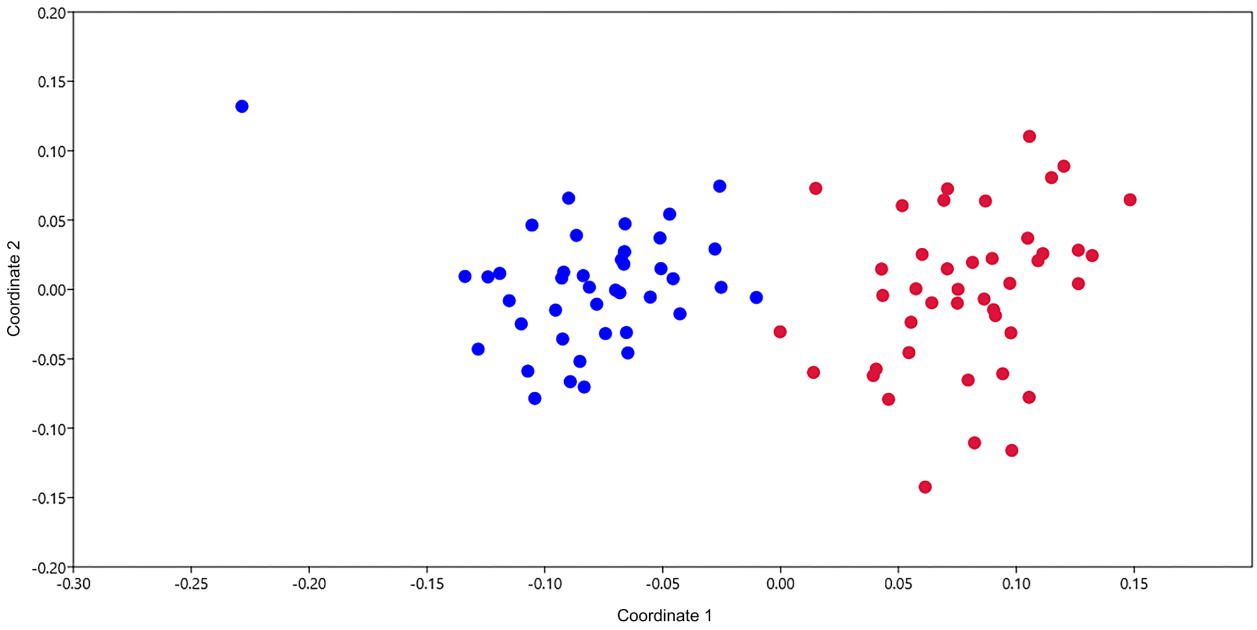

Fig. 5. Bray Curtis-based non-metric multidimensional scaling (NMDS) plot of 85 specimens of *Senecio apenninus* (blue dots) and *S. doronicum* subsp. *orientalis* (red dots) based on 27 morphometric characters.

Phenology — Flowering in June–July, fruiting in July–August.

Distribution — *Senecio apenninus* is endemic to the C Apennines, widespread in Umbria, Marche, Lazio and Abruzzo. The occurrence in Molise recorded by Lucchese (1995) without locality needs confirmation. We were not able to trace any herbarium specimens from Molise region.

Ecology — Meadows, edges and clearings of forests of *Fagus sylvatica* L.

Conservation status — According to IUCN criteria (IUCN Standards and Petitions Subcommittee 2017), we propose to include *Senecio apenninus* in the following category: Least Concern (LC).

Remarks — Tausch (1828: 252) described *Senecio apenninus* from the Apennines without any specific collection locality with a short description: "corymbo paucifloro inaequali, involucris anthodio duplo brevioribus; foliis denticulatis glabris, inferioribus ovatis obtusis petiolatis, superioribus lanceolatis acutis subamplexicaulibus". The author added also some differences between *S. doronicum* and *S. apenninus*: "Proximus *S. doronico* L. sed differt corymbo sub 4-floro prolifero, pedunculis nempe inferioribus longioribus, nec furcatis; floribus duplo minoribus pallidis; involucro anthodium non adaequante". According to Stafleu & Cowan (1986), Tausch's herbarium is housed in PRC (duplicates in PR, Mráz P., in litt.). Others duplicates are kept in BUC, CGE, LE, PH, REG, W, WU. We were not able to trace any original material in the above-mentioned herbaria. Even Calvo & al. (2015) were not able to find it. In PRC the *Asteraceae* (former German University herbarium) collection has not been yet merged with the Czech herbarium and then accessible for research purposes (Mráz P., in litt.). Thus, we select a specimen collected in the C Apennines during the annual field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society held in 2016 (Bartolucci & al. 2019), which matches Tausch's protologue (long peduncles, small capitula, and short supplementary bracts), as neotype (see Art. 9.13 of the *International Code of Nomenclature for algae, fungi, and plants*; Turland & al. 2018).

Identification key to *Senecio apenninus* and related taxa occurring in Italy

1. Basal leaves ovate to lanceolate, usually discolorous; supplementary bracts broadly lanceolate to triangular, sometimes with scarious margin, ± imbricate; synflorescence reduced to a solitary capitulum, rarely up to 4 . . . . . ***S. provincialis***
– Basal leaves lanceolate to oblanceolate, ± concolorous; supplementary bracts subulate, without scarious margin, not imbricate; capitula 1–15(–50) **2**
2. Capitula (3–)4–15(–50), (25–)28–38(–42) mm in diam.; involucral bracts (6.6–)6.9–8.9(–9.5 mm; supplementary bracts (3.2–)3.3–5.3(–7) × (0.4–)0.5–0.9(–1) mm, 2/5–2/3 × as long as involucral ones . . . . . ***S. apenninus***
– Capitula 1–4(–9), 27–60.4 mm in diam.; involucral bracts 6.8–13(–15) mm, supplementary bracts 6.4–17 × 0.5–1.5 mm, 2/3–1.5 × as long as involucral ones **3**

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

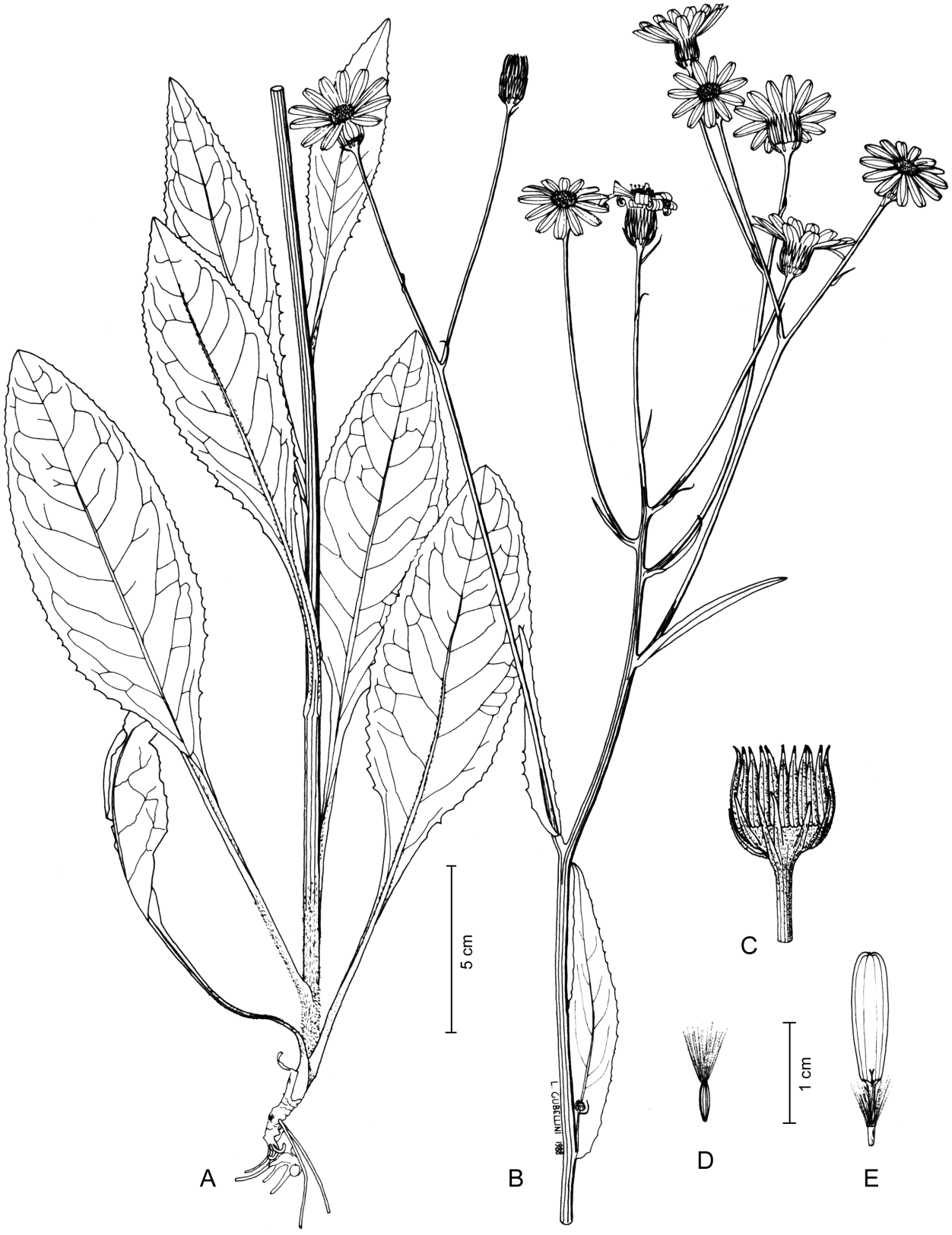

Fig. 6. *Senecio apenninus* – A: lower part of plant showing basal and lower cauline leaves; B: upper part of plant showing upper cauline leaves and synflorescence; C: involucre with distal portion of peduncle; D: achene with pappus; E: tubular floret. – Source: Italy, Marche, Gruppo del Montigno, Valle del Forno, tra Casa di Corradino e la Fonte del Forno, 6 Jul 1979, *A. Brilli-Cattarini & L. Gubellini* (PESA). – Drawn by L. Gubellini.

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

3. Leaves with scattered arachnoid trichomes above, weakly arachnoid to floccose beneath; involucre weakly arachnoid to floccose . . . . . ***S. doronicum*** subsp. ***doronicum***
– Leaves glabrescent above, covered with scattered scabrid-arachnoid trichomes beneath; involucre glabrescent or with scattered scabrid-arachnoid trichomes . . . . . ***S. doronicum*** subsp. ***orientalis***

Discussion

The present work revaluates *Senecio apenninus*, an endemic species of the C Apennines, widespread in Marche, Umbria, Lazio, Abruzzo and doubtfully occurring in Molise. *Senecio apenninus* is easily recognizable by the length of supplementary bracts and in particular by the ratio of length between the involucral bracts and supplementary bracts, capitula size, and number of capitula. Our results support the recognition of *S. apenninus* at specific rank as it shows peculiar characters, taxonomically more relevant, than those used by Calvo & al. (2015) for the description of the intraspecific variability of *S. doronicum* and also because it is sympatric with *S. doronicum* subsp. *orientalis*.

Contrary to what was observed by Calvo & al. (2015) *Senecio doronicum* subsp. *orientalis* has frequently and not rarely a single capitulum. Also, in Calvo & al. (2014) the number of capitula, the length of supplementary bracts and leaves with glabrescent to arachnoid indumentum are key characters of *S. doronicum* subsp. *orientalis,* which are supported by the results from the present study as they discriminated between the two evaluated taxa. According to our study *S. doronicum* subsp. *orientalis* and *S. apenninus* can occur in the same localities and they are sympatric in some places.

Senecio apenninus adds to the large contingent of endemic taxa occurring in the Apennines, some of which were recently described (i.e. Peruzzi & al. 2007; Conti & Bartolucci 2017; Conti & al. 2018, 2019; Rosati & al. 2018). Many of these taxa are endemic of C Italy, such as *Adonis distorta* Ten., *Cardamine apennina* Lihová & Marhold, *Corydalis densiflora* subsp. *apennina* F. Conti & al., *Erodium alpinum* (Burm. f.) L'Hér., *Gagea tisoniana* Peruzzi & al., *Iris marsica* I. Ricci & Colas., *Lathyrus apenninus* F. Conti, *Noccaea stylosa* (Ten.) Rchb., *Oxytropis ocrensis* F. Conti & Bartolucci, *Paeonia officinalis* subsp. *italica* N. G. Passal. & Bernardo, *Ranunculus giordanoi* F. Conti & Bartolucci, *Saxifraga exarata* subsp. *ampullacea* (Ten.) D. A. Webb, *Silene notarisii* Ces., etc. According to Bartolucci & al. (2018), 1707 taxa are endemic to Italy, Italy and Corsica (France), or Italy and Malta and among these, 1340 are narrow endemics to Italy (subspecies of *Hieracium* L. and *Pilosella* Hill excluded, see also Peruzzi & al. 2014, 2015, continuously updated online). Italy appears to be one of the Mediterranean countries with the highest number of endemic taxa (Peruzzi & al. 2014). The endemic taxa are key elements for setting national, regional or local conservation priorities and for driving conservation strategies (Orsenigo & al. 2018).

Acknowledgements

Many thanks are due the directors and curators of the consulted herbaria. This work was supported by the "Progetto di Ricerca di Rilevante Interesse Nazionale" (PRIN) "PLAN.T.S. 2.0 - towards a renaissance of PLANt Taxonomy and Systematics" lead by the University of Pisa, under the grant number 2017JW4HZK (Principal Investigator: Lorenzo Peruzzi). We gratefully acknowledge Joel Calvo and Carlos Aedo for providing us with some digital images of *Senecio apenninus*. We also thank two anonymous reviewers for their comments on an earlier version of this article.

References

Bartolucci F., Cancellieri L., Conti F., Banfi E., Bouvet D., Celestini M., Ciaschetti G., Di Pietro R., Falcinelli F., Fascetti S., Galasso G., Lattanzi E., Masin R. R., Pennesi R., Rosati L., Stinca A., Tilia A., Forte T. G. W. & Scoppola A. 2019: Contribution to the floristic knowledge of Velino and Aterno valleys (Lazio-Abruzzo, central Italy). – Ital. Bot. **7:** 93–100.

Bartolucci F., Peruzzi L., Galasso G., Albano A., Alessandrini A., Ardenghi N. M. G., Astuti G., Bacchetta G., Ballelli S., Banfi E., Barberis G., Bernardo L., Bouvet D., Bovio M., Cecchi L., Di Pietro R., Domina G., Fascetti S., Fenu G., Festi F., Foggi B., Gallo L., Gottschlich G., Gubellini L., Iamonico D., Iberite M., Jiménez-Mejías P., Lattanzi E., Marchetti D. Martinetto E., Masin R. R., Medagli P., Passalacqua N. G., Peccenini S., Pennesi R., Pierini B., Poldini L., Prosser F., Raimondo F. M., Roma-Marzio F., Rosati L., Santangelo A., Scoppola A., Scortegagna S., Selvaggi A., Selvi F., Soldano A., Stinca A., Wagensommer R. P., Wilhalm T. & Conti F. 2018: An updated checklist of the vascular flora native to Italy. – Pl. Biosyst. **152:** 179–303.

Bremer K. 1994: *Asteraceae*: cladistics & classification. – Portland: Timber Press.

Calvo J., Álvarez I. & Aedo C. 2014: Three new combinations and a replacement name in Eurasian *Senecio* (*Compositae*, *Senecioneae*). – Novon **23:** 139–142.

Calvo J., Álvarez I. & Aedo C. 2015: Systematics of *Senecio* section *Crociseris* (*Compositae*, *Senecioneae*). – Phytotaxa **211:** 1–105.

Chater A. O. & Walters S. M. 1976: *Senecio* L. in: Tutin T. G., Heywood V. H., Burges N. A. & Valentine D. H. (ed.) Flora europaea **4:** 191–205. – Cambridge: Cambridge University Press.

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

Conti F., Abbate G., Alessandrini A. & Blasi C. (ed.) 2005: An annotated checklist of the Italian vascular flora. – Roma: Palombi Editori.

Conti F., Bartolucci F. 2017: *Ranunculus giordanoi* sp. nov. from the *R. auricomus* complex (*Ranunculaceae*), central Apennines (Italy). – Nordic J. Bot. **35:** 322–327.

Conti F., Bracchetti L., Uzunov D. & Bartolucci F. 2019: A new subspecies of *Corydalis densiflora* (*Papaveraceae*) from the Apennines (Italy). – Willdenowia **49:** 53–64.

Conti F., Pennesi R., Uzunov D., Bracchetti L., Bartolucci F. 2018: A new species of *Oxytropis* (*Fabaceae*) from central Apennines (Italy). – Phytotaxa **336:** 69–81.

Fiori A. 1927: Nuova flora analitica d'Italia **2, fasc. 4:** 481–640. – Firenze: Tip. Ricci.

Gower J. C. 1971: A general coefficient of similarity and some of its properties. – Biometrics **27:** 857–871.

Greuter W. & Raab-Straube E. von (ed.) 2008: Med-Checklist. A critical inventory of vascular plants of the circum-mediterranean countries **2.** – Palermo, Genève & Berlin: OPTIMA.

Hammer Ø., Harper D. A. T. & Ryan P. D. 2019: PAST: paleontological statistics software package for education and data analysis. – Published at https://folk.uio.no/ohammer/past/

IUCN Standards and Petitions Subcommittee 2017: Guidelines for using the IUCN Red List categories and criteria. Version 13. Prepared by the Standards and Petitions Subcommittee of the IUCN Species Survival Commission. – Published at http://www.iucnredlist.org/documents/RedListGuidelines.pdf [accessed 15 Apr 2019].

Kandziora M., Kadereit J. W. & Gehrke B. 2016: Dual colonization of the Palaearctic from different regions in the Afrotropics by *Senecio*. – J. Biogeogr. **44:** 147–157.

Laflamme M., Schiffbauer J. D. & Dornbos S. Q. (ed.) 2011: Quantifying the evolution of early life: numerical approaches to the evaluation of fossils and ancient ecosystems. – London: Springer. – [Topics Geobiol. **36**].

Liu M-L., Yu W-B., Li D-Z., Mill R. R. & Wang H. 2013: Seed morphological diversity of *Pedicularis* (*Orobanchaceae*) and its taxonomic significance. – Pl. Syst. Evol. **299:** 1645–1657.

Lucchese F. 1995: Elenco preliminare della flora spontanea del Molise. – Ann. Bot. (Rome) **53, Suppl. 12:** 1–386.

Michener C. D. & Sokal R. R. 1957: A quantitative approach to a problem in classification. – Evolution **11:** 130–162.

Nordenstam B. 2007: *Senecioneae*. – Pp. 208–241 in: Kadereit J. W. & Jeffrey C. (ed.), The families and genera of vascular plants **8.** Flowering plants. Eudicots. *Asterales*. – Berlin: Springer.

Nordenstam B., Pelser P. B., Kadereit J. W. & Watson L. E. 2009: *Senecioneae*. – Pp. 503–525 in: Funk V. A., Susanna A., Stuessy T. F. & Bayer R. J. (ed.), Systematics, evolution and biogeography of *Compositae*. – Vienna: International Association for Plant Taxonomy.

Orsenigo S., Montagnani C., Fenu G., Gargano D., Peruzzi L., Abeli T., Alessandrini A., Bacchetta G., Bartolucci F., Bovio M., Brullo C., Brullo S., Carta A., Castello M., Cogoni D., Conti F., Domina G., Foggi B., Gennai M., Gigante D., Iberite M., Lasen C., Magrini S., Perrino E., Prosser F., Santangelo A., Selvaggi A., Stinca A., Vagge I., Villani M., Wagensommer R. P., Wilhalm T., Tartaglini N., Duprè E., Blasi C. & Rossi G. 2018: Red Listing plants under full national responsibility: extinction risk and threats in the vascular flora endemic to Italy. – Biol. Conservation **224:** 213–222.

Pelser P. B., Nordenstam B., Kadereit J. W. & Watson L. E. 2007: An ITS phylogeny of tribe *Senecioneae* (*Asteraceae*) and a new delimitation of Senecio L. – Taxon **56:** 1077–1104.

Peruzzi L., Bartolucci F., Frignani F., Minutillo F. 2007: *Gagea tisoniana*, a new species of *Gagea* Salisb. sect. *Gagea* (*Liliaceae*) from central Italy. – Bot. J. Linn. Soc. **155:** 337–347.

Peruzzi L., Conti F. & Bartolucci F. 2014: An inventory of vascular plants endemic to Italy. – Phytotaxa **168:** 1–75.

Peruzzi L., Domina G., Bartolucci F., Galasso G., Peccenini S., Raimondo F. M., Albano A., Alessandrini A., Banfi E., Barberis G., Bernardo L., Bovio M., Brullo S., Brundu G., Brunu A., Camarda I., Carta L., Conti F., Croce A., Iamonico D., Iberite M., Iiriti G., Longo D., Marsili S., Medagli P., Pistarino A., Salmeri C., Santangelo A., Scassellati E., Selvi F., Soldano A., Stinca A., Villani M, Wagensommer R. P. & Passalacqua N. G. 2015: An inventory of the names of vascular plants endemic to Italy, their loci classici and types. – Phytotaxa **196:** 1–217.

Pignatti S. 1982: Flora d'Italia **3**. – Bologna: Edagricole.

Pignatti S. 2018: Flora d'Italia **3**, ed. 2. – Bologna: Edagricole.

R Core Team 2019: R: A language and environment for statistical computing. – Vienna: R Foundation for Statistical Computing. – Published at http://www.R-project.org/

Rasband W. S. 199–2016: ImageJ – Bethesda: U.S. National Institutes of Health. – Published at http://imagej.nih.gov/ij/

Rosati L., Coppi A., Farris F., Fascetti S., Becca G., Peregrym M., Tan K. & Selvi F. 2018: The genus *Gymnospermium* (*Berberidaceae*) in Italy: identity and relationships of the populations at the western limit of the genus range. – Pl. Biosyst. **153:** 796–808.

Stafleu F. A. & Cowan R. S. 1986: Taxonomic literature. A selective guide to botanical publications and collections with dates, commentaries and types. Volume

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use

VI: Sti–Vuy. Second edition. – Utrecht/Antwerpen: Bohn, Scheltema & Holkema; The Hague/Boston: dr. W. Junk b.v., Publishers.

Tausch I. F. 1828: Diagnoses plantarum novarum aut minus cognitarum a Prof. Tausch. – Pp. 240–256 in: Hornschuch C. F. (ed.), Sylloge plantarum novarum itemque minus cognitarum **2.** – Ratisbonae: typis viduae C. E. Brenck.

Thiers B. 2019+ [continuously updated]: Index herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's virtual herbarium. – Published at http://sweetgum.nybg.org/science/ih/ [accessed 19 Apr 2019].

Turland N. J., Wiersema J. H., Barrie F. R., Greuter W., Hawksworth D. L., Herendeen P. S., Knapp S., Kusber W.-H., Li D.-Z., Marhold K., May T. W., McNeill J., Monro A. M., Prado J., Price M. J. & Smith G. F. (ed.) 2018: International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. – Glashütten: Koeltz Botanical Books. – [Regnum Veg. **159**].

Wahlsteen E. & Tyler T. 2019: Morphometric analyses and species delimitation in *Legousia* (*Campanulaceae*). – Willdenowia **49:** 21–33.

Zangheri P. 1976: Flora italica **1.** – Padova: CEDAM.

Willdenowia

Open-access online edition bioone.org/journals/willdenowia

Online ISSN 1868-6397 · Print ISSN 0511-9618 · Impact factor 1.156

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin

© 2019 The Authors · This open-access article is distributed under the CC BY 4.0 licence

Downloaded From: https://complete.bioone.org/journals/Willdenowia on 18 May 2025
Terms of Use: https://complete.bioone.org/terms-of-use