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Morphometric comparison of *Senecio germanicus* and *S. nemorensis* (Compositae) with a new species from Romania

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Morphometric comparison of three taxa of the *Senecio nemorensis* group, namely *S. germanicus* Wallr., *S. nemorensis* L. and a new species ***S. dacicus*** Hodálová & Marhold is presented. *S. dacicus*, representing plants with eight ligules from the Romanian Carpathians, previously identified as *S. nemorensis* L., is shown to be clearly distinct from the Siberian plants of *S. nemorensis*, which include the lectotype of this Linnaean name. Detailed data on the distribution of *S. dacicus* are presented. Numerical methods used include principal components analysis, cluster analysis, and canonical and non-parametric classificatory discriminant analysis.

ADDITIONAL KEY WORDS:—*Asteraceae* – Carpathians – distribution – numerical taxonomy – ***Senecio dacicus* sp. nov.**

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INTRODUCTION

In his description of *Senecio nemorensis*, Linnaeus (1753) stressed the occurrence of flowers with eight ligules ("corollis radiantibus octonis"), and specified its distribution

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as "*Habitat in Germaniae, Sibiriae nemoribus*". Wallroth (1822) recognized plants previously treated by German authors under the name *S. nemorensis* ("*S. nemorensis* ... auct. fl. germ.") as a new species, namely *S. germanicus*. Later, Reichenbach (1825) described plants of this group having five ligules, depicted by Jacquin (1774: Tab. 184), as a new species, *S. jacquinianus*, which is now widely accepted as a synonym of *S. germanicus*. At the same time he classified plants from Germany with seven to eight ligules as *S. nemorensis* L. However, the plant on Reichenbach's (1825) illustration (Tab. 294, no. 467), originating from around the town of Dresden, Germany, with seven ligules, is from its overall habit not much different from his *S. jacquinianus* and most probably represents a rather rare case of *S. germanicus* (= *S. jacquinianus*) with seven ligules. *S. germanicus* according to our results (see below) and according to Oberprieler (1994) usually has five ligules. *S. nemorensis* and *S. germanicus* (= *S. jacquinianus*) were treated for a long time as synonyms and even Chater & Walters (1976) in *Flora Europaea* treated them within the same subspecies, namely *S. nemorensis* subsp. *nemorensis*. Only Konečnaja (1979) stressed the idea that the name *S. nemorensis* should be applied only to the Siberian and Middle Asian populations of the *S. nemorensis* group which regularly possess eight ligules. Herborg (1987) fully accepted the arguments of Konečnaja (1979), treating *S. germanicus* and *S. nemorensis* as a separate species. He defined the distribution area of *S. nemorensis* as the Kola Peninsula, Archangelsk and Ural in the West to Sakhalin in the East. Furthermore, Herborg reported a specimen of this species from Romania, from the vicinity of the town of Sibiu ["Siebenbürgen, in silvis Transsilvaniae pr. Neudorf [Noul near Sibiu], 08. 08. ?, Fuss (WU)"], classifying this locality as a western outpost of *S. nemorensis*. This specimen prompted us to study populations from south and west Romania in more detail and to compare them with material from Siberia in order to find out if they are really conspecific (within the narrow concept of species) or not.

In order to reveal the taxonomic position of the Romanian plants, corresponding to the specimen identified by Herborg (1987: 102) as *S. nemorensis* and referred to in the present paper as *S. dacicus*, we decided to compare them morphologically with the plants of the *S. nemorensis* group from Siberia and with the most closely related taxon of this group, namely *S. germanicus*. The inclusion of *S. germanicus* in our study was also stimulated by the fact that Oberprieler (1994) considered these populations (treated under the name *S. nemorensis* subsp. *jacquinianus*) to be conspecific with *S. nemorensis*, while at the same time granting some other taxa of this group (e.g. *S. ovatus* (P. Gaertn. *et al.*) Willd.) the level of species.

MATERIAL AND METHODS

Two hundred and thirteen plants were included in the morphometric study. They represented: (a) 138 specimens of *S. germanicus* from the whole range of the Carpathians; (b) 43 specimens of *S. dacicus* from the western and southern Carpathian part of Romania including the specimen cited by Herborg (1987); (c) 32 specimens of *S. nemorensis* from Siberia (for details of their origins see Appendix 1). The following ten quantitative and one binary characters were measured or scored for each plant: length of stem leaves (LL); maximum width of stem leaves (WL); width of base of stem leaves (WLB); length of supplementary bracts (calyculus bracts) (LSB); length of involucral bracts (LB); number of involucral bracts (NB); length of ligules (LLG);

number of ligules (NL); length of tubular florets (LF); number of tubular florets (NF); indument of supplementary bracts (IB): long articulate hairs (1), glandular hairs (2). Character state 1 of IB corresponds to "Flaumhaare" and state 2 to "Drüsenhaare" in the sense of Oberprieler (1994: 12, 13). The indument character was not included in the multivariate analyses because of its qualitative nature, but it was scored and is discussed later. The characters LL, WL, LSB and LB were measured using an image analyser ASBA (WILD, Heerbrugg, Switzerland). Leaves were measured in the middle part of the stem.

The morphometric analyses were performed using the individual specimens as OTUs as follows:

(1) Exploratory data analysis (Tukey, 1977).
(2) Computation of the correlation coefficients among characters (Pearson coefficient and non-parametric Spearman coefficient) for the whole material and for each of the above-mentioned three groups of specimens.
(3) UPGMA cluster analyses (Everitt, 1986), using the Euclidean distance coefficient, based on quantitative characters only.
(4) Principal components analysis based on the correlation matrix (Krzanowski, 1990), using quantitative characters only.
(5) Discriminant analyses (Klecka, 1980; Krzanowski, 1990) based on quantitative characters, using membership in the above-mentioned three groups of specimens as the classification variable: (a) canonical discriminant analysis using transformed values of all characters, except NL (since all characters deviated from the normal distribution attempts were made to improve their distribution using arcsin, logarithmic or square root transformation; for all characters, except NL, the best results were achieved by logarithmic transformation, while distribution of character NL was not improved by any transformation); (b) nonparametric classificatory discriminant analysis using cross validation analyses for the determination of discriminatory power.

The numerical analyses were performed using the SYNTAX package (Podani, 1993) and procedures CANDISC, CORR, DISCRIM, PRINCOMP and UNIVARIATE, available in the SAS package (SAS Institute 1990 a, b). Analyses using SAS were performed on the mainframe computer of the University of Vienna, Austria.

RESULTS

Some statistics obtained in exploratory data analysis of the quantitative characters are given in the Table 1. From the ranges of characters it is clear that it is not possible to distinguish the individuals from the given three groups using single characters. Even the number of ligules (NL), which is generally five in *S. germanicus* and eight in *S. nemorensis* and *S. dacicus* is not completely stable and overlaps to a certain extent. However, median values of characters differ among at least some of groups. From Table 2 it is clear that *S. nemorensis* and *S. germanicus* are characterized by long articulate hairs (IB = 1), while in *S. dacicus* both plants with glandular hairs (IB = 2) and those with long articulate hairs, can be found.

From Table 3, which gives the correlation coefficients exceeding the arbitrary level of 0.6 it is clear that the highest correlations in the pooled matrix of characters

TABLE 1. Medians, standard deviations, coefficients of variations (cv) and percentiles (5%, 95%) for quantitative characters of *Senecio germanicus* (GER, $n=138$), ***S. dacicus* sp. nov.** (DAC, $n=43$) and *S. nemorensis* (NEM, $n=32$)

Characters/(mm)	group	median	standard deviation	cv	5%	95%
LL/	GER	145.20	28.55	19.32	106.4	201.6
	DAC	180.80	37.58	20.75	126.4	244.8
	NEM	141.20	27.35	19.23	97.6	187.2
WL/	GER	59.36	4.84	16.18	44.42	77.8
	DAC	69.60	5.95	16.95	53.52	89.48
	NEM	49.12	6.65	26.38	30.08	70.6
WBL/	GER	6.00	2.10	33.12	4.0	10.0
	DAC	6.00	2.64	39.34	3.5	10.0
	NEM	2.50	1.79	56.82	1.5	7.0
LSB/	GER	6.39	1.60	25.07	3.76	9.47
	DAC	8.93	1.79	19.85	6.6	12.34
	NEM	5.54	1.66	28.38	4.08	8.4
LB/	GER	5.31	0.80	15.00	4.16	6.81
	DAC	8.93	1.78	20.26	5.75	11.64
	NEM	4.87	0.61	12.27	4.15	6.57
NB/	GER	10.00	1.23	12.75	8	12
	DAC	13.00	1.18	9.50	10	14
	NEM	13.00	1.88	14.89	10	18
LLG/	GER	15.00	2.45	16.40	11	19
	DAC	20.00	2.91	14.38	15	25
	NEM	13.00	2.23	16.11	10	18
NL/	GER	5.00	0.42	8.18	5	6
	DAC	8.00	0.71	9.31	6	8
	NEM	8.00	0.84	11.27	6	8
LF/	GER	7.50	0.69	9.20	6	9
	DAC	9.00	0.96	10.32	8	11
	NEM	6.00	0.74	11.37	6	8
NF/	GER	15.00	2.18	14.97	11	19
	DAC	22.00	3.94	16.84	17	30
	NEM	23.50	5.01	21.06	17	32

TABLE 2. Frequencies of the character states of IB in *Senecio germanicus*, ***S. dacicus* sp. nov.** and *S. nemorensis* (1, long articulate hairs; 2, glandular hairs)

	Frequency in the group (number of presences)		
Character state of IB	GER	DAC	NEM
1	138	17	32
2	0	26	0

are among characters NB, NF and NL. All these characters are connected with the morphology of flowers and they seem to be the most useful for characterization of the groups studied. Leaf characters have lower correlations with the above characters, indicating their lower taxonomic significance (at least in our context). Within-group correlations among characters are not so strong.

In the cluster analysis (Fig. 1), Romanian plants of *S. dacicus* form a coherent group. This confirms our initial suggestion that these plants, originally identified as

TABLE 3. Correlation coefficients (exceeding the arbitrary level of 0.6 in bold) among the characters of *Senecio germanicus*, ***S. dacicus* sp. nov.** and *S. nemorensis*. Correlation coefficients Pearson/Spearman

Characters	Whole material	(1)	(2)	(3)
LL-WL	**0.62308**	0.54099	0.57270	**0.62698**
	0.59257	0.54385	0.59926	**0.60411**
LL-LB	0.20250	0.07382	**−0.64424**	−0.22966
	0.21646	0.05017	**−0.62253**	−0.32321
LSB-LB	**0.60734**	0.44315	0.09734	0.59235
	0.63610	0.41987	0.11585	0.43092
IB-LB	**0.70592**	–	0.43206	–
	0.50193	–	0.44532	–
LB-LF	**0.60048**	0.30383	−0.24682	0.12325
	0.58379	0.28366	−0.27208	0.00187
NB-NL	**0.72649**	0.30179	0.04342	0.46130
	0.72749	0.23917	−0.01417	0.50697
NB-NF	**0.73979**	0.38598	0.39123	0.45712
	0.74157	0.41842	0.37713	0.44447
LLG-LF	**0.63745**	0.17831	0.52868	0.23769
	0.53956	0.17760	0.58358	0.13602
NL-NF	**0.77378**	−0.00506	0.14827	0.38474
	0.73405	−0.00455	0.11447	0.39432

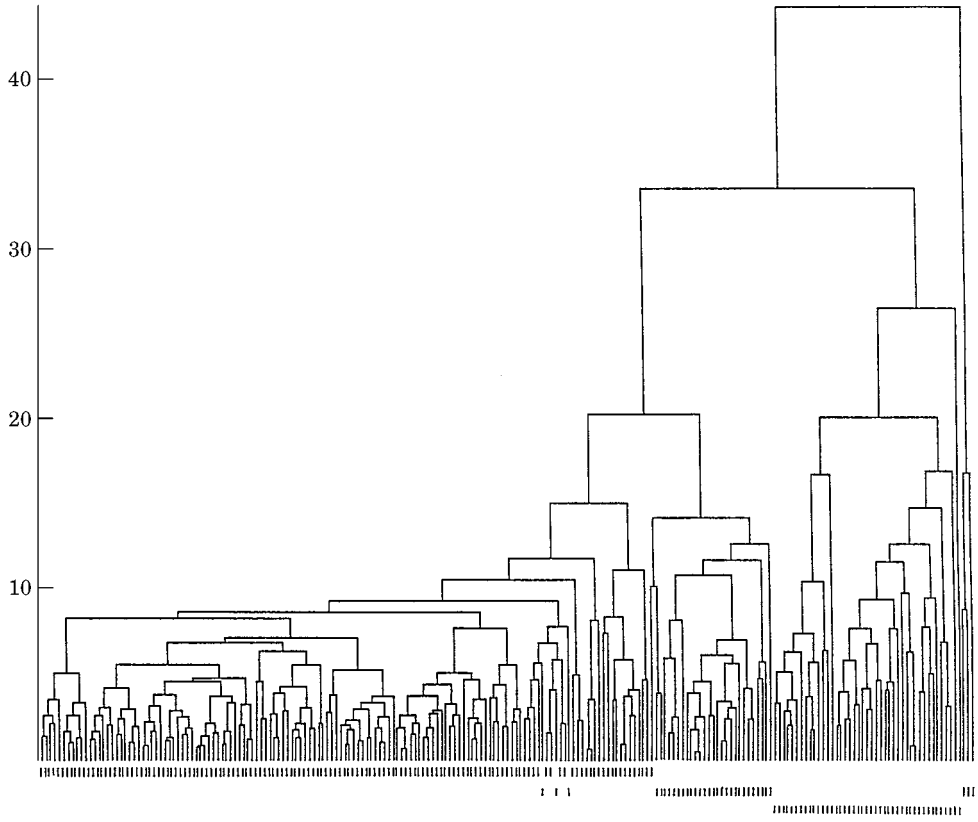

Figure 1. Cluster analysis (UPGMA) of *Senecio germanicus* (upper line), ***S. dacicus* sp. nov.** (bottom line) and *S. nemorensis* (middle line).

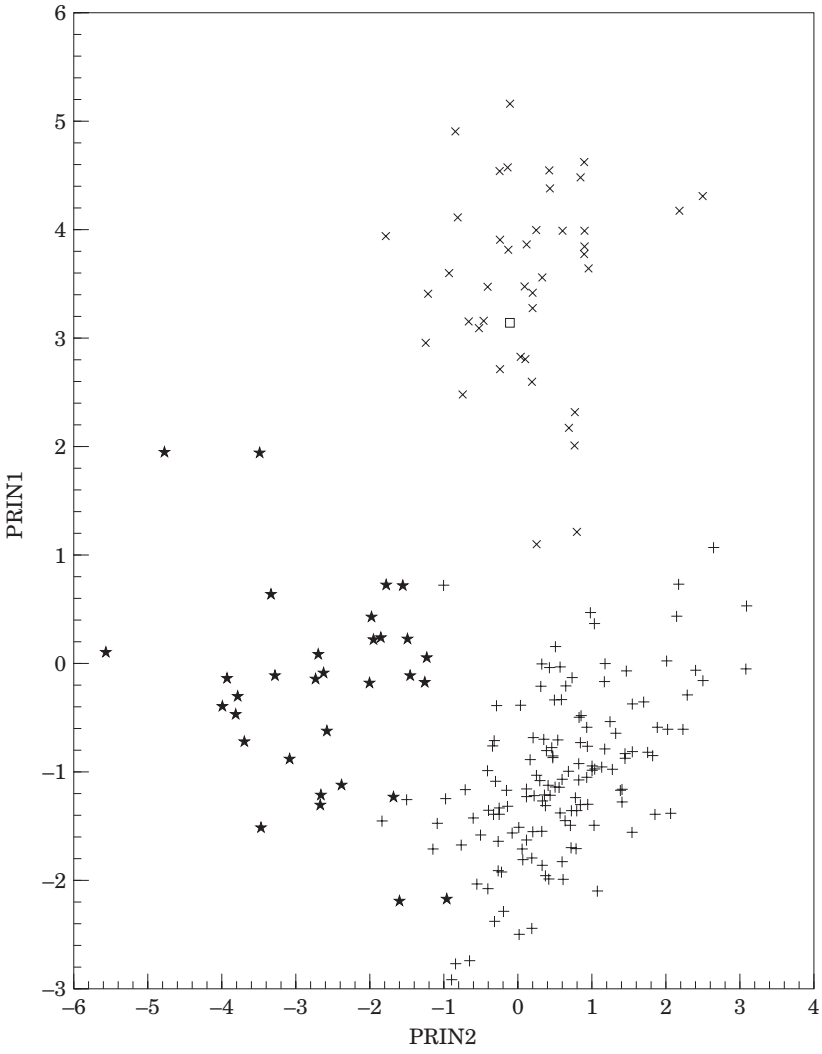

Figure 2. Principal components analysis of *Senecio germanicus* (+), ***S. dacicus* sp. nov.** (×) and *S. nemorensis* (★). The specimen of *S. dacicus*, studied and cited by Herborg (1987: 102) is indicated by the square.

S. nemorensis (e.g. by Herborg, 1987, see above), are well differentiated from this taxon, while the plants from Siberia are closer to *S. germanicus*. Three plants of *S. nemorensis* form a separate cluster probably only due to their small size. The slight overlap of the *S. germanicus* and Siberian plants might suggest that the latter does not form a taxonomically completely uniform group.

The ordination diagram derived from the principal components analysis is given in Figure 2. Three groups of plants are apparent on this two-dimensional diagram supporting the concept that three taxa exist in the material studied. These two axes explain 60.12% of the variability (38.56% for PC1 and 21.56% for PC2). Thus only slightly more than half of the variation among the studied plants is connected with

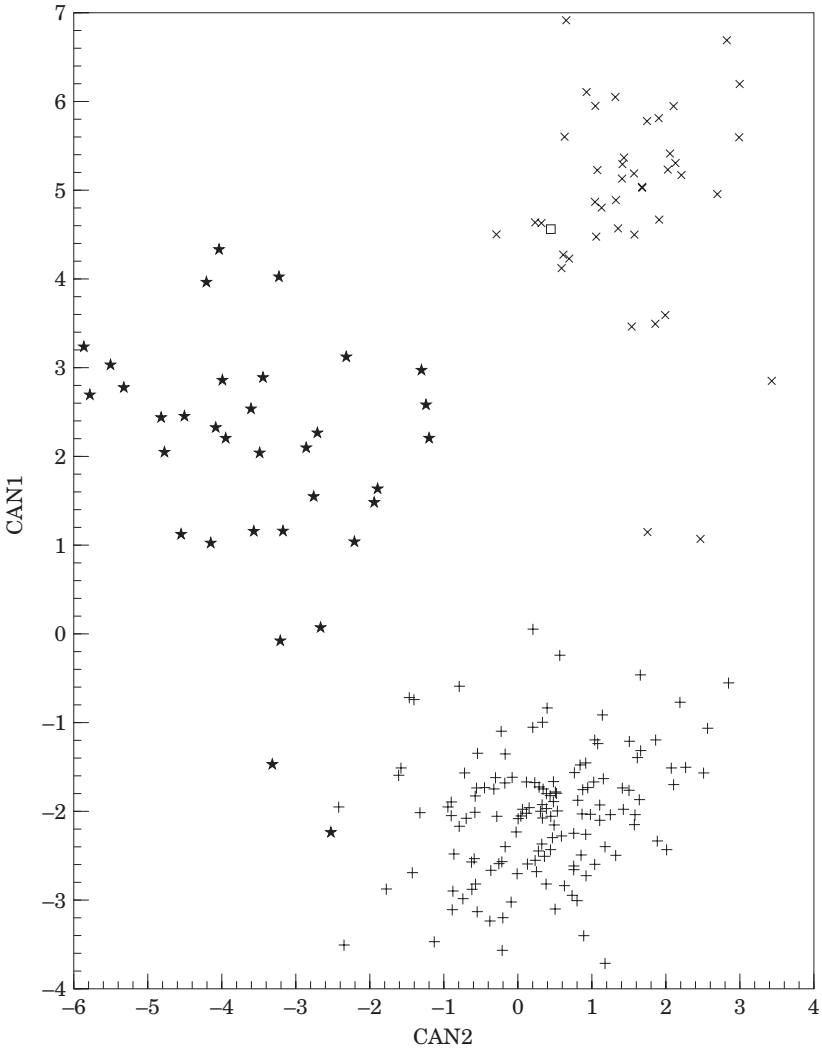

Figure 3. Canonical discriminant analysis of *Senecio germanicus* (+), ***S. dacicus* sp. nov.** (×) and *S. nemorensis* (★). The specimen of *S. dacicus*, studied and cited by Herborg (1987: 102) is indicated by the square.

their division into three taxa. All floral characters, i.e. LB, NL, LLG, LF, NF, LSB and NB, are rather highly correlated (correlation coefficients from 0.607 to 0.776) with the first component axis which indicates their importance for the division of the Romanian plants of *S. dacicus* from the rest of the material studied. The second axis, along which *S. germanicus* and Siberian *S. nemorensis* are divided is most correlated with the following characters: WBL, NF, NB, WL and NL.

The ordination diagram from the canonical variates analysis (Fig. 3) presents almost the same picture as that of principal components analysis. This indicates that the most important part of the variation of the studied material is concentrated on the differences among the above-mentioned three groups of plants (i.e. the direction

TABLE 4. Total canonical structure and standardized canonical coefficients obtained in the canonical discriminant analysis of *Senecio germanicus*, ***S. dacicus* sp. nov.** and *S. nemorensis*

Character	Total canonical structure		Standardized canonical coefficients	
	CAN1	CAN2	CAN1	CAN2
NL	0.929	−0.267	1.651	−0.746
NF	0.816	−0.296	0.599	−0.302
NB	0.711	−0.274	0.077	0.027
LB	0.671	0.559	0.800	0.587
LLG	0.522	0.507	0.261	0.326
LSB	0.454	0.420	0.075	0.039
LF	0.435	0.743	0.181	0.785
LL	0.330	0.303	0.345	0.021
WBL	−0.161	0.674	−0.207	0.406
WL	0.157	0.546	−0.130	0.351

TABLE 5. Results of non-parametric classificatory discriminant analysis of *Senecio germanicus*, ***S. dacicus* sp. nov.** and *S. nemorensis*. Predicted group membership (Number of observations/percentage classified into groups)

Actual group	GER	DAC	NEM
GER	137/99.28	0/0.00	1/0.72
DAC	1/2.33	42/97.67	0/0.00
NEM	1/3.12	0/0.00	31/96.88

of the largest part of variation among plants is very similar to that among the three groups of plants). The first canonical axis is important for the division of *S. germanicus* from *S. dacicus*, while the latter group is separated from the Siberian plants of *S. nemorensis* on the second axis. Floral characters are again among the most important characters correlated with the first canonical axis, namely NL, NF and NB. The comparison of the total canonical structure (canonical correlations) with the standardized canonical coefficients (Table 4) confirms a certain amount of redundancy of information in the floral characters (see low values of these coefficients for characters NB and LSB compared with their canonical correlations). On the other hand, characters LF, WBL, LB, WL and LSB are highly correlated with the second canonical axis and thus they are important for the differentiation of Siberian *S. nemorensis* from the rest of the material studied. The results of the non-parametric classificatory discriminant analysis (Table 5) provide additional confirmation of these results.

DISCUSSION

It was shown by the morphometric analyses that floral characters, especialy NL, NF and NB, permit delimitation of Romanian plants (referred to by Herborg [1987] as *S. nemorensis* and called here *S. dacicus*) from *S. germanicus*, while characters LF, LB, WBL, WL and LSB differentiate quite well *S. dacicus* and true, Siberian, populations

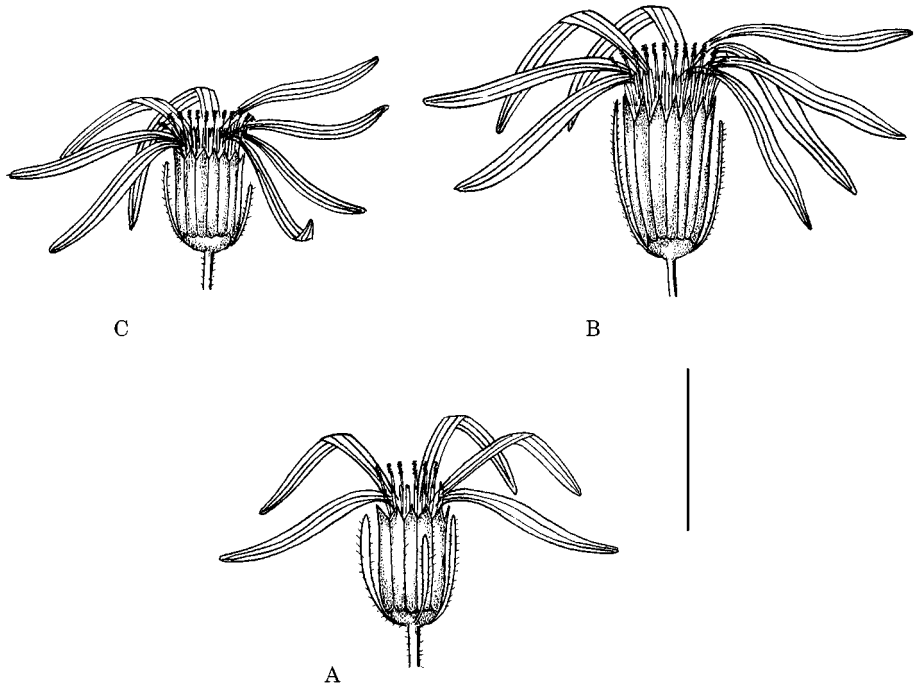

Figure 4. Capitulum. A, *Senecio germanicus*; B, ***S. dacicus* sp. nov.**; C, *S. nemorensis*. Scale bar = 10 mm. Del. Z. Komárová.

of *S. nemorensis* (Figs 4–6). Apart from these quantitative characters, *S. dacicus*, *S. germanicus* and *S. nemorensis* are to a certain extent identifiable by the indumentum of supplementary bracts (Table 2). This leads us to the conclusion that Romanian plants of *S. dacicus* are quite different from *S. nemorensis* and should be described as a separate species.

The name *S. nemorensis* L. was typified by Jeffrey & Chen Yi-Ling (1984: 362) by the specimen deposited in the Linnaean herbarium in London (LINN no. 996.59). Indeed, this specimen corresponds very well to the Siberian plants of the *S. nemorensis* group included in this study (e.g. in the indumentum of supplementary bracts, length of involucral bracts, and by the length of tubular flowers). It is likely that this specimen was collected in Siberia and sent to Linnaeus by J. F. Gmelin as his polynom from *Flora Sibirica "Solidago foliis lanceolatis serratis, floralibus ad pedunculum minimis"* is cited by Linnaeus in the protologue (Linnaeus, 1753: 870).

However, the results of our study suggest also the possibility that the Siberian material of *S. nemorensis* might form a complex which might be split into more taxa after careful study. (e.g. *S. octoglossus* DC. described from Altaj, which we consider at the moment to be conspecific with *S. nemorensis*, but requiring further study).

Oberprieler (1994) classified the *S. nemorensis* group into three groups, which he considered to be 'evolutionary' species: "Sippengruppe I – *S. cacaliaster*", "Sippengruppe II – *S. nemorensis*", and "Sippengruppe III – *S. ovatus*". Our study supports his idea that populations of *S. germanicus* and true *S. nemorensis*, included by him in "Sippengruppe II" are closely related. The position of *S. dacicus* with respect to Oberprieler's classification is not clear. In respect of the number of ligules, number

Figure 5. *Senecio nemorensis*. Russia, Buryatia, Lake Baikal, S of the village Maksimiha (Loc. no. 18). Scale bar = 50 mm. Del. Z. Komárová.

of involucral bracts, and number of tubular florets it is close to his "Sippengruppe II. – *S. nemorensis*". However, some plants of *S. dacicus* possess glandular hairs, typical of Oberprieler's "Sippengruppe I – *S. cacaliaster*" and some other characters (e.g.

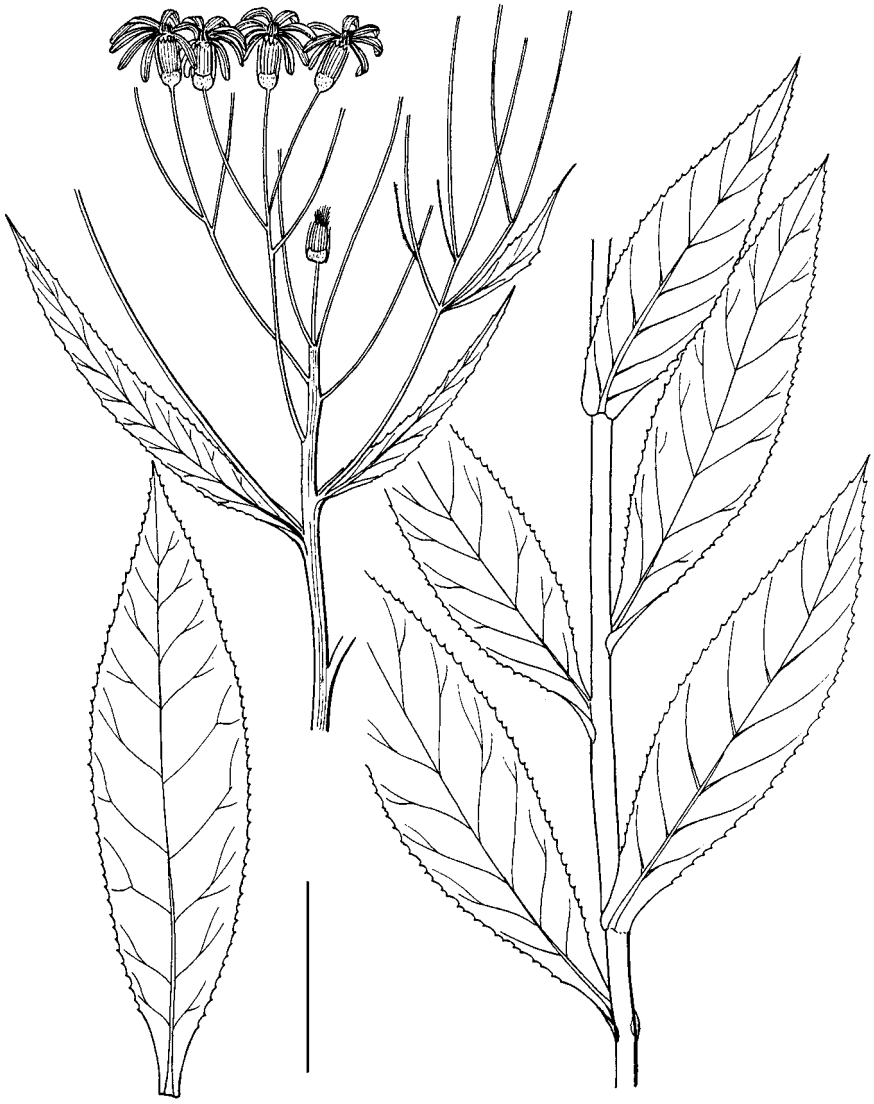

Figure 6. ***Senecio dacicus* sp. nov.** Romania, Munţii Cindrel, Paltiniş, Poiana Muacelului (Loc. no. 10). Scale bar = 50 mm. Del. Z. Komárová.

length of involucral bracts, length of tubular florets) also indicate its affinities with *S. hercynicus* Herborg (*S. cacaliaster* subsp. *hercynicus* (Herborg) Oberprieler) another member of this group. The pattern of variation in the indumentum of the supplementary bracts of the studied taxa requires some comments. *S. nemorensis* and *S. germanicus* possess long articulate hairs, while in *S. dacicus* plants with long articulate hairs and those with glandular hairs can be found. The above-mentioned dimorphism in *S. dacicus* requires further study, nevertheless this taxon is rather uniform with respect to all other characters and we have no doubt that it represents a single species.

Senecio dacicus Hodálová & Marhold, **sp. nov.**

Planta perennis; caulis florifer erectus, (50–) 70–150 cm altus, viridis vel purpurascens, glaber, subglaber vel pilosus. Folia ovata, anguste ovata, vel lanceolata, (12.2–) 12.6–24.5 (–26.5) × (2.4–) 5.4–8.9 cm; ad basin cuneata vel late-sessilia, semiamplexicaulia, (2.5–) 3.5–10.0 (–14.0) mm lata. Hyperflorescentia multicapitata, pedunculis glandulosis, pilosis. Phyllidia involucri interiora 10–14, (5.6–) 5.8– 11.6 (–11.9) mm longa, phyllidia involucri exteriora (5.9–) 6.6–12.3 (–14.0) mm longa, glandulosa vel pilosa (pilis articulatis). Ligulae plerumque 6–8, 15–25 (–27) mm longae; flosculi 17–30 (–31), (7.5–) 8–11 mm longi.

Habitat in sylvis et nemoribus montanis et subalpinis.

Floret VI/VIII.

Type. Romania, Munţii Cindrel, Sibiu, the tourist resort Paltiniş, Poiana Muacelului, 1600 m, 15.7.1995, leg. I. Hodálová, (Holotype SAV).

PERENNIAL. STEMS erect, (50–) 70–150 cm, green or purplish, in the lower part glabrous, subglabrous or hairy. Cauline leaves ovate, narrowly-ovate or lanceolate, (12.2–) 12.6–24.5 (–26.5) × (2.4) 5.4–8.9 cm, cuneate, sessile or semiamplexicaul, (2.5–) 3.5–10.0 (–14.0) mm wide at the base. HYPERFLORESCENCE multicapitular corymbs, peduncles glandular or hairy. Inner involucral bracts 10–14, (5.6–) 5.8–11.6 (–11.9) mm long; outer involucral bracts (5.9–) 6.6–12.3 (–14.0) mm long, with glandular or long articulate hairs (holotype with glandular hairs only). Ligules 6–8, 15–25 (–27) mm long, tubular florets 17–30 (–31), (7.5–) 8–11 mm long. Flowering time VI/VIII.

Distribution. Herbarium data shows that *S. dacicus* is distributed in the mountain ranges in south and west Romania: Munţii Mezeş, Muntele Mare-Vlădeasa, Munţii Trascău, Munţii Cindrel (Cibin) and Munţii Retezat. This taxon is, however, probably much more widespread also covering the area of Danube Carpathians (distr. Banat).

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APPENDIX 1

List of the localities of the population samples and herbarium specimens used for the morphometric study [number of specimens in square brackets, abbreviations of herbaria according to Holmgren, Holmgren & Barnett, 1990].

Senecio germanicus

1. Slovakia, Strážovské vrchy, between the villages of Zliechov and Čičmany, 700 m (1991 Hodálová & Marholdová SAV) [20]
2. Slovakia, Veľká Fatra, near the road between the village of Harmanec and Dolný Harmanec, 420 m (1989 Hodálová SAV) [9]
3. Slovakia, Veľká Fatra, Ružomberok, part Hrabovo, 550 m (1990 Hodálová & Matisová SAV) [19]
4. Slovakia, Bukovské vrchy, Nová Sedlica, 550 m (1989 Hodálová SAV) [14]
5. Ukraine, Prikarpattja, Knjaž Dvor, 440 m (1990 Hodálová & Kagalo SAV) [12]
6. Ukraine, Zakarpats"ke peredhir'ja, Uglja, 600 m (1991 Hodálová & Kagalo SAV) [13]
7. Ukraine, Gorgany, near the road to the village of Kremenci, 1700 m (1990 Hodálová & Kagalo SAV) [20]
8. Romania, Munţii Cindrel, Sibiu, the tourist resort Paltiniş, 1300 m (1992 Hodálová SAV) [12]
9. Romania, Munţii Cindrel, Sibiu, the tourist resort Paltiniş, Poiana Muacelului, 1400 m (1994 Hodálová SAV) [19]

***Senecio dacicus* sp. nov.**

10. Romania, Munţii Cindrel, the tourist resort Paltiniş, Poiana Muacelului, 1600 m (1992 Hodálová SAV) [13]
11. Romania, Munţii Cindrel ("Transsilvania, in fagetis et pinetis montium Cibinensium abunde") (1883 Orway [?] BP) [1]
12. Romania, Munţii Retezat, Cimpu lui Neag, foot of Mt. Piatra Iorgovanului, N (1993 Hodálová et Valachovič SAV) [17]
13. Romania, Munţii Retezat ("Retyezat") (1857 Haynald BP) [1]

14. Romania, Munţii Retezat ("Transsilvaniae alpes Retyezát, secum rivulum Zsugyele in alpinis") (1874 Simonkai BP) [1]
15. Romania, Munţii Retezat, Valereasca ("Transsilvania, montes Retyezát, in mughetis supra locum Valeriaszka dictum") (1907 Lengyel BP) [1]
16. Romania, Noul near the town of Sibiu ("Siebenbürgen, in silvis Transsilvaniae pr. Neudorf") (s.d. Fuss WU) (referred to by Herborg (1987: 102)) [1]
17. Romania, Munţii Apuseni, Muntele Mare, near the chalet Baişoara, N, 1300 m (1993 Valachovič SAV) [8]

Senecio nemorensis

18. Russia, Buryatia: Lake Baikal, village Maksimiha, S, 464 m (1994 Hodálová, Valachovič & Anenhonov SAV) [26]
19. Russia, Lake Baikal, Barguzinskij hrebet, mouth of the Bol'šaja Čeremšana river into Lake Baikal, 465 m ("Sibiria: regio baicalensis: pars orientalis: Barguzinskij chrebet montes: in valle fluminis Bol'šaja Čeremšana: apud ostium in lacum Bajkal: ad ripam fluminis. 465 m s.m.") (1992 Danihelka BRNM) [1]
20. Russia, Lake Baikal, Barguzinskij hrebet, valley of the river Bol'šaja Čeremšana, 800 m ("Sibiria: regio baicalensis: pars orientalis: Barguzinskij chrebet montes: in valee fluminis Bol'šaja Čeremšana: 4 km ab ostio in lacum Bajkal: in clivo graminoso. 800 m s.m.") (1992 Chaloupková BRNM) [1]
21. Russia, Lake Baikal, Barguzinskij hrebet, valley of the river Bol'šaja Čeremšana, stream Prjamoj, 1700 m ("Sibiria: regio baicalensis: pars orientalis: Barguzinskij chrebet montes: territorium fluviale fluminis Bol'šaja Čeremšana: in valle rivi Prjamoj: in clivo petrososo. 1700 m s.m.") (1992 Danihelka BRNM) [1]
22. Russia, Buryatia: Barguzinskij Range, near the mouth of the Bol'šoj Čivyrkuj river into Lake Baikal, 460 m (1993 Danihelka & Chytrý BRNM) [1]
23. Russia, Buryatia, Barguzinskij Range, the Bol'šoj Čivyrkuj river valley, meadows 5 km SE from the mouth, 460 m (1993 Danihelka & Chytrý BRNM) [1]
24. Russia, Basin of the river Tyrma, top of the mountain ridge, near the river Jauryn [Bureinskij hrebet] ("Bassejn r. Tyrmy. Veršina hrebta po pros"ku k" r. Jauryn") (1909 Docturowsky BRNU) [1]

APPENDIX 2

Examined herbarium specimens of *S. dacicus* not included in morphometric study:

Munţii Mezeş, pădure de pe Dîmbău (1962 Hodişan CL). - Cluj (s.d. Wolff CL). - Muntele Mare, Cheile Feneşului (1962 Hodişan CL). - Munţii Trascăului, Colţeşti, Mt. Piatra Urdaşului (1960 Gergely CL). - Munţii Bihor, between Albac and Scărişoara (1995 Kochjarová & Mártonfi SAV). - Munţii Cindrel, between Orlat and Sibiu ("Orlat - Hermannstadt") (1850 Meschendörfer SIB). - Munţii Cindrel, Păltiniş ("Hohe Binna") (1925 s.coll. SIB).