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MORPHOMETRY AND DISTRIBUTION OF *SENECIO NEMORENSIS* AGG. SPECIES (ASTERACEAE) IN POLAND

Kaja Rola

Abstract. A morphometric analysis based on 316 herbarium specimens of *Senecio nemorensis* agg. indicated the occurrence of the following four species in Poland: *S. germanicus* Wallr., *S. hercynicus* Herborg, *S. ovatus* (G. Gaertn. *et al.*) Willd. and *S. ucranicus* Hodálová. Principal component analysis (PCA), analysis of variance (ANOVA)/Kruskal-Wallis test and canonical discriminant analysis (CDA) were applied. Quantitative characters such as supplementary bract length, leaf base width, ligule length and the supplementary/involucral bract length ratio clearly discriminated taxa within *S. nemorensis* agg. Included is a distribution map of the investigated species based on the examined material, with particular emphasis on the course of the northeastern boundary of *S. hercynicus* and the northwestern boundary of *S. ucranicus*. Also given is a determination key for species within *S. nemorensis* agg. in Poland, together with morphological descriptions of particular species.

Key words: morphometric analysis, multivariate statistics, nomenclature, distribution, taxonomy, Poland

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Introduction

Senecio nemorensis agg. comprises nine taxa widely distributed throughout Europe and east to Central and East Asia (Schischkin 1961; Herborg 1987; Hodálová 1999a). In the past few years a great deal of effort has been devoted to clarifying the complexity of this group, and several papers on morphological variability within *Senecio nemorensis* agg. have been published (Kucowa 1976; Hodálová & Marhold 1996, 1998; Hodálová 1999b; Raudnitschka *et al.* 2007; Oberprieler *et al.* 2010, 2011). The wide variation of morphology observed recently suggests that there are several taxa within *Senecio nemorensis* agg., and also intermediates presumably of hybrid origin. In some cases such hybridization is the rule rather than the exception (Oberprieler 1994; Hodálová 2002; Raudnitschka *et al.* 2007; Oberprieler *et al.* 2010).

This study examined four species: *S. germanicus* Wallr., *S. hercynicus* Herborg, *S. ovatus* (G. Gaertn. *et al.*) Willd. and *S. ucranicus* Hodálová. *Senecio ovatus*, *S. germanicus* and *S. hercynicus* are distributed in much of Western, Central and Southern Europe (Chater & Walters 1976; Herborg 1987). *Senecio ucranicus* is confined to Slovakia, Poland, Ukraine and Romania (Hodálová 1999a, b). For a long time *S. nemorensis* and *S. germanicus* were treated as synonymous. For *S. nemorensis* L. s.str. this study adopts the concept of Konechnaja (1979), Herborg (1987) and Hodálová (1999a) to maintain *S. germanicus* Wallr. and *S. nemorensis* L. as distinct species (see also Hodálová & Marhold 1998). The name *S. nemorensis* should be applied only to the Siberian and Middle Asian populations of *S. nemorensis* agg., which regularly possess eight ligules (Hodálová & Marhold 1998). In Poland, for a long time only two taxa within the group were distinguished: *S. nemorensis* subsp. *fuchsii* (C. C. Gmel.) Čelak. and *S. nemorensis* subsp. *nemorensis* (Kucowa 1971; Szafer *et al.* 1976; Zając & Zając 2001). In the present study, and following Mirek *et al.* (2002), *S. nemorensis* subsp. *fuchsii* is treated as a synonym of *S. ovatus*. However, the name *S. nemorensis* subsp. *nemorensis* sensu Fl. Pol. included three species (*S. germanicus*, *S. hercynicus* and *S. ucranicus*) that in fact differ considerably.

This distorts the species concept. The species and their distribution ranges in Poland need to be clearly delineated.

Current research on the distribution of these species focuses mainly on Poland and adjacent countries. The Western and Eastern Carpathian provinces border each other within this area. The northeastern boundary of the range of *S. hercynicus* runs through Poland and Slovakia, and the northwestern boundary of *S. ucranicus* runs through Poland and Ukraine. Hodálová (1999a, b) reported that the distribution ranges of *S. hercynicus* and *S. ucranicus* are allopatric and that their geographical ranges do not overlap; *Senecio hercynicus* is restricted to the Western Carpathians, and *S. ucranicus* to the Eastern Carpathians and the eastern part of the Southern Carpathians. However, the precise course of the distribution range boundaries of *S. hercynicus* and *S. ucranicus* needs to be settled.

This study asked the following questions: Which species occur in Poland and what are their distribution ranges? How can the examined taxa best be discriminated? Which morphological characters are most diagnostic? In answering these questions a determination key for taxa within *S. nemorensis* agg. in Poland was developed, and is provided along with species descriptions.

Material and methods

morphological analysis

The study used material from two Polish herbaria (KRAM, KRA); 316 specimens (complete, undamaged and properly labelled) were selected for detailed morphometric analysis. The study included only specimens representing 'pure' morphospecies, excluding hybrid specimens with intermediate morphology. Based on previous reports and descriptions of taxa, individuals with evidently intermediate morphology were rejected during examination of specimens. This approach entails a degree of subjectivity but enabled me to identify the most diagnostic characters for the species in Poland. Morphological observations were focused on detailed biometric features. To determine differences between morphological groups I investigated the variability range of selected discrete cardinal and continuous characters as well as the most essential qualitative features. Seventeen characters (9 related to floral structures and 8 to vegetative parts) were selected for examination (Table 1). They included characters traditionally used

Table 1. List of quantitative and qualitative characters used in the present study: name and abbreviation of the character, and measurement unit or scale.

Character	Abb.	Unit/Scale
Leaf length	LL	mm
Leaf width	LW	mm
Leaf length/width ratio	LL/LW	ratio
Leaf base width measured 5 mm from stem	LBW	mm
Supplementary bract length	SBL	mm
Involucral bract length	IBL	mm
Supplementary/involucral bract length ratio	SBL/IBL	ratio
Ligule length	LGL	mm
Tubular floret length	TFL	mm
Number of involucral bracts	NIB	discrete cardinal
Number of ligules	NLG	discrete cardinal
Number of tubular florets	NTF	discrete cardinal
Supplementary bract indumentum	SuBI	1 – short articulate hairs; 2 – long articulate hairs; 3 – glandular hairs
Leaf edge indumentum	LEI	1 – glabrous; 2 – single hairs; 3 – many hairs
Leaf surface indumentum	LSI	1 – glabrous; 2 – single hairs; 3 – many hairs
Stem base indumentum	SBI	1 – glabrous; 2 – single hairs; 3 – many hairs
Stem color	SC	1 – claret; 2 – brown; 3 – green

to distinguish the taxa as can be found in determination keys and floras, and several others that appeared potentially useful for diagnosis. Since the study was aimed at assessing the value of morphological characters for diagnosis, the initial determination of specimens was made on the basis of descriptions of examined taxa and the most stable and diagnostically important feature – the type of indumentum on supplementary bracts, as described by several authors (Hodálová & Marhold 1998; Hodálová 1999a, b; Raudnitschka *et al.* 2007). On each herbarium sheet, measurements were made on two individuals when available, then averaged and treated as a single sample. Measurements associated with the capitulum were recorded twice for each variable and averaged. The supplementary/involucral bract length ratio was calculated from individual measurements and then the means of ratios were used in further analyses. Leaves were measured at the point 3/4 of the distance along the stem from its base. Morphological characters were counted, measured or estimated with a ruler and stereoscopic zoom microscope. The status and size of each character were determined on mature and flowering plants.

Statistical analyses

Each specimen was treated as an operational taxonomic unit (OTU) in accordance with the methods used in numerical taxonomy (Sokal & Sneath 1963). Prior to statistical analyses the distribution of the quantitative variables was checked for normality with the Lilliefors test. The variables that did not meet the assumptions of normality were log-transformed. Then the Pearson correlation coefficients or non-parametric Spearman correlation coefficients were calculated in order to check if any strong correlations (>0.90) exist among variables that could potentially affect the results of further multivariate analyses. The correlation coefficients for the logically correlated pair 'leaf width – leaf length/width ratio' exceeded $r = 0.90$, so leaf length/width ratio was excluded from the multivariate analyses.

Principal component analysis (PCA) was conducted for all quantitative characters, based on the correlation matrix (Sneath & Sokal 1973) to examine the overall pattern of variation of the first three components. In PCA the specimens were grouped without any *a priori* assumptions. Next, each specimen was marked on the scatterplot with a symbol corresponding to a particular species. The analysis yielded a reduced set of characters most strongly correlated with the principal components. Factors with eigenvalues >1 were chosen according to Kaiser's (1960) criterion. The characters with highest factor loadings on the first three principal components ($r>0.60$) were determined. These features contributed most to the variation and most fully explained it.

Next, descriptive statistics of the characters for the previously recognized groups were calculated. After using Levene's test to assess equality of variance, one-way ANOVA followed by the Tukey's HSD test for unequal sample frequencies was performed to assess the significance of differences between means of characters across all examined groups. Variables without a normal distribution were tested with the nonparametric Kruskal-Wallis test. The differences between groups (taxa) were assessed with nonparametric multiple comparison tests.

Standard discriminant analysis methods were used to determine which characters most discriminate the investigated taxa. The matrix of quantitative features was subjected to forward stepwise analysis. The data were standardized before the analysis in order to avoid the effect of differences between measurement scales. Discriminatory power was expressed by Wilks' lambda statistic. Then canonical discriminant analysis (CDA) and a classifying method were applied (Marhold 2011). This procedure gave the percentages of correct classification of individual specimens to the distinguished species. Data analyses and statistical calculations used Statistica ver. 9.1.

Results

Principal component analysis (PCA) indicated eight characters with the highest factor loadings on the first three principal components ($r>0.60$). Three components accounted for 60.51% of total variance (Table 2). The first explained 33.76% of variation, the second 14.96%, and the third 11.79%. The scatterplot showed four slightly overlapping groups of points (Fig. 1). PCA axis 1 was most highly influenced by supplementary bract length, leaf base width, supplementary/involucral bract length ratio, leaf width and number of tubular florets. On the right side of the scatterplot, specimens characterized by long supplementary bracts, a high supplementary/involucral bract length ratio, wide leaf bases and numerous tubular florets are grouped (Fig. 1). Ligule length and tubular floret length were most strongly and negatively correlated with the second principal component. It separated specimens representing *S. hercynicus*, having longer ligules and tubular florets than specimens

representing *S. germanicus*, which were grouped in the upper side of the scatterplot.

The ranges of variability of the quantitative characters for the designated morphological groups corresponding to the species are presented in Table 3 and Figure 2. One-way ANOVA revealed significant differences in all of the characters indicated by PCA ($p < 0.001$). The F and H statistics obtained from ANOVA and the Kruskal-Wallis test are presented in Table 3. Number of ligules, tubular floret length and leaf length did not distinguish species. The most important quantitative features were leaf base width, supplementary bract length, supplementary/involucral bract length ratio, number of involucral bracts, ligule length and leaf length/width ratio. Different traits differed significantly between some species (Table 4). All examined traits distinguished at least one species pair. *Senecio ovatus* was differentiated from *S. hercynicus* and *S. germanicus* by the greatest number of features. The qualitative characters for each species are shown in Figure 3. The following results should be emphasized. Claret-colored stems occurred most frequently in *S. ovatus*; the remaining species usually had green stems. Leaf edge indumentum occurred in the majority of *S. hercynicus* specimens, and usually hairiness of leaf blades also. Stem base indumentum was the least differentiated character; most specimens had glabrous stems, though 26% of *S. germanicus* specimens did show hairs on the stems.

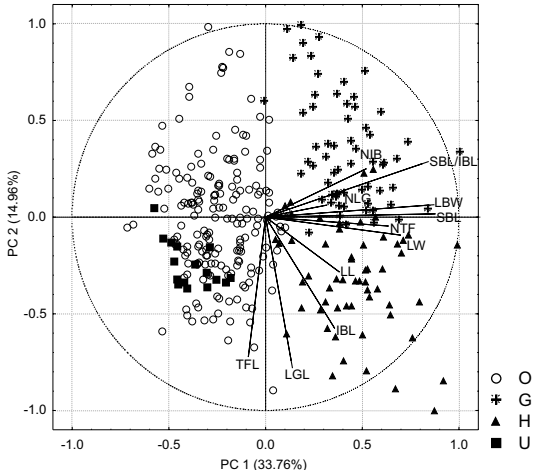

Fig. 1. Biplot of principal component analysis (PCA) of OTUs representing specimens corresponding to four species within *Senecio nemorensis* agg. G – *S. germanicus* Wallr.; H – *S. hercynicus* Herborg; O – *S. ovatus* (G. Gaertn. *et al.*) Willd.; U – *S. ucranicus* Hodálová. See Table 1 for abbreviations of characters.

Table 2. Principal component analysis (PCA) – eigenvalues, cumulative variance and factor loadings for eleven characters. Highest factor loadings (>0.60) are bolded. See Table 1 for abbreviations of characters.

Character	Factor loadings		
	1	2	3
LL	0.38	–0.28	**0.79**
LW	**0.70**	–0.09	0.57
LBW	**0.85**	0.06	0.02
SBL	**0.88**	0.02	–0.25
IBL	0.36	–0.58	–0.26
SBL/IBL	**0.81**	0.28	–0.16
NIB	0.52	0.25	–0.07
LGL	0.13	**–0.74**	–0.09
NLG	0.32	0.06	–0.27
TFL	–0.09	**–0.72**	–0.18
NTF	**0.64**	–0.05	–0.25
Eigenvalue	3.71	1.65	1.30
Cumulative variance (%)	33.76	48.72	60.51

Discriminant analysis confirmed the diagnostic value of the eight selected characters. The characters that most clearly discriminated the species within *S. nemorensis* agg. were leaf base width, ligule length, supplementary bract length and supplementary/involucral bract length ratio (Table 5). These features also had high factor loadings in PCA and are represented by high values of F/H statistics (see Tables 2 & 3). The number and length of tubular florets, leaf length and leaf width also significantly distinguished the groups but to a lesser extent (Table 5). In canonical discriminant analysis, the chi-square test for all canonical roots for the data matrix confirmed their statistical significance. Standardized coefficients of the discriminant function for canonical variables are presented in Table 5. A scatterplot of the canonical variables shows four distinct clusters formed by the examined taxa identified in previous analyses, though the cluster edges overlap somewhat (Fig. 4). The coefficients indicate that

Table 3. Twelve quantitative characters for each species within *Senecio nemorensis* agg. in Poland. One-way ANOVA (p<0.001): F and p values for characters with normal distributions. Kruskal-Wallis test (p<0.001): H and p values for characters with non-normal distributions. Highest F/H values are bolded. See Table 1 for abbreviations of characters. M – arithmetical mean; SD – standard deviation; Min – minimum value; Max – maximum value.

	S. ovatus		*S. germanicus*		*S. hercynicus*		*S. ucranicus*		F/H value; p value
Number of individuals	181		66		53		16		
Character	M±SD	Min-Max	M±SD	Min-Max	M±SD	Min-Max	M±SD	Min-Max	
LL	121.64±30.93	67.00–242.00	126.35±32.03	65.00–205.00	138.87±31.35	61.00–207.00	140.81±47.51	71.00–236.00	4.40; p=0.005
LW	26.46±9.18	10.00–75.00	38.92±12.10	18.00–74.00	39.89±10.84	21.00–66.00	25.88±12.65	12.00–58.00	**39.46;** p<0.001
LL/LW	4.89±1.37	2.26–9.76	3.37±0.72	2.09–5.04	3.60±0.78	2.17–6.50	5.81±1.13	4.07–7.84	**52.54;** p<0.001
LBW	1.67±0.70	1.00–4.00	6.23±2.15	2.00–12.00	5.94±2.06	2.00–11.00	3.56±1.21	1.00–6.00	**223.25;** p<0.001
SBL	3.81±0.61	2.00–6.00	6.39±1.54	4.00–10.00	6.63±1.58	4.00–12.00	2.91±0.49	2.00–4.00	**202.71;** p<0.001
IBL	5.17±0.61	4.00–7.00	5.25±0.69	4.00–7.00	6.00±0.81	4.00–9.00	5.13±0.50	4.00–6.00	20.02; p<0.001
SBL/IBL	0.74±0.13	0.42–1.13	1.22±0.25	0.62–1.90	1.11±0.22	0.67–1.67	0.57±0.10	0.36–0.78	**168.67;** p<0.001
NIB	7.90±0.63	6.00–10.00	8.82±0.75	7.00–11.00	8.67±0.85	7.00–11.00	8.72±0.63	7.00–10.00	**84.03;** p<0.001
LGL	14.48±1.83	10.00–21.00	13.15±2.03	9.00–20.00	17.36±2.44	12.00–25.00	17.41±1.90	14.00–22.00	**54.01;** p<0.001
NLG	4.93±0.19	4.00–6.00	5.00±0.15	4.00–6.00	5.02±0.09	5.00–6.00	5.00±0.00	5.00–5.00	9.82; p=0.020
TFL	7.31±0.86	5.00–10.00	6.93±1.04	5.00–10.00	7.31±1.00	5.00–10.00	7.38±0.67	6.00–9.00	3.86; p=0.001
NTF	10.92±2.26	7.00–19.00	12.59±2.02	9.00–18.00	14.02±2.06	10.00–19.00	9.69±1.60	8.00–14.00	**37.80;** p<0.001

leaf base width and supplementary bract length are related to the first canonical discriminant function (Table 5), which clearly separates *S. ovatus* and *S. ucranicus* from *S. hercynicus* and *S. germanicus*. Ligule length and the supplementary/involucral bract length ratio were strongly correlated with the second canonical discriminant function, which separates *S. ucranicus*, having the lowest supplementary/involucral bract length ratio. The other features are weakly correlated with the canonical functions but they can be used in supplementary description of the taxa. Based on the classification matrix (Table 6), it can be concluded that a large share of the specimens were correctly classified. The high percentage of correct assignments also indicates that different taxa within the *S. nemorensis* agg. are distinguishable and well-described by the selected morphological traits. More than 90% of the *S. ovatus* and *S. ucranicus* specimens were correctly classified. The shares of *S. germanicus* and *S. hercynicus* correctly classified were slightly lower. The incorrect classifications mainly involved assignment of *S. germanicus* to *S. hercynicus* and vice versa (Table 6). These misclassified specimens confirm the high variability of quantitative characters within these two species and the lack of a clear discontinuity between them.

Discussion

This study of *Senecio nemorensis* agg. based on statistical analyses of morphological characters confirmed the occurrence four species of *S. nemorensis* agg. in Poland: *S. germanicus*, *S. hercynicus*, *S. ovatus* and *S. ucranicus*. Multivariate statistical analyses separated morphological groups corresponding to the species. Characters of diagnostic value were found. The species differed significantly in respect to most of the analyzed characters (Tables 3–5). The characters that most clearly discriminated species within *S. nemorensis* agg. were supplementary bract length, leaf base width, supplementary/involucral bract length ratio and ligule length. Depending on the species, each character is of greater or lesser importance for determining taxa. For this reason I recommend examining the highest possible number of quantitative and

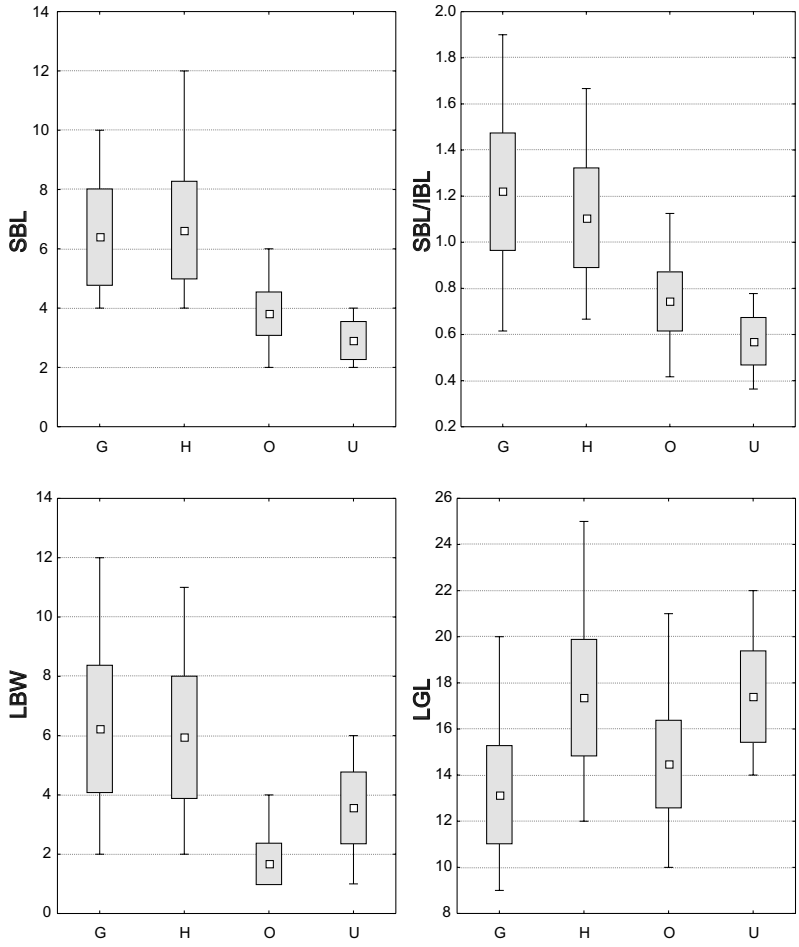

Fig. 2. Box-and-whisker plots of selected characters for four species within *Senecio nemorensis* agg. G – *S. germanicus* Wallr.; H – *S. hercynicus* Herborg; O – *S. ovatus* (G. Gaertn. *et al.*) Willd.; U – *S. ucranicus* Hodálová. Boxes represent standard deviations (means are squares in center), whiskers represent minimum and maximum values. See Table 1 for abbreviations of characters.

qualitative features in order to avoid confusion during diagnosis.

Several authors have suggested that taxa within *S. nemorensis* agg. can be distinguished by supplementary bract length, leaf base width and ligule length (Hodálová 1999b; Oberprieler *et al.* 2010, 2011). My study supports the usefulness of these characters (Tables 3 & 5). Supplementary/involucral bract length ratio, mentioned only by Kucowa (1976) and Oberprieler *et al.* (2010, 2011), also reliably distinguished the examined taxa. This parameter plainly indicates which type of bract is longer. Generally that ratio is below 1 in *S. ovatus* and *S. ucranicus* and above 1 in *S. germanicus* and *S. hercynicus* (see Table 3, Figs 2, 5). Supplementary bract length effectively separated *S. germanicus* and *S. hercynicus* from *S. ovatus* and *S. ucranicus*, with only a little overlap (see Fig. 2). The supplementary bracts are longer in *S. germanicus* and *S. hercynicus*. *Senecio germanicus* also has wider supplementary bracts than the other taxa (Fig. 5).

Leaf base width is another good feature for differentiating species. *Senecio germanicus*, *S. hercynicus* and *S. ucranicus* always have sessile or semiamplexicaule leaves at the base, whereas

Table 4. Post-hoc tests: Tukey's HSD test for characters with normal distributions, multiple comparison tests for characters with non-normal distributions. + – statistically significant, $p<0.05$; ns – not significant. See Table 1 for abbreviations of characters. G – *S. germanicus* Wallr.; H – *S. hercynicus* Herborg; O – *S. ovatus* (G. Gaertn. *et al.*) Willd.; U – *S. ucranicus* Hodálová.

Characteristic	O-H	O-G	G-U	H-U	O-U	H-G
LW	+	+	+	+	ns	ns
LL/LW	+	+	+	+	ns	ns
LBW	+	+	ns	ns	+	ns
SBL	+	+	+	+	+	ns
IBL	+	ns	ns	+	ns	+
SBL/IBL	+	+	+	+	+	ns
LGL	+	+	+	ns	+	+
NIB	+	+	ns	ns	+	ns
NTF	+	+	+	+	ns	+
Number of characters distinguishing pairs	9	8	6	6	5	3

Table 5. Wilks' lambda, partial Wilks' lambda and p values for eight characters from discriminant analysis of the specimens examined. Standardized coefficients for canonical variables after canonical discriminant analysis. Values for which the discriminant functions are most weighted are bolded. See Table 1 for abbreviations of characters.

Character	Wilks' lambda	partial Wilks' lambda	p value	Root 1	Root 2
LBW	0.17	0.46	0.000	**–0.76**	–0.44
SBL	0.09	0.87	0.000	**–0.51**	–0.08
LGL	0.11	0.72	0.000	0.03	**–0.80**
SBL/IBL	0.08	0.93	0.000	–0.06	**0.60**
NTF	0.08	0.95	0.001	0.01	0.12
TFL	0.08	0.97	0.015	0.15	0.22
LL	0.08	0.95	0.002	0.26	–0.25
LW	0.08	0.96	0.004	–0.15	0.27
Eigenvalue	–	–	–	4.45	0.79
Cumulative proportion	–	–	–	0.81	0.95

Table 6. Canonical discriminant analysis. Matrix classification of specimens to taxa. Rows – observed classification; columns – predicted classification.

	Classification matrix of specimens (number/% of specimens classified into each group)			
Taxon	*S. ovatus*	*S. germanicus*	*S. hercynicus*	*S. ucranicus*
S. ovatus	180/99.45	0/0	1/0.55	0/0
S. germanicus	2/3.03	55/83.33	9/13.64	0/0
S. hercynicus	2/3.77	7/13.21	44/83.02	0/0
S. ucranicus	1/6.25	0/0	0/0	15/93.75

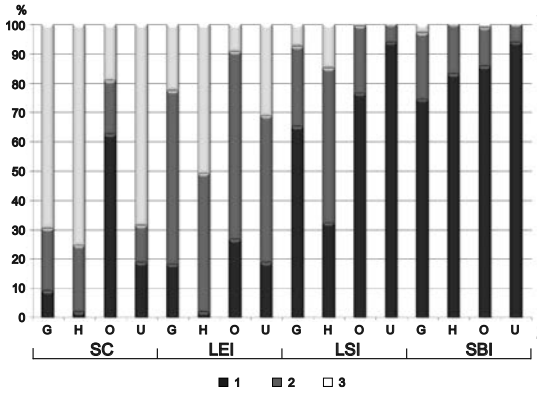

Fig. 3. Frequencies of qualitative characters in the examined species. The numbers (1, 2, 3) and abbreviations of characters are explained in Table 1. G – *S. germanicus* Wallr.; H – *S. hercynicus* Herborg; O – *Senecio ovatus* (G. Gaertn. *et al.*) Willd.; U – *S. ucranicus* Hodálová.

S. ovatus usually has petiolate leaves which never clasp the stem. This feature is very useful if it can be unambiguously determined but it is often difficult to assess it precisely. Another leaf character that proved useful for identifying specimens is leaf length/width ratio; it was much higher in *S. ovatus* and *S. ucranicus*, which often have more lanceolate leaves, than in *S. hercynicus* and *S. germanicus*, which usually have ovate leaves.

The type of indumentum of supplementary bracts is one of the most important features for diagnosis. My detailed examination of herbarium materials confirmed the significance of this character. In glandulous taxa the glandular hairs occurred on supplementary bracts and often also on involucral bracts, the capitulum base and upper parts of stems (Fig. 5); they were also frequently noted on leaf edges. Eglandulose taxa did not possess glandular hairs on any of those structures. The length of hairs unambiguously distinguished *S. germanicus* from *S. ovatus*. In *S. germanicus* they were 7–10 times longer than in *S. ovatus* and were built of more cells (see Fig. 5). *Senecio hercynicus* always possessed clearly visible multicellular glandular hairs; the terminal cells of those hairs were clearly globular (Fig. 5) and filled with brown content, though a few proximate cells sometimes also had brown content. *Senecio ucranicus* is the only taxon that did not show a definite type of indumentum. Different kinds of hairs could be observed on a single individual; in most specimens, glandular hairs (homologous to those in

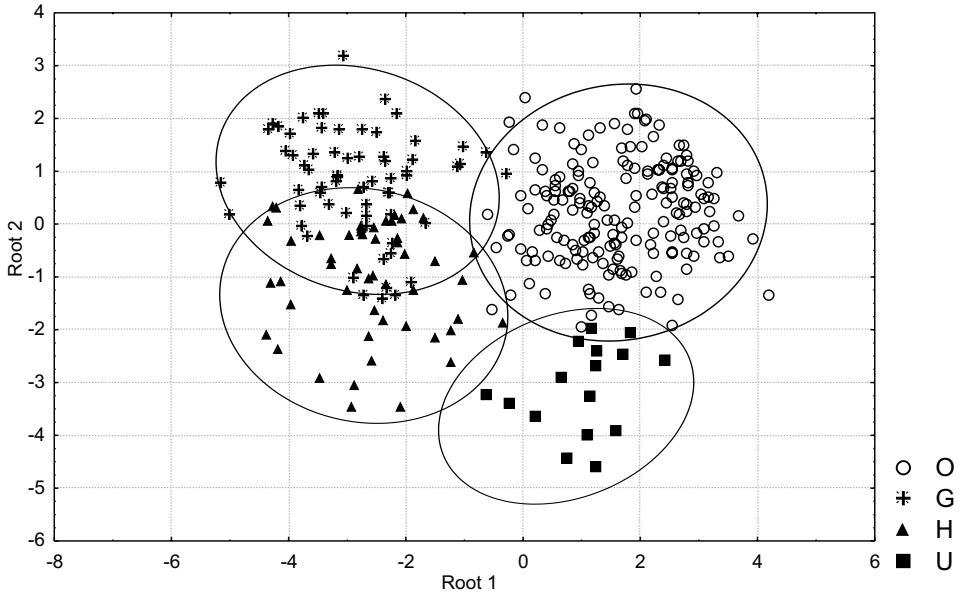

Fig. 4. Scatterplot from canonical discriminant analysis of specimens representing taxa within *Senecio nemorensis* agg. G – *S. germanicus* Wallr.; H – *S. hercynicus* Herborg; O – *S. ovatus* (G. Gaertn. *et al.*) Willd.; U – *S. ucranicus* Hodálová.

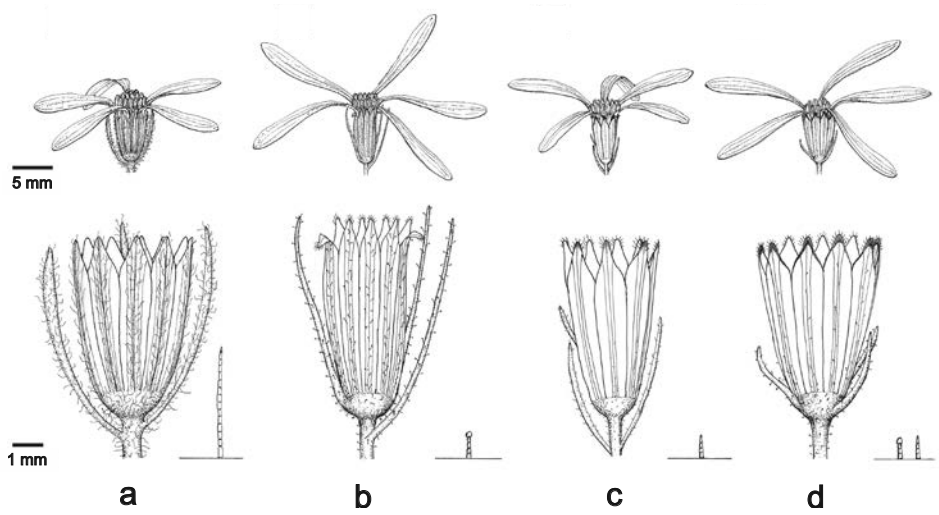

Fig. 5. Capitulum and details of involucral and supplementary bracts. a – *Senecio germanicus* Wallr.; b – *S. hercynicus* Herborg; c – *S. ovatus* (G. Gaertn. *et al.*) Willd.; d – *S. ucranicus* Hodálová. Drawn by Jolanta Urbanik.

S. hercynicus) predominated but sometimes were accompanied by short articulate hairs (Fig. 5). Nevertheless, the distinction of *S. ucranicus* from the other glandulous taxa in Poland is supported by its geographical range, basically restricted to the Eastern Carpathians. Within species, the indumentum on involucral bracts and the lower part of the capitulum was similar to that on supplementary bracts (Fig. 5). *Senecio germanicus* and *S. hercynicus* usually had densely hairy involucral bracts, whereas *S. ucranicus* involucral bracts had sparse hairs of different types, with glandular ones predominating. *Senecio ovatus* involucral bracts were usually glabrous or at least very sparsely hairy.

The other examined qualitative features varied in their usefulness for diagnosis. The indumentum of the stem base was considered diagnostic by some authors (Kucowa 1976; Grulich 2004) but did not prove diagnostic in this work. *Senecio germanicus* often has a densely hairy stem but it is not a constant feature and other species sometimes have a sparsely hairy stem base (Fig. 3). Claret stem color is characteristic mainly for *S. ovatus* but sometimes the stem is brown or green. Several specimens of other species I examined also had purplish stems. *Senecio hercynicus* more frequently showed indumentum on the leaf edges and leaf surface than the other species.

The herbarium revision revealed that the distribution ranges of *S. ovatus*, *S. hercynicus* and *S. germanicus* partly overlap, and that *S. ucranicus* overlaps only *S. germanicus*. Figure 6 gives a distribution map of the investigated taxa, prepared on the basis of this revision. *Senecio ucranicus* occurs primarily in the Eastern Carpathians. In Poland it occurs in the Bieszczady Zachodnie Mts and Góry Sanocko-Turczańskie Mts but was also recorded in the Pogórze Dynowskie foothills, which are part of the Western Carpathians (Fig. 6). Its northernmost localities are in the Volhynian and Podolian uplands (Ukraine). Its range extends south through the Eastern Beskids, Gorgany Mts, Chornohora Mts, Chivchin Mts and Munţii Maramureşului Mts. It was also recorded in the eastern part of the Southern Carpathians in Romania, consistent with reports from Hodálová (1999a). *Senecio hercynicus* occurs only in the Western Carpathians and Sudetes, and is most numerous in the Tatra Mts. Its easternmost localities are in the Beskid Sądecki Mts in Poland, consistent with Hodálová's (1999b) statement that the ranges of these two glandulous species do not overlap. Greuter (2003) treats *S. ucranicus* as a subspecies of *S. hercynicus* but there is considerable controversy over the status of this taxon. My study showed that *S. ucranicus* shares many features with *S. ovatus*

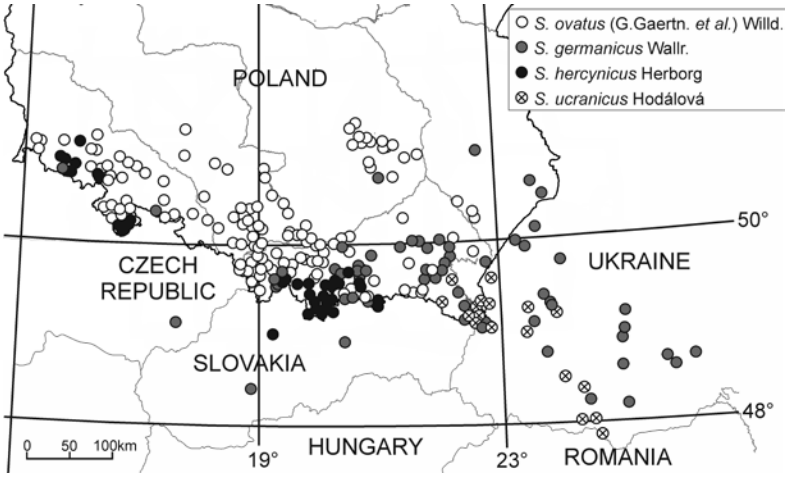

Fig. 6. Distribution map of *Senecio nemorensis* agg. in Poland and adjacent countries, based on material examined.

(see Table 3 & 4). Hodálová (1999a) considered the plants described originally by Nyárády (1950) as *S. fuchsii* f. *sessilis* to be *S. ucranicus*, which also shows the similarities between *S. ovatus* and *S. ucranicus*. The taxonomic status of *S. ucranicus* should be resolved by molecular studies. *Senecio germanicus* was recorded from Western Europe (Alps) to the Czech Republic, Poland and Slovakia, and its range reaches east to the eastern part of Ukraine (Fig. 6). In Central Europe it occurs in the Sudetes and Carpathians but I found it to be much more frequent in the Carpathians. It also has numerous localities in southeastern Poland (Carpathian foothills, Kotlina Sandomierska basin, Wyżyna Lubelska upland) and the western part of Ukraine, the Volhynian and Podolian uplands (Fig. 6). In Poland, *S. ovatus* occurs frequently in uplands and in some parts of mountain ranges it is virtually the only species of this aggregation that occurs (e.g., Beskid Niski Mts, Beskid Makowski Mts, Beskid Śląski Mts, Góry Świętokrzyskie Mts). The most easterly localities were recorded in the Kotlina Sandomierska basin in Poland, and in my material there were no specimens from east of the Polish border. The list of specimens examined is presented in the Appendix 1.

Different multivariate statistical analyses separated four groups related to the species occurring in Poland. Based on these analyses and my observations, a determination key for these species of *S. nemorensis* agg. is presented below, followed by taxonomic descriptions. The values represent 10% and 90% percentiles, and the values in parentheses are minima and maxima.

Key for determination of *Senecio nemorensis* agg. in Poland

1. Supplementary bracts with glandular hairs 2
1*. Supplementary bracts without glandular hairs. Supplementary bract indumentum consisting of short or long articulate hairs 3
2. Supplementary bracts (2–)3–4 mm long, shorter than involucral bracts; supplementary/involucral bract length ratio (0.36–)0.50–0.70(–0.78). Tubular florets 8–13(–14) . . . . . ***S. ucranicus***
2*. Supplementary bracts (4–)5–9(–12) mm long, usually longer than or as long as involucral bracts; supplementary/involucral bract length ratio (0.67–)0.83–1.44(–1.67). Tubular florets (10–)12–16(–19) . . . . . ***S. hercynicus***
3. Supplementary bracts (2–)3–4(–6) mm long, usually shorter than involucral bracts, sparsely hairy with indumentum consisting of short articulate hairs. Width of leaf base 5 mm from stem 1–2(–4) mm. Stem color often claret 4
3*. Supplementary bracts (4–)5–9(–10) mm long, usually longer than or as long as involucral bracts, densely hairy with indumentum consisting of long articulate hairs. Width of leaf base 5 mm from stem

(2–)4–9(–12) mm. Stem color usually green to brown . . . . . ***S. germanicus***

4. Leaves usually petiolate. Leaf base width measured 5 mm from stem 1–2(–4) mm. Involucral bracts (6–)8(–10) . . . . . ***S. ovatus***

4*. Leaves usually sessile. Leaf base width measured 5 mm from stem (1–)2–5(–6) mm. Involucral bracts (7–)8–10 . . . . . ***S. ucranicus***

List of species

The species descriptions are based on the material examined during this study.

Senecio ovatus (G. Gaertn. *et al.*) Willd.

Sp. Pl. ed. 4, **3**(3): 2004. 1803. – *Jacobaea ovata* G. Gaertn. *et al*., Oekon. Fl. Wetterau **3**: 212. 1801.

= *Senecio fuchsii* C. C. Gmel., Fl. Bad. **3**: 444. 1808. – *S. nemorensis* var. *fuchsii* (C. C. Gmel.) W. D. J. Koch., Syn. Fl. Germ. Helv. ed. 2, **1**: 430. 1843. – *S. nemorensis* subsp. *fuchsii* (C. C. Gmel.) Čelak., Prodr. Fl. Böhm. **2**: 241. 1871.

= *Senecio nemorensis* var. *angustifolius* Neilr., Fl. Wien: 252. 1846.

Stems erect, 70–150 cm high, usually purplish, rarely green or brown, glabrous in lower part. Leaves usually petiolate, blades lanceolate, (6.7–)8.6–15.7(–24.2) cm long, (1.0–)1.7–3.7(–7.5) cm wide, with glabrous adaxial surface and usually sparsely hairy and finely serrate edges. Leaf width at base 1–2(–4) mm. Synflorescence with numerous capitula forming corymbs, peduncles glabrous. Involucral bracts (6–)7–9(–10), 4–6(–7) mm long, glabrous or rarely sparse hairy (Fig. 5c). Supplementary bracts (2–)3–5(–6) mm long, sparsely hairy with short articulate hairs (Fig. 5c). Ligules 5, yellow, (11–)12–17(–21) mm long. Tubular florets (7–)8–14(–18), (5–)6–8(–10) mm long. Flowering: end of July and August.

Senecio germanicus Wallr.

Sched. Crit. **1**: 476. 1822. – *S. nemorensis* var. *germanicus* (Wallr.) Beck, Fl. Nieder-Oesterreich: 1219. 1893.

= *Senecio jacquinianus* Rchb., Pl. Crit. **3**: 80. 1825. – *S. nemorensis* var. *jacquinianus* (Rchb.) Fuss, Fl. Transsilv.: 351. 1866. – *S. nemorensis* subsp. *jacquinianus* Čelak., Prodr. Fl. Böhmen **2**: 241. 1871.

– *Senecio nemorensis* subsp. *nemorensis* sensu Fl. Pol. **12**: 337. 1971.

– *Senecio nemorensis* subsp. *nemorensis* sensu Fl. Europ. **4**: 196. 1976.

Stems erect, 70–150 cm high, usually green, glabrous or sparsely hairy in lower part. Leaves sessile, usually semiamplexicaul, blades ovate, (6.5–)8.2–17.0(–20.5) cm long, (1.8–)2.5–5.5 (–7.4) cm wide, with glabrous/subglabrous adaxial surface and usually sparsely hairy or hairy, serrate or doubly serrate edges. Leaf width at base (2–)4–9(–12) mm. Synflorescence with numerous capitula forming corymbs, peduncles usually hairy. Involucral bracts (7–)8–10(–11), 4–7 mm long, usually densely hairy (Fig. 5a). Supplementary bracts (4–)5–9(–10) mm long, densely hairy with long articulate hairs consisting of a several cells (Fig. 5a). Ligules 5, yellow, (9–)10–16(–20) mm long. Tubular florets (9–)10–16(–18), 5–8(–10) mm long. Flowering: August to September.

Senecio hercynicus Herborg

Senecio hercynicus Herborg, Diss. Bot. **107**: 160. 1987. – *S. cacaliaster* subsp. *hercynicus* (Herborg) Oberprieler, Ber. Bayer. Bot. Ges. **64**: 36. 1994.

= *Senecio sarracenicus* var. *graniticus* Beck. Fl. Nieder-Oesterreich **2**(2): 1220. 1893.

– *Senecio nemorensis* subsp. *nemorensis* sensu Fl. Pol. **12**: 337. 1971.

Stems erect, 70–150 cm high, usually green, glabrous or subglabrous in lower part. Leaves sessile, usually semiamplexicaul, blades ovate, (6.1–)9.6–18.1(–20.7) cm long, (2.1–)2.5–5.2 (–6.6) cm wide, with sparsely to densely hairy adaxial surface and usually hairy, serrate or doubly serrate edges, frequently with glandulous hairs. Leaf width at base (2–)4–9(–11) mm. Synflorescence with numerous capitula forming corymbs, peduncles usually glandulous-hairy. Involucral bracts 7–10(–11), (4–)5–7(–9) mm long, usually densely glandulous-hairy (Fig. 5b). Supplementary bracts (4–)5–9(–12) mm long, densely hairy with glandular hairs (Fig. 5b). Ligules 5, yellow, (13–)14–21 (–25) mm long. Tubular florets (10–)12–16(–19), 6–9(–10) mm long. Flowering: June to August.

Senecio ucranicus Hodálová

Folia Geobot. **34**: 334. 1999. – *S. hercynicus* subsp. *ucranicus* (Hodálová) Greuter, Willdenowia **33**: 247. 2003.

= *Senecio fuchsii* fo. *sessilis* Nyár., Bul. Şti. Acad. Rep. Pop. Române **2**: 83. 1950.

– *Senecio nemorensis* subsp. *nemorensis* sensu Fl. Pol. **12**: 337. 1971.

Stems erect, 70–150 cm high, usually green, rarely purplish, glabrous in lower part. Leaves sessile or semiamplexicaul, blades lanceolate, (7.1–)8.4–20.8(–23.6) cm long, 1.2–4.5(–5.8) cm wide, with glabrous adaxial surface and usually sparsely hairy or hairy, serrate or doubly serrate edges. Leaf width at base (1–)2–5(–6) mm. Synflorescence with numerous capitula forming corymbs, peduncles sparsely hairy, often with glandular hairs. Involucral bracts (7–)8–10, 4–6 mm long, sparsely hairy, usually with both glandular and short articulate hairs (Fig. 5d). Supplementary bracts 2–3(–4) mm long, sparsely hairy, usually with both glandular and short articulate hairs (Fig. 5d). Ligules 5, yellow, (13–)14–20(–22) mm long. Tubular florets 8–13(–14), (6–)7–8(–9) mm long. Flowering: June to August.

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Appendix 1. Herbarium specimens examined.

Senecio ovatus (G. Gaertn. *et al.*) Willd.

POLAND. Beskid Makowski Mts: Budzów vill., 24 July 2006, *D. Kempa* (KRA 348215); Lubomir Mt., 27 July 1994, *W. Bartoszek* (KRA 260207); Babica Mt., 18 Aug. 1995, *W. Bartoszek* (KRA 259799); Sularzówka Mt., 17 Aug. 1995, *W. Bartoszek* (KRA 259785); Zamczysko nad Rabą nature reserve, 4 Aug. 1992, *K. Jędrzejko* (KRA); Sucha Beskidzka, 7 Aug. 1959, *M. Guzikowa* (KRAM 214317). Beskid Mały Mts: Międzybrodzie Żywieckie vill., 24 July 1987, *B. Kotońska* (KRA 326139); Przegibek pass, 22 July 1979, *B. Kotońska* (KRA 327501); Mała Straconka vill., 21 July 1980, *B. Kotońska* (KRA 327499); Koźle vill., 22 July 1980, *B. Kotońska* (KRA 327489); Rzyki vill. near Andrychów, 5 Aug. 1994, *A. Kołodziej* (KRAM); Wieprz vill. near Andrychów, 27 Aug. 1935, *M. Łańcucka* (KRAM 19023). Beskid Niski Mts: Huta Polańska vill., 20 Aug. 1999, *J. Mitka* (KRA 370318); Dobańce vill., 31 Aug. 1987, *B. Wierzbicka* (KRA 129391); Rozstajne vill., 9 Aug. 1999, *M. Zarzyka* (KRA 310661); Ptaszkowa vill., Jaworze Mt., *J. Staszkiewicz* (KRAM); Beskid Sądecki Mts: Miliczki stream near Żegiestów vill., 20 Sept. 2003, *A. Tyc* (KRA 294535); Pasmo Radziejowej range, Hala Konieczna, 11 Aug. 2006, *K. Stawowczyk* (KRA 381782); Mała Radziejowa Mt., 9 Aug. 2006, *K. Stawowczyk* (KRA 381781); Milik vill., 20 Aug. 2004, *A. Tyc* (KRA 294962); Beskid Śląski Mts: Wisła nature reserve, 19 Aug. 1985, *K. Jędrzejko, H. Klama & J. Żarnowiec* (KRA 131230); Grodziec vill., 15 July 1981, *K. Jędrzejko, H. Klama & J. Żarnowiec* (KRA 132923); Barania Góra Mt., 10 Aug. 1994, *Wołoszyński* (KRAM); Barania Góra nature reserve, 28 Aug. 1985, *K. Jędrzejko, H. Klama & J. Żarnowiec* (KRA 129900); Szczyrk near Bielsko-Biała, 11 Aug. 1952 (KRAM 257582); Ustroń near Cieszyn, 13 Aug. 1957, *B. Wiarcka* (KRAM 260364); Dzięgielów vill. near Cieszyn, 18 Aug. 1934, *A. Kozłowska* (KRAM 190008); Brenna vill., 8 Aug. 1999, *K. Jędrzejko* (KRAM 515903, 521361). Beskid Wyspowy Mts: Luboń Wielki Mt., 6 Sept. 1967, *A. Drula* (KRAM 63755). Beskid Żywiecki Mts: Butorza nature reserve, Sól vill., 20 July 1984, *K. Jędrzejko, H. Klama & J. Żarnowiec* (KRA 129952); Zawoja vill., 7 Aug. 1959, *M. Guzikowa* (KRA 149160); Grojec Mt. near Żywiec, 16 July 1986, *K. Nowak* (KRAM 525679). Gorce Mts: Łąkcica vill. near Krościenko nad Dunajcem, 31 Aug. 1957, *J. Kornaś* (KRA 149158). Kotlina Jasielsko-Krośnieńska basin: Malinówka nature reserve near Haczów vill., 1978, *E. Pniak* (KRAM 128671). Kotlina Oświęcimska basin: Czechowice-Dziedzice, 15 Aug. 1952, *H. Błaszczyk* (KRAM 167855, 148159); Bieruń vill., 31 Aug. 1954, *E. Pancer* (KRAM 225929); Piasek vill. near Pszczyna, 15 Aug. 1962, *E. Sowaty* (KRAM 257569). Kotlina Rabczańska basin: Rabka-Zdrój, 1960, *B. Skowrońska* (KRA 149180). Kotlina Sądecka basin: Podglinka vill., 27 July 1969, *K. Towpasz* (KRA 80853); Chełmiec vill. near Nowy Sącz, Aug. 1928,

Wołoszczak (KRA 149175). Kotlina Sandomierska basin: Uście Solne vill., 5 Sept. 1990, *H. Trzcińska-Tacik* (KRA 361734); Bukowina vill., 3 Aug. 2005, *A. Nobis* (KRA 330289); Brzyska Wola vill., 24 July 2004, *A. Michalewska* (KRA 333844); Puszcza Niepołomicka forest, 25 July 1994, *B. Barabasz* (KRA 142600); Ispina vill., 11 Aug. 1993, *B. Barabasz* (KRA); Lipówka nature reserve, 10 Oct. 1968, *E. Dubiel* (KRA 98175); Kopaliny vill. near Bochnia, 29 July 1968, *J. Barycki* (KRAM); Mielec-Rzochów, 12 Aug. 1965, *E. Kotkowicz* (KRAM 260376); Podgórze Rzeszowskie foothills, Łańcut, 9 Aug. 1953 (KRAM 260319); Puszcza Niepołomicka forest, 25 Sept. 1875, *J. Krupa* (KRAM 167568); Wola Batorska vill. near Niepołomice, 13 Aug. 1951, *A. Jasiewicz* (KRAM 418533). Nizina Śląska lowland: Płaskowyż Głubczycki plateau, Prudnik, July 1916 (KRA); Głogówek vill., 8 Aug. 1974, (KRA 89642); Prudnik, 3 Aug. 1952, *K. Ryczek* (KRAM 257562); Kamień Śląski vill. near Krapkowice, 3 Aug. 1959, *E. Wolska* (KRAM 260369); Kotlina Raciborska basin, Kuźnia Raciborska, 15 Sept. 1957, *F. Jacek* (KRAM 260360); Kędzierzyn-Koźle, 30 Aug. 1961, *P. Szotkowski* (KRAM 257588); Równina Oleśnicka plateau, Polkowskie vill. near Namysłów, 12 Sept. 1962, *T. Kowal* (KRAM 257570); Komorzno vill. near Kluczbork, 3 Aug. 1967, *A. Sendek* (KRAM 257589); Równina Opolska plateau, Olesno, 3 Sept. 1966, *M. Ciaciura* (KRAM 257404); Płaskowyż Głubczycki plateau, Sękowice vill. near Nysa, 23 July 1965, *M. Ciaciura* (KRAM 260353, 260403); Nizina Śląsko-Łużycka lowland: Równina Chojnowska plateau, Paszowice vill. near Jawor, Aug. 1960, *E. Łonk* (KRAM); Wysoczyzna Lubińska plateau, Lubin, 6 Oct. 1971, *H. Piękoś* (KRAM 243243); Pawłowice Małe vill. near Legnica, 22 Aug. 1962, *M. Ciaciura* (KRAM 257572); Pieniny Mts: *Zaskalskie*-Bodnarówka nature reserve, *B. Wójcikiewicz* (KRA 237532); Czorsztyn vill., 20 Aug. 1964, *A. Stengl* (KRAM 149178, 149188); Jarmuta Mt., 4 Aug. 1966, *A. Zielińska* (KRAM 63820), 18 Aug. 1967, *B. Pietras* (KRAM). Pogórze Ciężkowickie foothills: Tarnów along Wątok stream, 5 July 2003, *A. Chrobok* (KRA 291848). Pogórze Jasielskie foothills: Brzyska vill. near Jasło, *K. Wiśniewicz* (KRA 149179). Pogórze Przemyskie foothills: Węgierka vill., 1 Sept. 1998, *K. Wilk* (KRA 242526). Pogórze Śląskie foothills: Czarne Doły near Cieszyn, 7 Aug. 1995, *E. Rojczyk* (KRA); Bielsko-Biała-Mikuszowice, 7 Sept. 1969, *B. Wojbor* (KRAM 257442); Skoczów near Cieszyn, 11 Sept. 1960, *K. Czaja* (KRAM 257543, 505381). Pogórze Strzyżowskie foothills: Gnojnica vill., 19 Sept. 1979, *K. Towpasz* (KRA 3613141). Pogórze Wielickie foothills: Dobczyce, 30 Aug. 1979, *B. Romańczyk* (KRA 122883); Brody vill., near Kalwaria Zebrzydowska, 18 Aug. 1999, *K. Jędrzejko* (KRAM 523616), 17 Sept. 1923, *K. Piech* (KRAM 225709), 31 July 1999, *K. Jędrzejko* (KRAM 509443); Lanckorona, 7 Aug. 2002, *K. Jędrzejko & E. Walusiak* (KRAM 505637). Pogórze Zachodniosudeckie foothills: Pogórze Kaczawskie foothills, Pomocne vill. near Jawor, 16 Aug. 1962, *M. Ciaciura* (KRAM 260402); Świebodzice near Świdnica, 26 Aug. 1959, *J. Kuc* (KRAM 260361); Pogórze Wałbrzyskie foothills, Bogaczowice vill. near Jawor, *T. Kowal* (KRAM 257571); Pogórze Kaczawskie foothills, Chmielno vill. near Lwówek Śląski, 18 July 1953, *L. Michalik* (KRAM 257566); Pogórze Izerskie foothills, Uniegoszcz vill. near Lubań, 7 Sept. 1962, *J. Czarna* (KRAM 257538); Pisarzowice vill. near Lubań, 24 Aug. 1962, *J. Błomka* (KRAM 257537); Leśna vill. near Lubań, 3 Sept. 1967, *W. Kręgiel* (KRAM); Pogórze Kaczawskie foothills, Złotoryja, 1 July 1964, *J. Zwierko* (KRAM 260401). Pojezierze Lubulskie lakeland: Bobowicko vill. near Międzyrzecz, 17 Aug. 1959 (KRAM 260391). Przedgórze Sudeckie foreland: Wzgórza Niemczańsko-Strzelińskie hills, Strzelin, 27 July 1953, *E. Zacharko* (KRAM 260373); Masyw Ślęży Mts, Ślęża Mt., 11 Aug. 1960, *M. Ciaciura* (KRAM); Sobótka vill., 4 Sept. 1968, *B. Hewryk* (KRAM 257541); Równina Świdnicka plateau, Imbramowice vill., 8 Sept. 1965, *M. Ciaciura* (KRAM 260404); Obniżenie Otmuchowskie plateau, Kłodobok vill. near Grodków, 17 Sept. 1961, *M. Ciaciura* (KRAM 260413); Sudety Środkowe Mts: Góry Bardzkie Mts, Bardo vill., 5 June 1952, *J. Sibilski* (KRAM 167854); Góry Kamienne Mts, Sokołowsko vill., 19 Aug. 1952, *S. Kneblach* (KRAM); Jedlinka vill., 29 July 1967, *E. Badys* (KRAM 257438); Wałbrzych-Sobięcin, 2 May 1952, *C. Wójtowicz* (KRAM 260370); Góry Orlickie Mts, Duszniki-Zdrój, 5 Aug. 1959, *E. Rurak* (KRAM 260362); Duszniki-Zdrój, 20 Aug. 1967, *M. Stewbaka* (KRAM 257436); Góry Sowie Mts, Zagórze Śląskie vill. near Wałbrzych, 8 Sept. 1965, *A. Babska* (KRAM 257594); Kotlina Kłodzka basin, Międzylesie vill., 10 Aug. 1967, *M. Dobrowolska* (KRAM); Piotrowice vill., 18 July 1988, *Z. Szeląg* (KRAM); Mielnik vill., Dębowa Góra Mt., 16 July 1988, *Z. Szeląg* (KRAM 446234); Góry Stołowe Mts, Polanica-Zdrój, 20 Aug. 1959, *K. Marczak* (KRAM 260406); Góry Sowie Mts, Kamionki vill. near Dzierżoniów, 12 Aug. 1962, *B. Chruplewicz* (KRAM 257660); Góry Bystrzyckie Mts, Spalona pass near Bystrzyca Kłodzka, 27 July 1958, *S. Gołowin* (KRAM 149313). Sudety Wschodnie Mts: Masyw Śnieżnika Mts, Miedzygórze vill., 26 Aug. 1951, *W. Kaglik* (KRAM 257561); Miedzygórze vill. – Muszany Dół, 13 Aug. 1989, *Z. Szeląg*

(KRAM 446515); Góry Opawskie Mts, Konradów vill., 29 July 1965, *M. Ciaciura* (KRAM 260355); Góry Złote Mts, Lądek-Zdrój, Aug. 1954, *s.col.* (KRAM 10764). Sudety Zachodnie Mts: Kotlina Jeleniogórska basin, Jelenia Góra-Zachełmie, *M. Włodawska* (KRAM 257568). Wał Trzebnicki: Gaszowice vill. near Syców, 24 Aug. 1960, *M. Ciaciura* (KRAM 260409). Wyżyna Kielecka upland: Garb Gielniowski, Rędocin vill. near Skarżysko-Kamienna, 11 Aug. 2003, *M. Podgórska* (KRA 353184); Rozwady vill. near Gielniów, 20 July 2006, *M. Podgórska* (KRA 353182); Drożdżów vill. near Skarżysko-Kamienna, 30 July 2005, *M. Podgórska* (KRA 353173); Lubienia vill. near Starachowice, 20 Aug. 2002, *M. Nobis* (KRA 366834); Lipie forestry near Starachowice, 12 Aug. 2003, *M. Nobis* (KRA 328539); Majdów vill., 3 Aug. 2003, *M. Nobis* (KRA 328456); Sadek Mały vill., 8 Aug. 2003, *M. Nobis* (KRA); Małyszyn vill., 14 Aug. 2003, *M. Nobis* (KRA 328454); Kochanów vill., 27 Aug. 2003, *M. Nobis* (KRA 328545); Kutery forestry, 21 July 2003, *M. Nobis* (KRA 328546); Rzuców vill., 26 July 2003, *M. Nobis* (KRA 328538); Krzemionki Opatowskie archaeological reserve, July 2002, *R. Piwowarczyk* (KRA 356766); Henryk vill. near Starachowice, 16 July 2002, *M. Nobis* (KRA 322948); Iwaniska vill., 14 Aug. 1964, *M. Wayda* (KRA); Góry Świętokrzyskie Mts, Podgórze vill., 26 Aug. 2009, *K. Jędrzejko & M. Sikorski* (KRAM 239420); Święta Katarzyna vill., 14 Aug. 2007, *K. Jędrzejko & M. Sikorski* (KRAM 562664); Świnia Góra nature reserve, 13 Aug. 1964, *H. Piękoś* (KRAM 64996, 64997); Łysica Mt., 8 Aug. 1926, *K. Kaznowski* (KRAM 167848); Błoto vill. near Suchedniów, 17 Aug. 1923, *K. Kaznowski* (KRAM 167846); Bukowa Góra nature reserve, 17 July 1926, *K. Kaznowski* (KRAM 167849); Suchedniów, 29 July 1926, *K. Kaznowski* (KRAM 167851). Wyżyna Krakowsko-Częstochowska upland: Kraków-Bieżanów, 27 July 2008, *K. Ochyra* (KRA 353392); Kraków-Tyniec, 4 Aug. 1967, *I. Kucowa* (KRA 63400); Tenczynek vill., 2 Oct. 1966, *H. Trzcińska-Tacik* (KRA 373750); Laski vill. near Olkusz, 22 Aug. 1989, *H. Trzcińska-Tacik* (KRA 376547); Dolina Mnikowska valley, 15 Aug. 2001, *A. Michalewska* (KRA 335046); Panieńskie Skały nature reserve, June 1987, *K. Jędrzejko, H. Klama & J. Żarnowiec* (KRA 130587); Dębowa Góra nature reserve, 1 Aug. 1987, *K. Jędrzejko, H. Klama & J. Żarnowiec* (KRA 133486); Częstochowa, *Gajos-Kędzierska* (KRA); Ojców vill., 10 July 1952, *A. Duffer* (KRAM 260383); Tenczynek vill., 3 Aug. 1977, *A. Żmuda* (KRAM 10766); Zabierzów, Skała Kmity nature reserve, 14 Aug. 1991, *A. Woszczenko* (KRAM 403336). Wyżyna Śląska upland: Segiet nature reserve, Tarnowskie Góry, 28 Aug. 1956, *L. Kobierski* (KRA 149330); Chwałowice vill. near Rybnik, 13 Aug. 1992, *I. Gruszczyk* (KRA 249593); Cisy w Hucie Starej nature reserve, *H. Klama* (KRA 130088); Gliwice, 22 June 2007, *A. Trzeszkowska* (KRAM 563558); Zabrze, 10 Aug. 1959, *M. Bonk* (KRAM 260366); Brzezinka vill. near Gliwice, 14 July 1957, *T. Bidkiewicz* (KRAM 257560); Borowa Wieś vill., 21 July 2004, *M. Musioł & B. Kowalczyk* (KRAM 534578); Księży Las near Zbrosławice, 12 July 2003, *A. Stebel & M. Molenda* (KRAM 514265); Czerwionka-Leszczyny, 14 Aug. 2008, *A. Nikiel, K. Jędrzejko* (KRAM); Ruda Śląska – Halemba, 10 July 2007, *K. Jędrzejko & M. Chojnacka* (KRAM 564191); Pagóry Jaworznickie hills, Chrzanów – Chełmek Fabryczny, 3 Sept. 1974, *A. Sendek* (KRAM 556356); Mysłowice, 8 Aug. 2008, *A. Tajer* (KRAM 570885); Świerklaniec vill., 18 Aug. 1997, *K. Jędrzejko* (KRAM); Kazimierówka vill. near Zawiercie, 22 June 2000, *B. Kubat* (KRAM); Katowice, 13 Sept. 1959, *J. Kopytko* (KRAM 260411); Mikołów, 14 Aug. 2008, *A. Nikiel & K. Jędrzejko* (KRAM 564343); Kleszczówka-Żory, 15 June 2007, *A. Noras & K. Jędrzejko* (KRAM 562814); Zabrze-Makoszowy, 22 July 2004, *M. Musioł & B. Kowalczyk* (KRAM 531505); Gliwice-Taciszów, 21 Sept. 1966, *J. Serwatka* (KRAM 257557).

AUSTRIA. Ambras near Innsbruck, 2 Sept. 1894, *B. Kotula* (KRAM); Mürzsteg Alps Mts, Mürzsteg vill., Aug. 1904, *A. Klammerth* (KRAM 167842). BELGIUM. Warnach vill., 18 Aug. 1953, *Wilczek* (149166). CZECH REPUBLIC. Strakonice vill., Aug. 1950, *J. Dostál* (KRAM 358943). FRANCE. Marne vill., 2 Aug. 1971, *B. de Retz* (KRAM 203938); Creuse vill., 27 Aug. 1971, *R. Lugagne* (KRAM 203937); Flavigny vill., Aug. 1935, *G. Desplantes* (KRAM 167853); Gex vill., Ain, 20 Sept. 1972, *P. Hainard* (KRAM 215107). GERMANY. Wemding vill., 26 July 1937, *L. Obernede* (KRAM 86399); Weilburg, Hessen, 22 July 1978, *H. Kalheber* (KRAM 244947); Harz Mts, Hahausen vill., 22 Aug. 1973, *K. Larsen, L. Holm-Nielsen & S. Larsen* (KRAM 215108); Saxony, Dresden, Aug. 1960, *C. F. Seidel* (KRA); Bavaria, Brannenburg, *A. H. Rosenheim* (KRA 149165). ITALY. Pistoia, Maresca vill., 17 July 1958, *A. Contardo* (KRAM 38812); Valle Formazza, Casse, 23 Aug. 1916, *M. O. Boggiani* (KRA 149173); Brenner vill., *D. Szymkiewicz* (KRA 149170). NETHERLANDS. Duivelsberg near Beek (KRA 149174).

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POLAND. Beskid Niski Mts: Besko vill., 4 Aug. 1989, *W. Deptuch* (KRAM 395469); Dukla near Krosno, 12 Aug. 1952, *G. Uliasz* (KRAM 260382).

Beskid Sądecki Mts: Żegiestów vill., 28 July 1926, *J. Dobrzańska* (KRA 149333); Krynica, 1857, *Berdau* (KRAM 168406); Pasmo Radziejowej range, Wietrzne Dziury, *B. Pawłowski* (KRAM 167844). Beskid Wyspowy Mts: Greblok vill., 25 July 1997, *M. Szewczyk* (KRA 261165); Młynne vill., 23 Sept. 1998, *M. Szewczyk* (KRA 263450). Beskid Żywiecki Mts: Pilsko Mt., 19 July 1938, (KRA 149307); Dolina Buczynki valley, 16 Aug. 1970, *K. Białecka* (KRA 109224). Bieszczady Zachodnie Mts: Bukowiec vill., near Terka, 10 Sept. 1962, *A. Jasiewicz* (KRAM 10799); Bukowe Berdo Mt., 1 Aug. 1960, *A. Jasiewicz* (KRAM 418560); Stuposiany vill., 17 May 1956, *A. Jasiewicz* (KRAM 418572); Riaba Skała Mt., 7 July 1951, *A. Jasiewicz* (KRAM 418571); Połonina Caryńska, 13 Aug. 1961, *A. Jasiewicz* (KRAM 418559, 10798); Wielka Rawka Mt., 7 July 1951, *A. Jasiewicz* (KRAM 419086); Bukowiec Mt., 10 Sept. 1962, *A. Jasiewicz* (KRAM 418570); Halicz Mt., 20 Aug. 1896, *J. Paczoski* (KRAM). Góry Sanocko-Turczańskie Mts: Lesko, 20 Aug. 1953, *Słotwińska* (KRAM 260579). Kotlina Sandomierska basin: Krzywa vill. near Ropczyce, 9 July 1957, *Bajor* (KRAM 260400); Rzeszów, 31 Aug. 1990, *A. Nowak* (KRAM 403103); Podgórze Bocheńskie foothills, Bochnia, 7 Sept. 1963, *K. Czesak* (KRAM 257573). Kotlina Żywiecka basin: Żywiec, 15 Sept. 1961, *Romaniec* (KRAM). Pieniny Mts: Wąwóz Szopczański valley, 25 Aug. 1968, *K. Zarzycki* (KRAM 359561); Przechodki Wielkie pass, 25 Aug. 1975, *K. Zarzycki* (KRAM 359554); Gródek vill., 20 Aug. 1960, *K. Zarzycki* (KRAM 359581). Przedgórze Sudeckie foreland: Przedgórze Paczkowskie foreland, Nadziejów vill. near Nysa, 15 July 1967, *P. Szotkowski* (KRAM 257437, 257586). Pogórze Bukowskie footills: Stróże Małe vill., 20 Aug. 1921, *K. Piech* (KRAM 225701). Pogórze Ciężkowickie foothills: Przydonica vill., 16 Sept. 1992, *K. Towpasz* (KRA 326856); Dąbrówka Szczepanowska vill., 16 Sept. 1992, *K. Towpasz* (KRA 339919); Jodłowa vill., 27 July 2004, *K. Piątek* (KRA 339365). Pogórze Dynowskie foothills: Dynów, 15 Aug. 1962, *Ż. Jamuta* (KRAM 260394); Brzozów vill., 23 Aug. 1966, *A. Piecuch* (KRAM); Błędowa Tyczyńska vill. near Rzeszów, 27 Aug. 1964, *Z. Chałdasz* (KRAM 260377); Piątkowa vill., 10 Sept. 1971, *J. Bober* (KRA 70985). Pogórze Przemyskie foothills: Przemyśl, 1877 (KRAM 168436); Jaksmanice vill. 4 Aug. 1877, *B. Kotula* (KRAM 344135). Pogórze Rożnowskie foothills: Witowice Dolne vill., 14 Sept. 1959, *M. Górska* (KRAM 260387); Ostra Góra Mt. near Rożnów, 13 July 1946, *A. Środoń* (KRAM 61297). Sudety Zachodnie Mts: Przesieka vill., 12 July 1953, *M. Włodawska* (KRAM 257567). Wyżyna Kielecka upland: Góry Świętokrzyskie Mts, Bardo vill. near Łagów, 31 July 1929, *K. Kaznowski* (KRAM). Wyżyna Lubelska upland: Bychawa vill., 8 July 1958, *D. Fijałkowski* (KRA 149321).

AUSTRIA. Brenner pass, Gries, 8 Sept. 1894, *B. Kotula* (KRAM 52823); Tyrol region, Gärberbach vill., 9 July 1896, *B. Kotula* (KRAM 52817); Franzensbrücke, 16 Aug. 1896, *B. Kotula* (KRAM 52818); Lilltal near Gärberbach vill., 11 Aug. 1898, *B. Kotula* (KRAM 52819); Solstein Ketle, 28 July 1895, *B. Kotula* (KRAM 52821); Lunzer See, *Wołoszczak* (KRAM 168446). CZECH REPUBLIC. Moravia, Bílovice vill., 9 Aug. 1927, *R. Doležal* (KRA 149264). GERMANY. Nussdorf am Inn, 10 Sept. 1897, *B. Kotula* (KRAM 52826). ROMANIA. Gorj vill. near Oltenia, 28 July 1972, *M. Cîrţu* (KRAM 261413); SLOVAKIA. Štiavnica Mts, Štiavnické Pohorie vill., 13 July 1970, *K. Zarzycki & K. Zahradniková* (KRAM 273542); Slovenský raj, Suchá Belá, 14 Sept. 1970, *K. Zarzycki & K. Zahradniková* (KRAM 273540). UKRAINE. Cheremosh River, Battagut, 18 Aug. 1934, *Środoń* (KRAM 10793); near Lviv, Aug. 1940, *K. Miczyński* (KRAM 10761); Ruzhyn vill., Zhytomyr Oblast, 7 July 1898, *A. Markiewiczówna* (KRAM 168200); Verkhnje Syn'ovydne, Lviv Oblast, 14 Aug. 1896, *J. Paczoski* (KRAM 168194); Vyzhnytsia, Chernivtsi Oblast, 30 July 1896, *J. Paczoski* (KRAM 168192); Myslivka vill., Ivano-Frankivsk Oblast, 1887, *Błocki* (KRAM 168411); Shuparka, Ternopil Oblast, 1856, *Zipser* (KRAM 168410); Nyzhniv vill., Ivano-Frankivsk Oblast, 1925, *M. Koczwara* (KRAM 168448); Dobrivlyany vill., Lviv Oblast, 3 Sept. 1878, *Tyniecki* (KRAM 168439); Yablunitsya vill., Ivano-Frankivsk Oblast, 6 Aug. 1882, *H. Zapałowicz* (KRAM 168400); Horodenka, Ivano-Frankivsk Oblast (KRAM 168395); Słobódka dolna, Ternopil Oblast, 19 July 1879, *A. Śleńdziński* (KRAM 168393); Monasterek vill., 1878, *B. Błocki* (KRAM 168442); Bilche Zolote, Ternopil Oblast, 1878, *B. Błocki* (KRAM 168440); Lipowiec, Lviv Oblast, *B. Kotula* (KRAM 168435); Stryi, Lviv Oblast, 1888, *E. Turczyński* (KRAM 167862); Kamionki vill., 24 Aug. 1878, *A. Śleńdziński* (KRAM 167865); Podhajce vill., Ternopil Oblast, 22 July 1873, *A. Śleńdziński* (KRAM 168420); Kudryntsi vill., Ternopil Oblast, 1876, *A. Śleńdziński* (KRAM 167863); Letnya vill., Lviv Oblast, 5 Sept. 1878, *Tyniecki* (KRAM 167866);

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POLAND. Beskid Sądecki Mts: Powroźnik vill. near Krynica, 7 July 1970, *I. Kucowa* (KRA 256055); Chełmiec vill. near Nowy Sącz, 5 July 1919, *K. Miczyński*

(KRA 149306); Muszyna vill., 2 July 1970, *Jemanek* (KRA 256056); Pasmo Radziejowej range, Prehyba Mt., 23 June 1952, *J. Staszkiewicz* (KRAM 407010); Prehyba Mt. – top surface, 11 July 2006, *K. Stawowczyk* (KRA 381783); Łazy Brzyskie vill., 26 Aug. 2006, *K. Stawowczyk* (KRA 381785); Krynica, July 1857, *Berdau* (KRAM 168408). Beskid Wyspowy Mts: Łopień Mt., 18 July 1967, *K. Towpasz* (KRA 80837); Pasmo Radziejowej Range, along Sopotnicki stream, 13 July 2006, *K. Stawowczyk* (KRA 381784); Ostra Mt., 13 July 1969, *K. Towpasz* (KRA 80842); Ostra Góra Mt. near Limanowa, 8 July 1955, *J. Staszkiewicz* (KRAM 454974). Beskid Żywiecki Mts: Babia Góra Mt., N slope, June 1964, *J. Błaszczyk* (KRA 95841); Zubrzyca Górna vill., 12 Sept. 1960, *M. Guzikowa* (KRA); Pilsko Mt., 19 June, *I. Król* (KRAM 19017); Babia Góra Mt. near Przełęcz Brona pass, 31 Aug. 1978, *B. Chwastowski* (KRAM 234272); Spytkowice vill., 4 July 1966, *M. & J. Guzikowie* (KRAM 69841). Gorce Mts: Dolina Potoku Turbacz valley, 21 June 1950, *J. Kornaś* (KRA 149325); Lubań Mt, SW slope, 27 July 1957, *J. Kornaś* (KRA 149328); Polana Jaworzyna grassland, 14 July 1949, *J. Kornaś* (KRA 149327). Pogórze Spisko-Gubałowskie foothills: Biały Dunajec vill., 28 Aug. 1955, *E. Pancer* (KRA 149319); Czarny Dunajec vill., 8 Aug. 1955, *K. Chronowska* (KRA 149322); Harenda, 17 Aug. 1955, *K. Chronowska* (KRA 149323); Leśnica stream, 8 July 1957, *E. Pancer* (KRAM 10758); Poronin vill., 26 July 1951, *Chałupek* (KRAM 260385); Czerwona Skała near Dursztyn vill., July 1961, *K. Grodzińska* (KRAM). Rów Podtatrzański: Zakopane, 7 Aug. 1960, *H. Piękoś* (KRAM 88370, KRA 149311); Zakopane near Murowanica, 25 June 1981, *J. Płazińska* (KRAM 288924). Sudety Środkowe Mts: Góry Wałbrzyskie Mts, Wałbrzych, 11 July 1955 (KRAM 260310); Góry Bystrzyckie Mts, Długopole-Zdrój vill., 20 Sept. 1989, *J. Wójcicki* (KRAM 404207); Wałbrzych, 5 July 1968, (KRAM); Góry Kamienne Mts, Jedlina-Zdrój vill., Aug. 1969, *A. Wojteczek* (KRAM 257447); Góry Wałbrzyskie Mts, Wałbrzych – Biały Kamień, 2 Aug. 1961, *M. Syranów* (KRAM 257541). Sudety Wschodnie Mts: Masyw Śnieżnika Mts, Średniak Mt., 22 July 1987, *Z. Szeląg* (KRAM 448386); Masyw Śnieżnika Mts, along Czarna stream, 19 July 1988, *Z. Szeląg* (KRAM 448062); Trójmorski Wierch Mt., 7 July 1988, *Z. Szeląg* (KRAM 448535); Miedzygórze vill., along Wilczka stream, 23 July 1987, *Z. Szeląg* (KRAM 446409); Jawor Mt., 21 July 1987, *Z. Szeląg* (KRAM 4466358); Szeroka Kopa Mt., 21 July 1987, *Z. Szeląg* (KRAM 446359); Czarna Góra Mt., 21 July 1987, *Z. Szeląg* (KRAM 446335); Mariańskie Skały, Żmijowiec Mt., 21 July 1988, *Z. Szeląg* (KRAM 448566). Sudety Zachodnie Mts: Leszczyna vill., 3 Aug. 2006, *K. Kozłowska* (KRA 380585); Góry Kaczawskie Mts, Road to Perła Zachodu hostel near Jelenia Góra, 10 Aug. 1953, *E. Lamer* (KRAM 257564); Karkonosze Mts, Karpacz – Bierutowice, 17 July 1951, *D. Sikora* (KRAM 257559); Karpacz, 11 July 1951, *M. Sopałowicz* (KRAM), Karpacz – Orlinek, 14 Aug. 1968, *M. Ciaciura* (KRAM 257592); Góry Kaczawskie Mts, Perła Zachodu hostel near Jelenia Góra, 10 Aug. 1953, *J. Barbich* (KRAM); Kotlina Jeleniogórska basin, Jelenia Góra, 9 Aug. 1953, *M. Izykurska* (KRAM 260408); Rudawy Janowickie, Góry Sokole Mts, Krzyżna Góra Mt., 24 Aug. 1974, *J. Wójcicki* (KRAM). Tatra Mts: Cyrhla near Morskie Oko lake, 9 Aug. 1955, *W. Wojewoda* (KRA 64776); Dolina ku Dziurze valley, 5 July 1951, *R. Rajchel* (KRA 149308); Dolina Tomanowa valley, 17 Aug. 1961, *A. Pacyna* (KRA 149312); Dolina Małej Łąki valley, 11 Aug. 1960, *R. Rajchel* (KRA 149317); Dolina Gąsiencowa valley, 12 Aug. 1955, *K. Chronowska* (KRA); Dolina Tomanowa valley, Rzędy, 11 Aug. 1967, *B. Pawłowski* (KRA 121018); Tarasówka near Bukowina Tatrzańska vill., 12 Aug. 1949, *Z. Radwańska-Paryska* (KRAM 38811); Dolina Kościeliska valley – Gronik, 5 July 1954, *K. Chronowska* (KRAM 221062), Kopki Mt., 31 July 1911, *A. Żmuda* (KRAM 10805); Dolina Małej Łąki valley, 13 Aug. 1875, *W. Kulczyński* (KRAM 168427); Łysa Polana vill., 8 Aug. 1975, *A. Jasiewicz* (KRAM 457935); Wantule in Dolina Miętusia valley, 13 Aug. 1981, *A. Jasiewicz* (KRAM 450707); Dolina Białego valley, 26 Aug. 1961, *R. Rajchel* (KRAM 149314).

BULGARIA. Balkan Mts, Kom Mt., 8 Aug. 1969 (KRAM 400697). SLOVAKIA. Belianske Tatry Mts, Havran Mt., 25 July 1878, *J. Szyszyłowicz* (KRAM 168432); Nowa Przełęcz pass, 25 July 1878, *J. Szyszyłowicz* (KRAM 168433); Veľká Fatra Mts, Malá Smrekovica Mt., 26 Aug. 1988, *H. Trzcińska-Tacik* (KRA 371834). SWITZERLAND. Graubünden canton, Val Roseg, 26 July 1973, *A. Jasiewicz* (KRAM 444916, 227919).

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POLAND. Bieszczady Zachodnie Mts: Otryt range, 18 July 1980, *M. Jagiełło* (KRAM 252474); Czarna vill., 7 July 1960, *A. Jasiewicz* (KRAM 418561); Dwernik vill., 9 July 1960, *A. Jasiewicz* (KRAM 10802, 418562); Mała Semanowa Mt., 25 Aug. 1960, *A. Jasiewicz* (KRAM 10800, 418503); Michniowiec vill., 29 June 2005, *M. Nobis* (KRA 356863); Paprotna near Stare Sioło vill., 12 July 1961, *A. Jasiewicz* (KRAM 10803, 418534, 418573); between Halicz Mt. and

Rozsypaniec Mt., 8 Aug. 1960, *A. Jasiewicz* (KRAM 419083); Komańcza vill., 29 June 1954, *W. Kurek* (KRAM 419085); Ustrzyki Górne vill., 8 Aug., *A. Kuc* (KRAM 10806); Widełki near Pszczeliny vill., 1 Aug. 1960, *A. Jasiewicz* (KRAM); between Tarnica Mt. and Moczarne settlement, 7 July 1961, *A. Jasiewicz* (KRAM 418564); between Widełki and Bukowe Berdo Mt., 1 Aug. 1960, *A. Jasiewicz* (KRAM 36279). Pogórze Dynowskie foothills: Temeszów vill., 24 Sept. 1971, *J. Bober* (KRA 70990); Mrzygłód vill., 16 Sept. 1971, *J. Bober* (KRA 70994).

ROMANIA. Southern Carpathians, Multenia, Prahova district, near Sinaia, 28 July 1922, *A. Borza* (KRA 149164); Southern Carpathians, Sinaia, Bucegi Mts, 9 Sept. 1972, *A. Jasiewicz* (KRAM 418557). UKRAINE. Eastern Carpathians, Gorgany Mts, Łopuszna, 29 July 1939, *A. Środoń* (KRAM 97716); Eastern Carpathians, Skole Beskids, Skole vill., Lviv Oblast, 1878, *Błocki* (KRAM 168412); Komariv vill. near Stryi, 1865, *P. Zipser* (KRAM 168418, 167857); Eastern Carpathians, Chornohora Mts, Pożyżewska grassland, 8 July 1927, *J. Mayr* (KRAM 256212); Eastern Carpathians, Gorgany Mts, Dora Mt, 13 July 1938, *A. Środoń* (KRAM 38801); Eastern Carpathians, Munţii Marmureşului Mts, Pip Ivan Mt., 14 July 1977, *V. Chopik* (KRAM 539411); Eastern Carpathians, Góry Sanocko-Turczańskie Mts, Magura Łomniańska Mt., 1880, *B. Kotula* (KRAM 167877); Podolian upland, Stebnyk vill., Lviv Oblast, 1880, *B. Kotula* (KRAM 167878); Podolian upland, Mizhenets vill., Lviv Oblast, *D. Szymkiewicz* (KRAM 167575); Eastern Carpathians, Chivchin Mts, Palenica Mt., 23 July 1934, *B. Pawłowski* (KRA 149358); Eastern Carpathians, Chivchin Mts, *M. Wayda* (KRA 125608).