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A taxonomic revision of the *Siler montanum* group (*Apiaceae*) in Italy and the Balkan Peninsula

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Abstract: A morphometric-based taxonomic revision of the *Siler montanum* group (*Apiaceae*) from Italy and the Balkan Peninsula was carried out. Multivariate and univariate analyses were performed on 47 morphological characters including seven ratios, and based on the study of 328 dried herbarium specimens. According to our results, the characters employed in the study revealed their suitability as key characters for the examined taxa. A taxonomic treatment was presented and a new diagnostic key to the *S. montanum* group is also provided for Italy and Balkan Peninsula. Ten taxa were recognized within the group, and among them three new subspecies were described: *S. montanum* subsp. *apuanum*, *S. montanum* subsp. *corrasianum* and *S. montanum* subsp. *ogliastrinum*. Furthermore, three new combinations were proposed: *S. zernyi* subsp. *laeve*, *S. zernyi* subsp. *ochridanum* and *S. montanum* subsp. *stabianum*. Six names were lectotypified: *Laserpitium garganicum* var. *balcanicum*, *L. garganicum* var. *laeve*, *L. garganicum* var. *scabrum*, *L. siculum* var. *stabianum*, *L. siler* var. *ovalifolium* and *Ligusticum garganicum*. Occurrences were confirmed for *Siler zernyi* subsp. *zernyi* in Greece and *S. zernyi* subsp. *laeve* in North Macedonia. Occurrences were excluded for *S. montanum* subsp. *garganicum* in Greece and North Macedonia and *S. montanum* subsp. *siculum* in C and S Italy.

Keywords: *Apiaceae*, Balkan flora, Italian flora, *Laserpitium*, morphometric analysis, new combinations, new subspecies, nomenclature, *Siler*, taxonomy, typification, *Umbelliferae*

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Introduction

A recent molecular study (Banasiak & al. 2016) reconstructed the phylogeny of the genera belonging to tribe *Scandiceae* subtribe *Daucinae* (*Apiaceae*), showing that the traditionally recognized genus *Laserpitium* L. is polyphyletic. Accordingly, *Laserpitium* was split into five genera: *Laserpitium* L., *Ekimia* H. Duman & M. F. Watson, *Laser* Borkh. ex G. Gaertn., B. Mey. & Scherb., *Siler* Mill., *Silphiodaucus* (Koso-Pol.) Spalik & al. and *Thapsia* L.

Laserpitium siler L. is a highly variable species, distributed in the rocky, hilly and mountainous regions of central and southern Europe (Hand 2011). Based on nrDNA ITS phylogeny, it was transferred by Banasiak & al. (2016) into the genus *Siler* as *S. montanum* Crantz. In addition to the type subspecies, two other subspecies are known for the flora of Italy, and new combinations for them were proposed by Iamonico & al. (2016): *S. montanum* subsp. *siculum* (Spreng.) Iamonico & al., endemic to central S Italy (Peruzzi & al. 2014, 2015; Bartolucci & al. 2018) and *S. montanum* subsp. *garganicum* (Ten.) Iamonico & al. confirmed in Italy only in Gargano promontory (Apulia) (Peruzzi & al. 2014, 2015; Bartolucci & al. 2018). Beside *S. montanum* subsp. *garganicum*, three other taxa within the *S. montanum* group have been reported from the Balkan Peninsula. They are currently recognized as infraspecific taxa or sometimes as distinct species (i.e. Micevski 1981; Hartvig 1986; Stevanović & al. 1993; Hand 2011; Dimopoulos & al. 2013): *Laserpitium garganicum* var. *laeve* Halácsy (N Greece), *L. ochridanum* Micevski (SW North Macedonia) and *L. zernyi* Hayek (Albania and North Macedonia). A number of infraspecific taxa of lower rank (var., subvar., f.) were also accepted by Thellung (1926), but they are not clearly linked to geographical areas (e.g. *S.*

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Table 1. Metadata of populations of the *Siler montanum* group studied for the taxonomic revision (see Fig. 1). – Area codes (following Euro+Med 2006+): Al = Albania, Au = Austria, BH = Bosnia and Herzegovina, Bu = Bulgaria, Cg = Montenegro, Ct = Croatia, Ga = France, Ge = Germany, Gr = Greece, He = Switzerland, It = Italy, Mk = North Macedonia, Sa = Sardinia, Si = Sicily, Sr = Serbia/Kosovo. – MGRS10x10 = coordinates for a geographical position according to Military Grid Reference System (MGRS) with squares of 10 × 10 km, based on Universal Transverse Mercator (UTM) projection (Lampinen 2001).

Taxon	**Area code**	**No. of specimens**	**Localities**	**MGRS10x10**
S. zernyi subsp. *zernyi*	Al	1	Mt Paštrik	34TDM57
	Gr	7	Mt Astraka, Mt Ossa, Mt Tzoumerka, Tsuka Rosa	34SDJ97, 34SDK82, 34SEK01, 34SFK40
	Mk	8	Mt Bistra, Mt Jablanica, Mt Korab, Poreč	34TDL66, 34TDM62, 34TDM80, 34TEM12
	Sr	5	Mt Paštrik, Mt Šar Planina	34TDM67, 34TDM74, 34TDM96, 34TDM97
S. zernyi subsp. *laeve*	Gr	9	Mt Olympus, Mt Ossa, Mt Vourinos	34SFK13, 34SFK40, 34SEK54
	Mk	5	Kozjak, Poreč	34TEL58, 34TEM12
S. zernyi subsp. *ochridanum*	Mk	12	Mt Galičica	34TDL83
S. montanum subsp. *montanum*	Au	6	Totes Gebirge	33TVN17
	Ga	4	Hautes Alpes, Savoie	31TGK33, 32TKS70
	Ge	2	Schwäbische Alb	32UNV80
	It	6	Dolomiti Friulane, Gran Paradiso, Monviso, Valle d'Aosta	32TLQ55, 32TLR55, 32TLR77, 33TUM11
	He	4	Canton Glarus	32TMT90
S. montanum subsp. *apuanum*	It	20	Alpi Apuane	32TPP07, 32TNP97, 32TNP98
S. montanum subsp. *corrasianum*	Sa	15	Sardinia (Mt Corrasi, Su Thuttureli)	32SNK34, 32TNK35
S. montanum subsp. *garganicum*	BH	4	Foča, Konjuh, Mt Romanija	34TCP16, 34TCP21, 34TCQ00
	Bu	2	Mt Pirin	34TGM11
	Ct	6	Fužine, Mt Velebit, Rupa, Samoborska Gora	33TVL43, 33TVL71, 33TWK03, 33TWL56
	It	30	Mt Gargano	33TWG51, 33TWG62, 33TWG81
	Cg	5	Mt Durmitor, Mt Orjen, Mt Prokletije	34TCN47, 34TBN91, 34TCN90, 34TDN00, 34TCN81
	Sr	34	Mt Giljeva Planina, Mt Kopaonik, Mt Mokra Gora, Mt Ozren, Mt Prokletije, Mt Rogozna, Mt Rtanj, Mt Stol, Mt Stolovi, Mt Studena Planina, Mt Suva Planina, Mt Svrljiške Planine, Mt Tupižnica, Mt Vidlič, Mt Vlaška Planina, Mt Zlatibor, Priboj, Šargan	34TCP74, 34TCP75, 34TCP85, 34TCP91, 34TCP94, 34TDN17, 34TDN23, 34TDN33, 34TDN67, 34TDN86, 34TDN89, 34TDP71, 34TDP72, 34TEN98, 34TEP72, 34TEP74, 34TEP93, 34TEP99, 34TFN09, 34TFN35, 34TFN38, 34TFN47
S. montanum subsp. *ogliastrinum*	Sa	15	Sardinia (Mt Tonneri, Seui)	32SNK21, 32SNK31, 32SNK44, 32TNK35
S. montanum subsp. *siculum*	Si	19	Sicily (Isnello, Madonie)	33SVC10, 33SVB18, 33SVB19

continued on next page

montanum var. *latisectum* Thell. partially corresponds to *S. montanum* subsp. *garganicum*) or occur only outside our study area (e.g. Massif Central, France, *L. siler* var. *asperum* Lecoq & Lamotte, mentioned by Reduron 2007). The taxonomy of this group has been unclear and continues to attract attention from researchers. Previous attempts at discussing the taxonomy of the *S. montanum* group employed bibliographic data and analysis of herbarium specimens (Santangelo & al. 2002). Popović & al. (2013) compared compositions of the sesquiterpene lactones of *L. ochridanum* and *L. zernyi*. Maggi & al. (2017) used the variability of volatile chemical compounds to

Taxon	Area code	No. of specimens	Localities	MGRS10x10
S. montanum subsp. *stabianum*	It	109	Calascio, Camosciara, Campo di Forogna – Terminilletto, Castrovillari, Gran Sasso, La Falconara, Matese, Mt Calvelluzzo, Mt Carpesco, Mt Catria, Mt Cervati, Mt Cervialto, Mt della Selva, Mt di Spigno Saturnia, Mt di Valle Caprara, Mt Gemmo di Matelica, Mt Gennaro, Mt Mattone, Mt Montevergine, Mt Morrone, Mt Pollino, Mt Polveracchio, Mt Porrara, Mt S. Angelo a Tre Pizzi, Mt Serra della Criva, Mt Sibilla, Mt Sirino, Mt Subasio, Mt Taburno, Mt Viglio, Mts Alburni, Mts Picentini, Pennapiedimonte, Picinisco ai Treconfini, Pietre Cernaie, Prati di Tivo, Roccamorice, Val di Teve	33SWE74, 33SWE91, 33SXE00, 33TUF97, 33TUG15, 33TUG63, 33TUG66, 33TUG88, 33TUG89, 33TUG93, 33TUG99, 33TUH16, 33TUH30, 33TUH38, 33TUH55, 33TUH70, 33TUH80, 33TUH90, 33TUJ11, 33TVE59, 33TVF48, 33TVF64, 33TVF73, 33TVG00, 33TVG02, 33TVG12, 33TVG20, 33TVG23, 33TVG24, 33TVG27, 33TVG36, 33TWE28, 33TWE45, 33TWE67, 33TWE68, 33TWF01, 33TWF10, 33TWF11

highlight the biochemical importance of the taxa as well as the importance of biochemical markers to the group. The same number of chromosomes (2*n* = 22) was reported in the populations examined so far (Peev & Andreev 1978; Löve & Löve 1982; Hartvig 1986; Romano & al. 1987; Shner & Pimenov 2013).

The aim of the current work is to attempt a taxonomic revision of the *Siler montanum* group from Italy and the Balkan Peninsula using morphological characters. The results will present a foundation for further systematic and taxonomic studies in the remaining part of its range.

Material and methods

This study is based mainly on field surveys (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Italy, Montenegro, North Macedonia, Serbia/Kosovo, Slovenia), an extensive analysis of relevant literature, and a careful examination of herbarium specimens (including the original material) kept in APP, BEO, BEOU, BM, CAG, CAT, FI, NAP and W (herbarium codes follow Thiers 2021+). In order to investigate the variability and to clarify the systematics of the *Siler montanum* group, a total of 328 dried specimens were studied. To simplify the presentation of observed and predicted taxonomic patterns, the taxa are presented in the analysis as informal groups indicated by the final epithet of the accepted name (*garganicum*, *laeve* and *montanum* currently known as subspecies of *S. montanum* as well as *ochridanum* and *zernyi* currently known as species). Additionally, five presumed new taxa were also included in the analysis as informal groups: *apuanum*, *corrasianum*, *ogliastrinum*, *siculum* and *stabianum* (Table 1, Fig. 1; Appendix 1 [Supplemental content online]).

All 328 specimens were subjected to measurements of 47 morphological characters, including 31 quantitative morphometric, eight quantitative meristic, seven ratios and a single qualitative character (Table 2, Appendix 1). The decurrent part of leaflets is the length of the basal part up to the point where the lamina becomes strongly en-

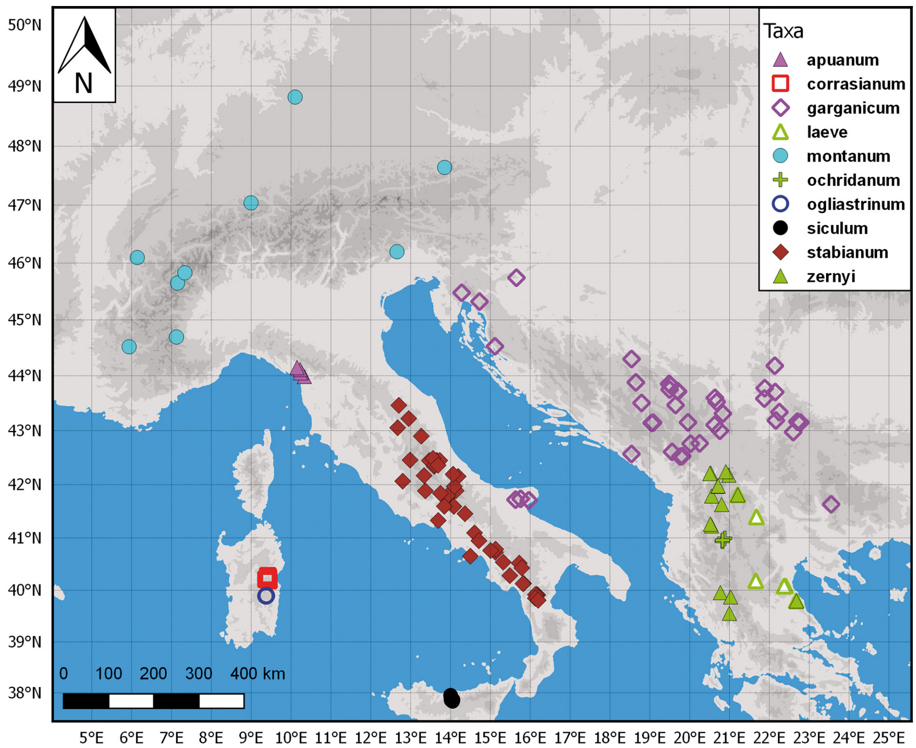

Fig. 1. The *Siler montanum* group in the C and E parts of its distribution range according to studied material (see Appendix 1 [Supplemental content online]).

larged (Fig. 2A). The asymmetric part of leaflets is the length of the basal part that is unequally wide on opposite sides of the rachis (Fig. 2B). The decurrent and asymmetric parts in the leaflets were measured where they were most evident. The flowers are usually white, rarely pink, and the leaves are green or glaucous; because these characters are not evident in herbarium specimens, we did not include them in the morphological analysis.

Fig. 2. Morphometric parameters of leaflets used for quantitative analyses. – A: decurrent part of leaflet (length); B: asymmetric part of leaflet (length).

The micromorphological analysis was carried out using a stereomicroscope on the stem, leaves, floral and fruit elements. Parameters were measured, after scanning, using ImageJ software (Rasband 1997–2016) or simply with a ruler.

For each quantitative character, Kolmogorov-Smirnov, Lillefors and Shapiro-Wilks normality tests were first used to determine their distribution. Since none of the examined morphometric characters had a normal distribution, it was necessary to perform a logarithmic transformation. Pairwise Pearson correlation analyses were also performed for quantitative characters and ratios in order to eliminate a single character from highly correlated pairs. The Pearson correlation coefficient exceeded 0.85 in eight pairs of characters and consequently eight characters were excluded from multivariate analysis: basal leaves leaflets (min. length), basal leaves leaflets (min. width), basal leaves leaflets (max. width), cauline leaves leaflets (min. length), cauline leaves leaflets (max. length), uppermost leaflet (length), angle of leaflets (max.), and rays (min. no.). A one-way analysis of variance (ANOVA) test of significant differences among the taxa was performed for each character. The test compared all possible combinations of taxa, and *post hoc* multiple comparisons Tukey HSD tests was applied to the ANOVA results and box-and-whisker plots were prepared to understand their relationships. Six characters with pure statistical significance (p) and F-test values were also eliminated from the multivariate analysis: basal leaves (max. length / width), basal leaves (max. length × width), bracts (max. no.), bracteoles (min. no.), secondary rays (max. no.), and style (length). To fully capture the ordination distance and similarity relationship of the group, 26 morphometric characters and six ratios were selected for multivariate analysis. Several multivariate approaches were used to compare all the evaluated characters and taxa including principal component analysis (PCA), canonical discriminant analysis (CDA) and cluster analysis in STATISTICA 7.0 (StatSoft 2008) package. The PCA was used to analyse matrices of characters and species to get a general overview of the variation in groups. In addition to individual scores, centroids were plotted for each taxon. A reduced character set (eight characters) was additionally used to sharpen the differences between the assumed two main groups, i.e. species (Table 2). To avoid linear clustering of scores due to weak overall variability and missing data, 98 samples from *apuanum*, *garganicum*, *montanum*, *siculum* and *stabianum* were excluded from that particular analysis. Based on pairwise multidimensional Euclidian distances of group means of PCA scores, a distance matrix was created for cluster analysis (Complete linkage). The CDA was performed with four predefined groups indicated in PCA as well as with all ten predefined groups (with reduced character set). Classificatory tests were performed and characters important to group differentiation were obtained. Depending on the correlations between the characters, the distances of group centroids were determined on the basis of square Mahalanobis distances. Matrices of these distances were used to generate clusters of taxa using the unweighted pair group method with arithmetic mean (UPGMA) and Complete linkage cluster analysis. The branching of the identification key corresponded to the structure of the phenograms. The ANOVA test for quantitative characters and ratios was applied at each identification step.

Nomenclature and typification of names within the *Siler montanum* group follow the *International Code of Nomenclature for algae, fungi, and plants* (Turland & al. 2018).

Results

In the PCA scatter plot of 328 specimens of ten known or presumed groups, represented with 26 quantitative characters and six ratios, the first three axes explain 30.88%, 12.21% and 9.66% of the total variability, respectively (Fig. 3). Although the first two axes account for only 43.09% of the total phenotypic variance, the significant drop in eigenvalues between axis one and two suggests that these axes are adequately informative in explaining a large proportion of the overall variance (especially axis one). Considering the very large data matrix, the ob-

Table 2. Analysed morphological characters used in the morphometric analyses and for assembling the identification key. Selected characters for multivariate analysis are marked with an asterisk (*); eight of them, marked with a double asterisk (**), are included in separate multivariate analyses important for distinguishing species.

	Character	Unit
*	Stem diameter (1 cm below first cauline leaf)	mm
**	Pinnate level of leaves	
*	Basal leaves (max. length)	mm
*	Basal leaves (max. width)	mm
	Basal leaves (max. length / width)	
	Basal leaves (max. length × width)	mm^2
*	Basal leaves petioles (max. length)	mm
*	First cauline leaf (length)	mm
*	First cauline leaf sheath (length)	mm
	Basal leaves leaflets (min. length)	mm
*	Basal leaves leaflets (max. length)	mm
	Basal leaves leaflets (min. width)	mm
	Basal leaves leaflets (max. width)	mm
*	Basal leaves leaflets (max. length / max. width)	
	Cauline leaves leaflets (min. length)	mm
	Cauline leaves leaflets (max. length)	mm
*	Cauline leaves leaflets (min. width)	mm
*	Cauline leaves leaflets (max. width)	mm
*	Cauline leaves leaflets (max. length / max. width)	
	Uppermost leaflet (length)	mm
*	Lateral upper leaflet (below uppermost leaflet) (length)	mm
**	Uppermost leaflet (length) / lateral upper leaflet (length)	
**	Decurrent part of leaflet (length) (Fig. 2A)	mm
**	Decurrent part (length) / leaflet (length)	
**	Asymmetric part of leaflet (length) (Fig. 2B)	mm
**	Asymmetric part (length) / leaflet (length)	
*	Angle of leaflets (mean)	°
	Angle of leaflets (max.)	°
	Leaflets margin	0 = entire, 1 = entire to slightly eroded, 2 = eroded, 3 = serrulate-denticulate
*	Leaflets petiolules (max. length)	mm
*	Bracts (min. no.)	
	Bracts (max. no.)	
**	Bracts (max. length)	mm
	Rays (min. no.)	
*	Rays (max. no.)	
*	Rays (max. length)	mm
	Bracteoles (min. no.)	
*	Bracteoles (max. no.)	
*	Bracteoles (max. length)	mm
	Secondary rays (max. no.)	
*	Secondary rays (max. length)	mm
*	Petal (length)	mm
**	Fruit (length)	mm
*	Fruit (width)	mm
*	Fruit wing (width)	mm
*	Fruit wing (width) / fruit (width)	
	Style (length)	mm

tained ordination of loading scores is appropriate in bidimensional space. Based on the significant loads of the extracted components, it can be concluded that a whole series of mainly vegetative morphometric characters mostly contributed to the first axis: stem diameter, basal leaves (max. length), basal leaves (max. width), first cauline leaf sheath (length), basal leaves leaflets (max. length), cauline leaves leaflets (max. width), and lateral upper leaflet (length). Various ratios and meristic vegetative characters were most correlated with the second axis: pinnate level of leaves, basal leaves leaflets (max. length / max. width), cauline leaves leaflets (max. length / max. width), decurrent part (length) / leaflet (length), asymmetric part (length) / leaflet (length), and angle of leaflets (mean), while reproductive characters mostly contributed to the third axis. Along the first axis, which mostly outlines the size of the vegetative organs, according to the variance of the character sets, the more robust representatives of the *zernyi* group were quite separated from the other representatives. Other representatives formed three groups along the axis: (1) *garganicum*, *laeve* and *montanum*; (2) *apuanum*, *corrasianum*, *ochridanum* and *siculum*; and (3) *ogliastrinum* and *stabianum*. Along the second axis, which mostly reflected the shape of vegetative organs, *apuanum* and *montanum* with narrow leaflets were rather separated from the rest, and at the opposite side, *laeve*, *ochridanum* and *zernyi* were slightly shifted.

Based on this plot, it can be concluded that only *Siler zernyi* subsp. *zernyi* is clearly differentiated. However, when only eight characters were selected, which were important for distinguishing between three Balkan endemic taxa (*zernyi*, *laeve* and *ochridanum*) and other representatives (Table 2), the PCA scatter plot indicated a distinct position of Balkan endemics along the first axis (Fig. 4). The first five axes explained 37.03%, 19.54%, 13.77%, 10.56% and 9.57% of the total variance, respectively. Decurrent part of leaflet (length), asymmetric part of leaflet (length) and one ratio [asymmetric part (length) / leaflet (length)] contribute the most to the first axis and reproductive characters [bracts (max. length) and fruit (length)] to the second axis. The ratio uppermost leaflet (length) / lateral upper leaflet (length) is highly correlated with the third (23%) and fourth (56%) axis. This is also the case with pinnate level of leaves in relation to the fifth axis (78%). Considering the small number of characters (eight), some of which very highly contribute to individual axes and overall variability, cluster analysis was based on Euclidian distances of PCA group means in five-dimensional space and it revealed two main clusters. The first one comprises *laeve*, *ochridanum* and *zernyi* and the second one comprises other representatives of the *S. montanum* group. Since ANOVA revealed that selected characters do not play a significant role in their separation, individual positions of *S. montanum* s.l. representatives on the tree are not informative enough and are therefore not shown.

The patterns seen on the PCA outcomes were applied to canonical analyses (Fig. 5). According to Fig. 4, *laeve*, *ochridanum* and *zernyi* were included in a single joint group. Other representatives were included in three predefined groups in accordance with the grouping along the first axis in Fig. 3 [(1) *garganicum*, *montanum*; (2) *apuanum*, *corrasianum*, *siculum*; (3) *ogliastrinum*, *stabianum*]. After backward stepwise discriminant analysis, the character traits that contributed mostly to the overall discrimination were bracts (min. no.), which also mostly contributed to the separation along the first axis, and angle of leaflets (mean). The percent of the discrimination interpreted by the first three axes were 56.67%, 33.72% and 9.6%, respectively (100% in total). CDA showed four well-separated groups (Wilks' Lambda = 0.0156, F (96.877) = 27.564, $p < 0.0000$), but more important in that respect is the clear separation of the *laeve*, *ochridanum* and *zernyi* group from the other (Fig. 5A). All specimens of this group were correctly classified and the associated three taxa also formed a separate clade on the cluster described via a matrix of square Mahalanobis centroid distances (Fig. 5B). The same separation can be observed in the cladogram in Fig. 4B, but in that case only eight morphological characters were selected, while in the CDA all 32 characters were entered into the analysis.

CDA and derived clustering based on 32 characters and 10 predefined groups (not shown) also revealed *laeve* and *zernyi* in a separate group, but *ochridanum* was associated with another cluster together with other representatives of *Siler montanum* s.l. However, when only eight important characters were selected (Table 2), *laeve*, *ochridanum* and *zernyi* form a separate group again along the first axis (Fig. 6), with two specimens of *laeve* classified as *garganicum*. In the CDA (Fig. 6A), the first three axes explained 46.42%, 21.18% and 14.7% of the overall discrimination, respectively. Backward CDA showed that the following characters mostly contributed to the overall discrimination: asymmetric part (length) / leaflet (length), fruit (length) (which also mostly contributed to the separation along the second axis), pinnate level of leaves, and decurrent part of leaflet (length) (which mostly contributed to the separation along the first axis). Similarly to Fig. 4, three taxa were clustered in a separate clade contrary to other representatives (Fig. 6B) and, since selected characters do not play a significant role in separation within a second clade, individual positions of *S. montanum* s.l. representatives are not shown.

Individual positions of *Siler montanum* s.l. representatives can be better depicted on a separate data subset, with the remaining seven taxa, based on all 32 characters (Fig. 7). CDA showed seven clearly separated groups [Wilks' Lambda = 0.000259, F (192.144) = 22.888 $p < 0.0000$] with no unclassified cases. The first three axes explained 48.29%, 26.01% and 11.5% of the overall discrimination, respectively. The characters that mostly contributed to the overall discrimination were in the following order: angle of leaflets (mean), asymmetric part (length) / leaflet (length) (which mostly contributed to the separation along the second axis), lateral upper leaflet (length), leaflets peti-

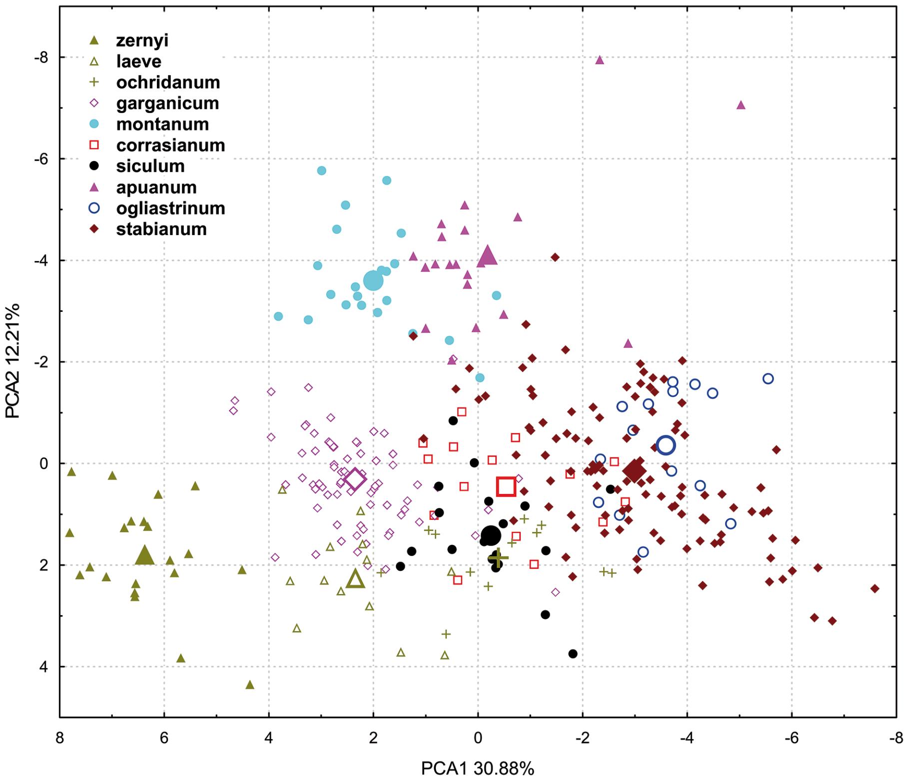

Fig. 3. Principal component analysis (PCA) scatterplot of first two axes based on 328 individuals of the *Siler montanum* group and 32 morphological characters (26 morphometric and six ratios). Group centroids are represented by enlarged markers.

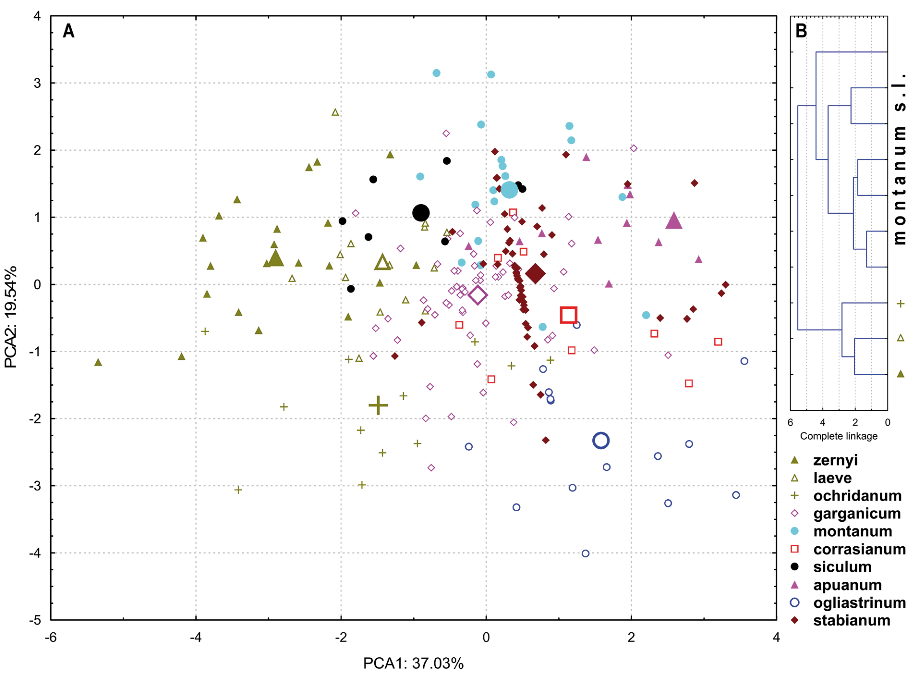

Fig. 4. Morphological differentiation among ten groups of the *Siler montanum* group. – A: principal component analysis (PCA) scatterplot of first two axes based on 230 individuals and eight morphological characters (five morphometric and three ratios). Group centroids are represented by enlarged markers. – B: cladogram based on Euclidian distances of PCA group means in five-dimensional space.

olules (max. length) and basal leaves leaflets (max. length / max. width). The three main groups were easily recognizable on the plot (Fig. 7A). Along the second axis, the group of three taxa with more acute leaflets (*apuanum*, *montanum* and *ogliastrinum*) were clearly separated. Other taxa were aggregated along the first axis: *corrasianum* and *garganicum* form a single cluster, and *siculum* and *stabianum* another. Identical distribution was revealed on the derived phenogram (Fig. 7B).

Within the first group, the scores of *apuanum* and *ogliastrinum* mostly overlapped in two-dimensional space (Fig. 7A). However, their scores along the third axis are quite separated from each other (not shown), and the particular data subset of this group showed distinct separation of the included three taxa (Fig. 8). The percent of the discrimination interpreted by the first two axes were 80.8% and 19.2%, respectively (100% in total). Unlike other groups, the most important role in overall discrimination here is played almost exclusively by reproductive characters. They are given in the following order: petal (length), fruit (length), bracts (min. no.), leaflets petiolules (max. length), fruit wing (width) and fruit wing (width) / fruit (width).

The results obtained from multivariate statistics were used in sequential ANOVA tests for every cluster and data subset that indicated separation. Based on significant diagnostic characters (Table 3), box-and-whisker plots were created, and they depicted some patterns in variability in the *Siler montanum* group and various subsets of taxa.

For example, within the studied group, it was noticeable that the more elongated leaflets are more common in *apuanum* and *montanum*. It is also obvious that representatives of the *apuanum–montanum–ogliastrinum* group (Fig. 7 and 8) have mostly acute leaflets, whereas *laeve* and *zernyi* have mostly obtuse leaflets (Fig. 9).

Significant diagnostic characters important for revealing the delimitation of the *laeve–ochridanum–zernyi* group from other taxa (Fig. 5 and 6) were: pinnate level of leaves, uppermost leaflet (length) / lateral upper leaflet (length), decurrent part of leaflet (length) and asymmetric part of leaflet (length) (Fig. 10). Representatives of that group have 2–3-pinnate leaves, with relatively long decurrent and asymmetric parts of leaves and very unequal terminal leaflets (except in *laeve*).

Within the *laeve–ochridanum–zernyi* group, the size of leaves and leaflets decreased evenly from *zernyi*, through *laeve* to *ochridanum* (Fig. 11). The taxon *ochridanum* was characterized by almost sessile and more or less acute leaflets, while *zernyi* had a distinctly robust habit with large leaves and cauline leaflets and very thick stem. Unlike the previous two taxa, *laeve* had relatively wider leaflets with a shorter decurrent part and a smaller number of bracts.

Within the *apuanum–montanum–ogliastrinum* group (Fig. 7 and 8) the size of the uppermost leaflets increased evenly from *ogliastrinum*, through *apuanum* to *montanum* (Fig. 12). On the other hand, *ogliastrinum* had a much lower number of secondary rays and very small fruits. The leaflets had very long petiolules in *montanum*, but were almost sessile in *ogliastrinum* and sessile in *apuanum*.

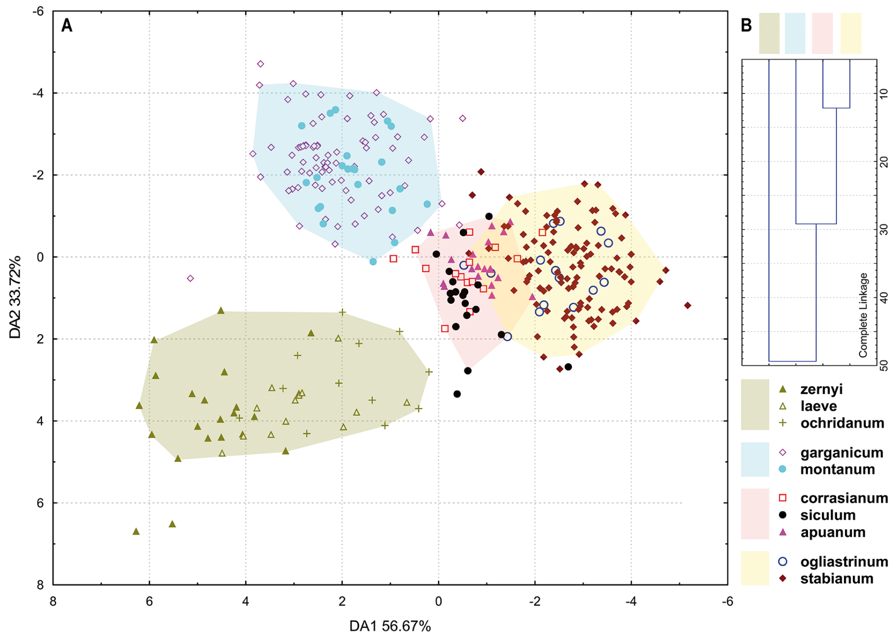

Fig. 5. Morphological differentiation among four groups of the *Siler montanum* group predefined in previous statistically analyses (PCA and clustering). – A: canonical discriminant analysis (CDA) scatterplot of first two axes based on 328 individuals and 32 morphological characters (26 morphometric and six ratios). 95% confidence polygons of groups are particularly marked. – B: cladogram based on CDA square Mahalanobis centroid distances for four predefined groups.

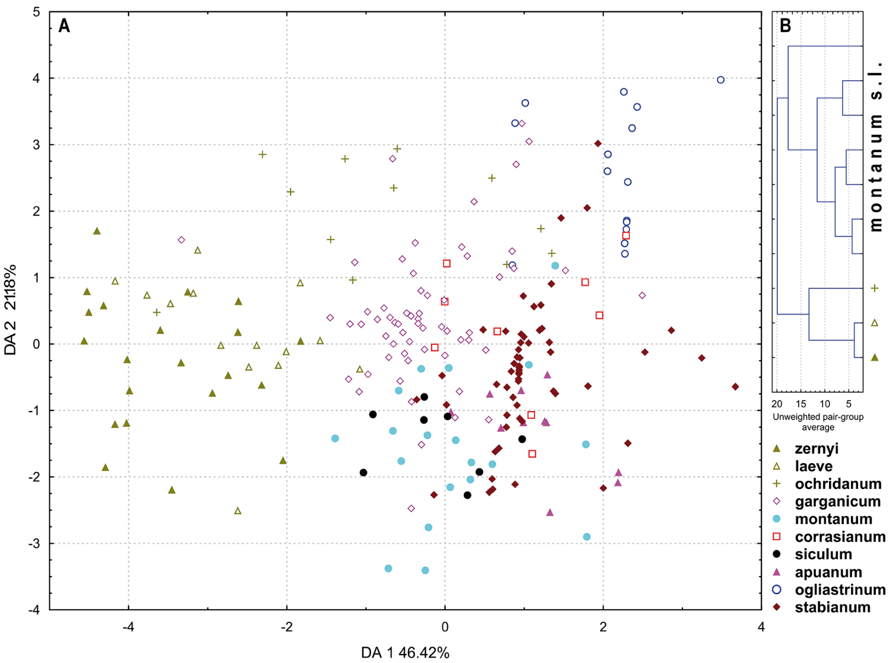

Fig. 6. Morphological differentiation among ten initially predefined groups of the *Siler montanum* group. – A: canonical discriminant analysis (CDA) scatterplot of first two axes based on 230 individuals and eight morphological characters (five morphometric and three ratios). – B: cladogram based on CDA square Mahalanobis centroid distances for ten predefined groups.

Important characters for the differentiation of *stabianum* in the *corrasianum–garganicum–siculum–stabianum* group (Fig. 7) were narrower and more acute cauline leaflets with a shorter decurrent part (Fig. 13).

Important characters for the differentiation of *corrasianum*, *garganicum* and *siculum* were: leaflets petiolules (max. length) (longest in *garganicum*, shortest in *siculum*), fruit wing (width) (widest in *siculum*), first cauline leaf (length) (longest in *garganicum*, shortest in *corrasianum*), asymmetric part (length) / leaflet (length) (highest in *siculum*, lowest in *corrasianum*) and rays (max. no.) (highest in *garganicum*) (Fig. 14).

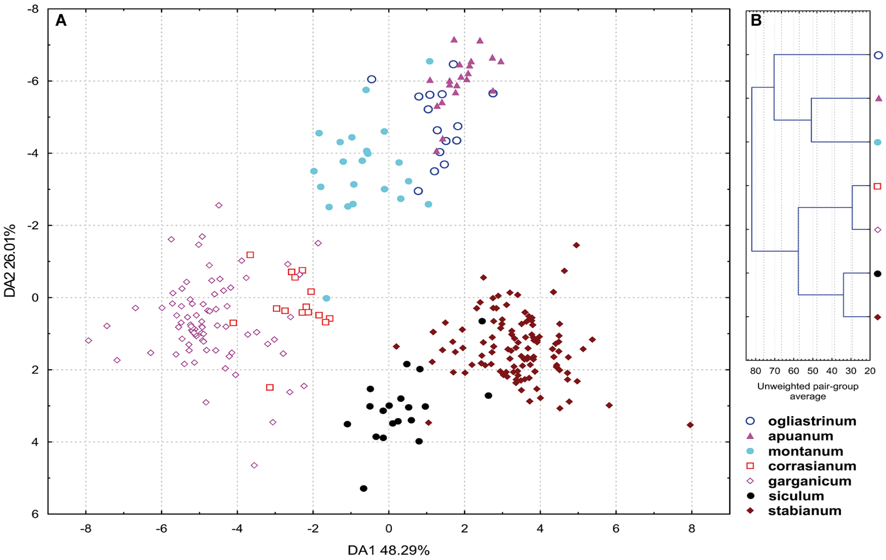

Fig. 7. Morphological differentiation among seven initially predefined groups of the *Siler montanum* group (all of them distributed in Italy, *S. montanum* subsp. *garganicum* also in the Balkan Peninsula). – A: canonical discriminant analysis (CDA) scatterplot of first two axes based on 281 individuals and 32 morphological characters (26 morphometric and six ratios). – B: cladogram based on CDA square Mahalanobis centroid distances for seven predefined groups.

According to our results, therefore, ten taxa are recognized in our taxonomic revision of the *Siler montanum* group in Italy and the Balkan Peninsula. Three of them represent new subspecies of *S. montanum* (subsp. *apuanum*, subsp. *corrasianum* and subsp. *ogliastrinum*) and the names of three taxa were transferred as new subspecific combinations under *S. montanum* (subsp. *stabianum*) and *S. zernyi* (subsp. *laeve* and subsp. *ochridanum*). We confirm the autonomy of *S. zernyi*, as a species endemic to the S Balkan Peninsula morphologically well differentiated from *S. montanum* by having lower leaves 2–3-pinnate, with larger leaflets (6–)8–12 cm long, adnate to the rachis in the upper part and decurrent on the rachis in the lower part; also by wider and undulate wings of the ripe fruit, 1–3(–4) mm wide.

Discussion

Siler montanum is a group of difficult classification, being very variable. Some of the recognized taxa are also interconnected by intermediate populations, and at the edge of their range intermediate individuals of difficult taxonomic attribution were observed. For instance, in the Balkan Peninsula, identified taxa of *S. zernyi* sometimes appear to be connected by intermediate populations (e.g. in Kozjak and Mt Ossa). Similarly, in the N Apennines, individuals with intermediate characters between *S. montanum* subsp. *montanum* and *S. montanum* subsp. *apuanum* were observed, while in the C and S Apennines there are intermediate individuals between *S. montanum* subsp. *stabianum* and *S. montanum* subsp. *apuanum* and between *S. montanum* subsp. *stabianum* and *S. montanum* subsp. *siculum*, respectively. The western, i.e. French non-Alpine and Spanish, populations generally belong to

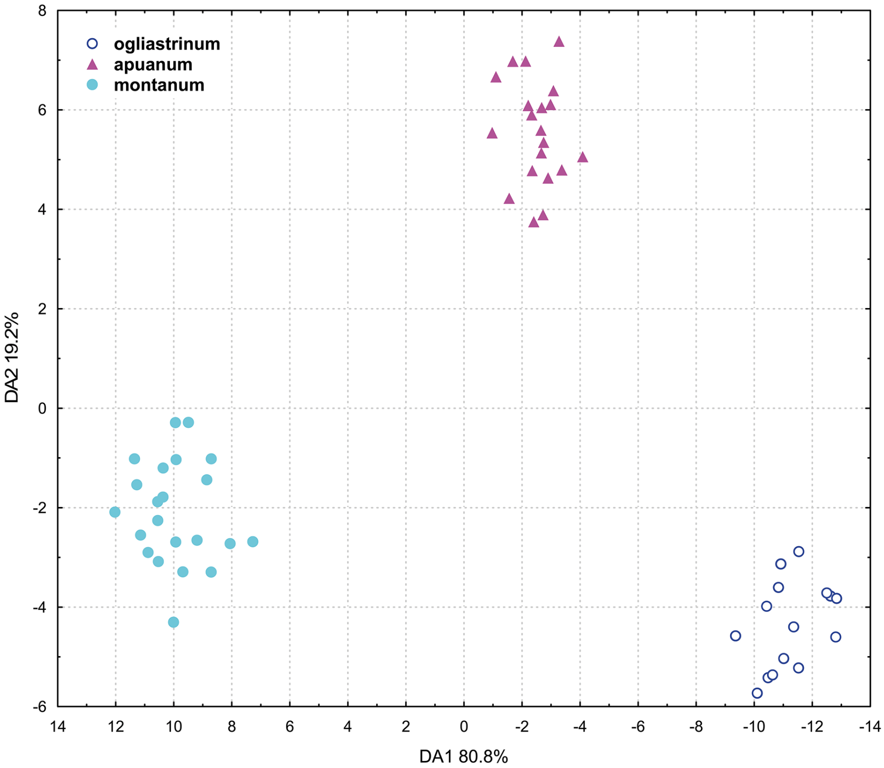

Fig. 8. Canonical scores of three initially predefined groups of the *Siler montanum* group obtained from discriminant analysis of 57 individuals and 32 morphological characters (26 morphometric and six ratios).

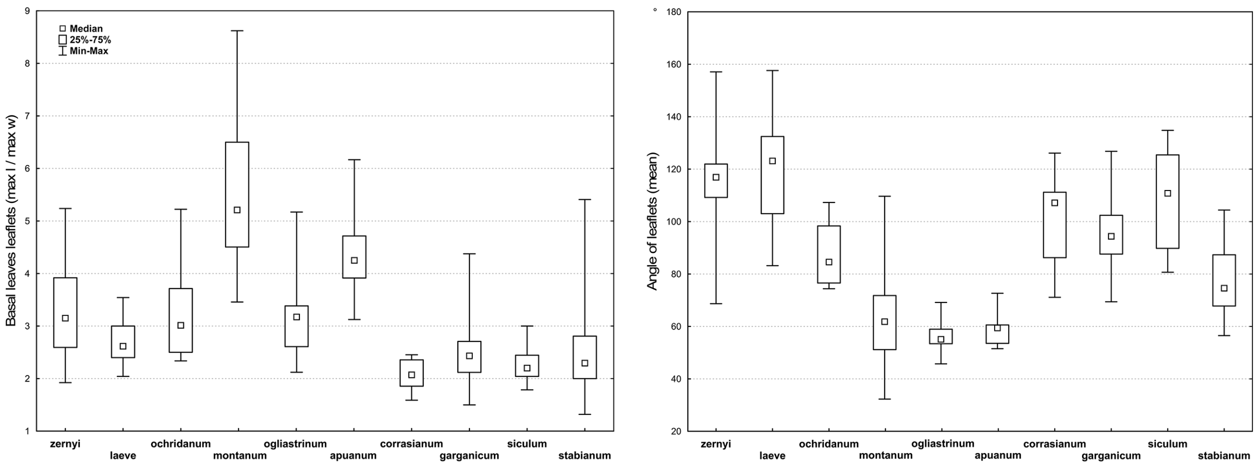

Fig. 9. Box-and-whisker plots showing variation of two selected diagnostic characters of ten groups of the *Siler montanum* group. Whiskers represent extreme values, boxes include inner two quartiles and small squares indicate median values.

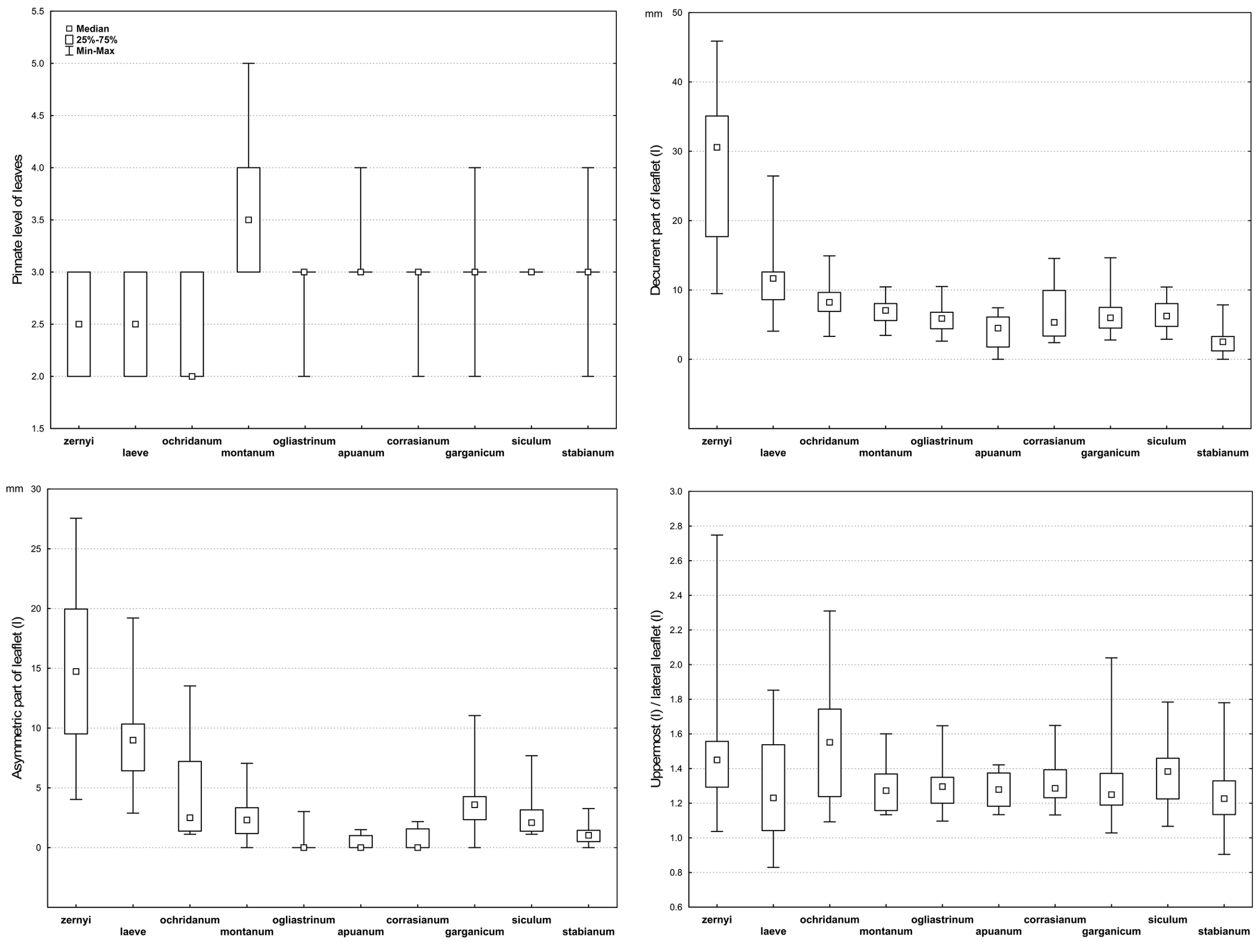

Fig. 10. Box-and-whisker plots showing variation of four selected characters of ten groups of the *Siler montanum* group. They are diagnostic for the *laeve–ochridanum–zernyi* group.

the type subspecies of *S. montanum* and they were not analysed in detail. However a marked similarity with *S. montanum* subsp. *garganicum* was observed in some of those populations. Although this subspecies was not mentioned for those areas, some of the observed plants should be related to it. Future comparative studies on the entire range of the genus should clarify the taxonomic position of the western populations.

Nevertheless, our multi- and univariate statistical analyses revealed that there are grounds for distinguishing ten taxa in Italy and the Balkan Peninsula, three of which are new to science. Based on the primary multivar-

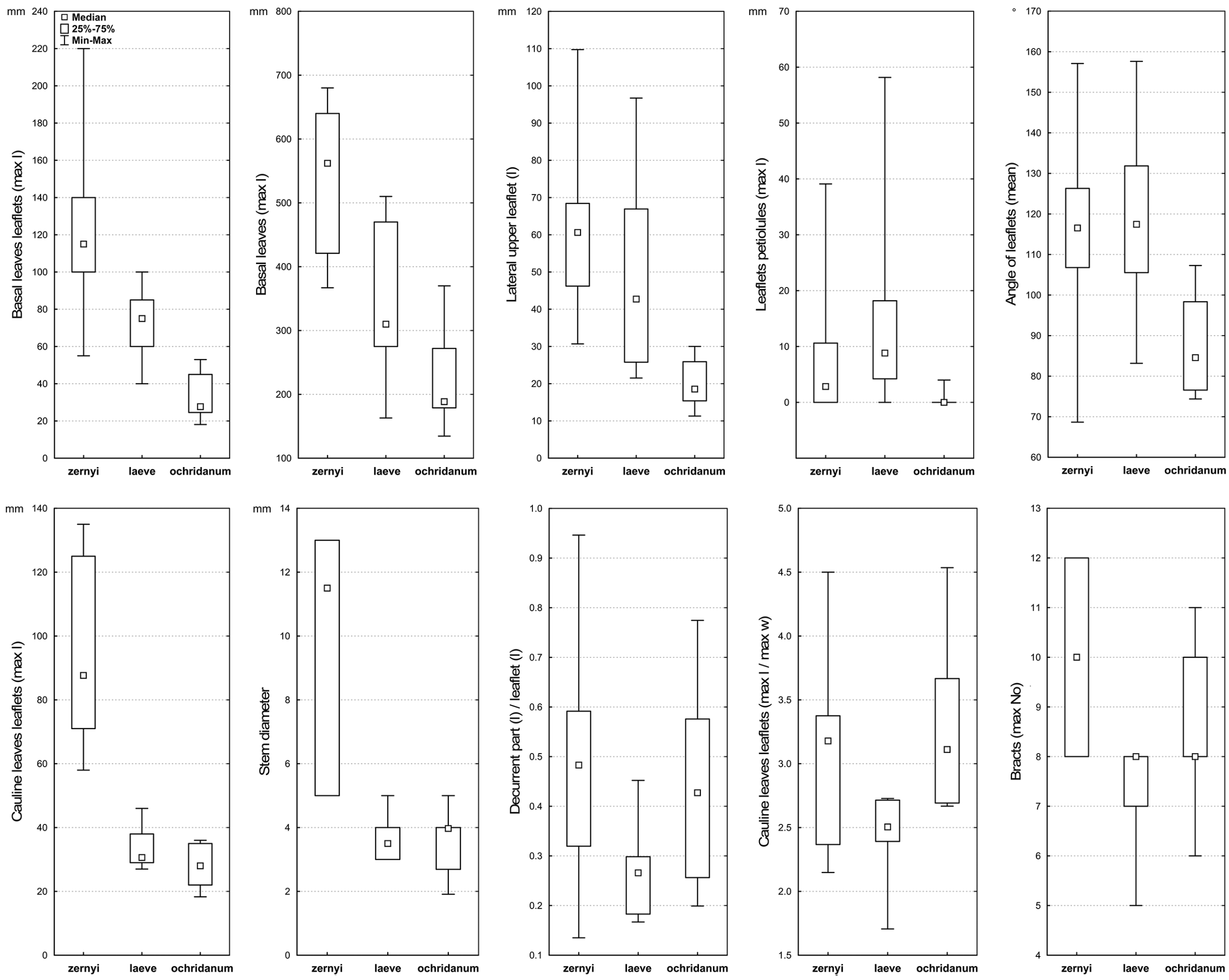

Fig. 11. Box-and-whisker plots showing variation of ten selected diagnostic characters within the *laeve–ochridanum–zernyi* group.

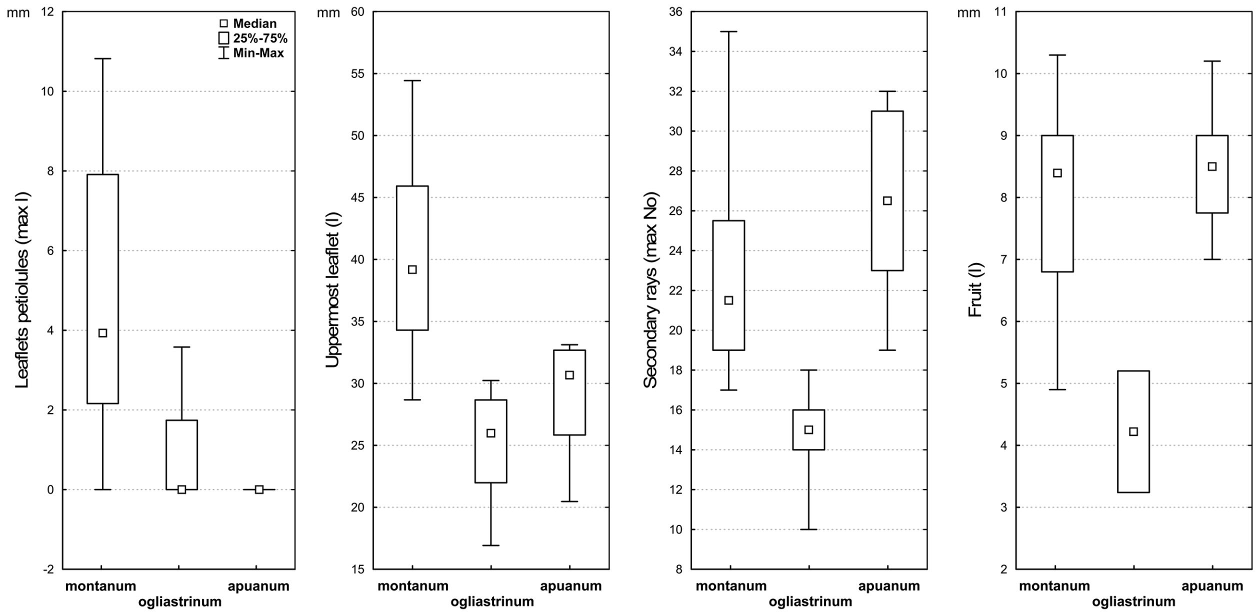

Fig. 12. Box-and-whisker plots showing variation of four selected diagnostic characters within the *apuanum–montanum–ogliastrinum* group.

Table 3. Main differences between the studied taxa. The most significant diagnostic characters are given in **boldface**. Quantitative continuous characters and ratios are reported as 25–75 percentiles (extreme values in brackets).

	Siler zernyi			*Siler montanum*						
	subsp. *zernyi*	**subsp. *laeve***	**subsp. *ochridanum***	**subsp. *montanum***	**subsp. *apuanum***	**subsp. *corrasianum***	**subsp. *garganicum***	**subsp. *ogliastrinum***	**subsp. *siculum***	**subsp. *stabianum***
Stem diameter (1 cm below first cauline leaf) (mm)	(5–)8.2–12.2 (–13)	3–4(–5)	(1.9–)2.9–4 (–5)	(4–)4.5–7 (–7.5)	(2.1–)3.5–5.9 (–7.2)	(2.4–)2.8–4.9 (–6.1)	(3.1–)4.98–6.7 (–9)	(1.7–)2–2.7 (–3.5)	(3.8–)4–4.6 (–5.1)	(1.2–)2.4–4.05 (–7.2)
Pinnate level of leaves	2–3	2–3	2–3	3–4(–5)	3(–4)	(2–)3	(2–)3(–4)	(2–)3	3	(2–)3(–4)
Basal leaves leaflets (max. length) (mm)	(55–)101–133 (–220)	(40–)63.5–82.5 (–100)	(18.1–)24.8–43 (–53)	(26.2–)32.5–48.6(–59.1)	(16–)24–33 (–43.5)	(26.3–)27.6–34.6(–40.5)	(20–)30–43.7 (–67.4)	(15.1–)26.5–33.4(–44.6)	(13.4–)18.2–22(–27)	(5.8–)12.5–22.8 (–37)
Basal leaves leaflets (max. length / max. width)	(1.9–)2.7–3.8 (–5.2)	(2–)2.4–3 (–3.5)	(2.3–)2.5–3.7 (–5.2)	(3.5–)4.5–6.5 (–8.6)	(3.1–)3.9–4.7 (–6.2)	(1.6–)1.9–2.3 (–2.4)	(1.5–)2.1–2.7 (–4.4)	(2.1–)2.6–3.4 (–5.2)	(1.8–)2.1–2.4 (–3)	(1.3–)2–2.8 (–5.4)
Cauline leaves leaflets (max. length / max. width)	(2.1–)2.5–3.3 (–4.5)	(1.7–)2.4–2.7 (–2.7)	(2.7–)2.8–3.6 (–4.5)	(3–)4.3–7.3 (–9)	(3.2–)3.5–4.5 (–5.6)	(1.6–)1.9–2.7 (–3.9)	(1.2–)1.9–2.61 (–3.6)	(2.1–)2.5–3.3 (–5)	(1.4–)1.8–2.3 (–2.4)	(1–)2–3.1 (–7.1)
Uppermost leaflet (length) / lateral upper leaflet (length)	(1–)1.3–1.5 (–2.7)	(0.8–)1–1.5 (–1.8)	(1.1–)1.3–1.7 (–2.3)	(1.1–)1.2–1.4 (–1.6)	(1.1–)1.2–1.4	(1.1–)1.2–1.4 (–1.6)	(1–)1.2–1.4 (–2)	(1.1–)1.2–1.3 (–1.6)	(1.1–)1.2–1.5 (–1.8)	(0.9–)1.1–1.3 (–1.8)
Decurrent part of leaflet (length) (mm)	(9.5–)17.9–35 (–45.9)	(4–)8.8–12.4 (–26.4)	(3.3–)7.1–9.2 (–14.9)	(3.4–)5.6–8 (–10.4)	(0–)2.6–5.9 (–7.4)	(2.4–)3.5–9.4 (–14.5)	(2.8–)4.5–7.4 (–14.6)	(2.6–)4.4–6.8 (–10.5)	(2.9–)4.8–7.8 (–10.4)	(0–)1.2–3.3 (–7.8)
Asymmetric part of leaflet (length) (mm)	(4–)9.5–19.8 (–27.5)	(2.9–)6.7–10.3 (–19.2)	(1.1–)1.5–5.5 (–13.5)	(0–)1.2–3.3 (–7)	0–0.9(–1.5)	0–1.4(–2.2)	(0–)2.4–4.3 (–11)	0(–3)	(1.1–)1.5–3 (–7.7)	(0–)0.5–1.4 (–3.3)
Angle of leaflets (mean) (°)	(68.7–)108–124.1(–157.1)	(83.2–)105.8–131(–157.6)	(74.4–)77.1–95.6(–107.3)	(32.2–)52.2–69.8(–109.7)	(51.5–)54–60.5(–72.6)	(71.1–)85.5–111.5(–126.1)	(69.4–)87.7–102.3(–126.8)	(45.7–)53.4–59(–69.1)	(80.7–)92.8–123.8(–134.8)	(56.5–)69–85.2(–104.4)

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	Siler zernyi			*Siler montanum*						
	subsp. *zernyi*	**subsp. *laeve***	**subsp. *ochridanum***	**subsp. *montanum***	**subsp. *apuanum***	**subsp. *corrasianum***	**subsp. *garganicum***	**subsp. *ogliastrinum***	**subsp. *siculum***	**subsp. *stabianum***
Leaflets margin	entire	entire to slightly eroded	entire to eroded	entire	serrulate-denticulate	eroded	entire to slightly eroded	entire	entire to eroded	serrulate-denticulate
Leaflets petiolules (max. length) (mm)	0–10.3(–39.1)	(0–)4.4–18.2 (–58.2)	0(–4)	(0–)2.2–7.9 (–10.8)	0	(0–)0.9–3.1 (–16.4)	(0–)3.6–11 (–27.5)	0–1.7(–3.6)	0–1(–2.4)	0–1(–4.55)
Bracts (max. no.)	8–12	(5–)7–8	(6–)8–9.5(–11)	8–13.2(–18)	(6–)8–9(–13)	(7–)8–9.5(–11)	(6–)8–11(–16)	(5–)7–8(–11)	(6–)7.2–9(–10)	(3–)6–9(–19)
Rays (max. no.)	(18–)25–40 (–42)	(10–)15–20 (–31)	(10–)14.5–26.2 (–31)	(23–)30–39 (–61)	(17–)25–30 (–32)	(9–)15.7–19.2 (–22)	(15–)24–41 (–76)	(9–)15–17.7 (–20)	(12–)16.2–19.7 (–29)	(4–)11–18 (–38)
Secondary rays (max. no.)	(12–)18–25 (–37)	(12–)16–20 (–24)	(12–)16–19.5 (–24)	(17–)19.5–25.25(–35)	(19–)23–31 (–32)	(10–)14.2–17.5 (–21)	(15–)19–26 (–38)	(10–)14–16 (–18)	(12–)15.5–24 (–25)	(8–)15–23 (–35)
Petal (length) (mm)	(1–)1.5–1.8 (–2)	1.5	1.4–1.5	(1.7–)2–2.2 (–2.6)	1.2–1.6(–1.8)	(1.2–)1.3–1.5 (–1.6)	1–1.7(–2)	(0.9–)1–1.1 (–1.3)	(1.3–)1.6–2	(0.7–)1.3–1.9 (–2.8)
Fruit (length) (mm)	(5–)7.7–10.6 (–14)	(6–)7–8.1 (–11)	4–7(–8)	(4.9–)6.9–9 (–10.3)	(7–)7.9–9 (–10.2)	(3.8–)7.5–8.6 (–10.2)	(2.5–)5.3–8 (–10.5)	(3.2–)3.7–4.7 (–5.2)	(4.1–)5.2–8.5 (–9)	(2.7–)5.5–8.48 (–10.1)
Fruit wing (width) (mm)	(0.3–)1–2.2 (–3)	(0.5–)0.9–1.1 (–1.7)	(0–)0.2–1 (–1.2)	0–0.6(–1.4)	(0.2–)0.5–0.7 (–1.2)	0.3–0.4 (–0.5)	0–0.5(–1)	0.4	(0.8–)1–1.3 (–1.5)	(0.1–)0.3–0.75 (–1.9)

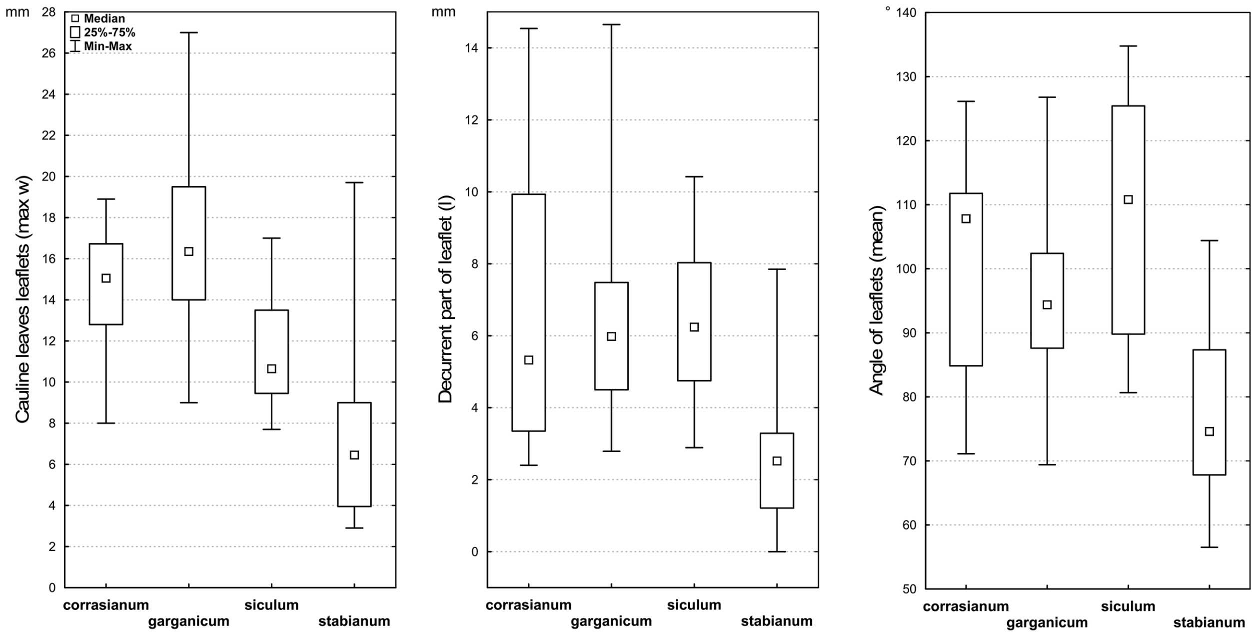

Fig. 13. Box-and-whisker plots showing variation of three selected diagnostic characters important to the differentiation of *Siler montanum* subsp. *stabianum* in the *corrasianum–garganicum–siculum–stabianum* group.

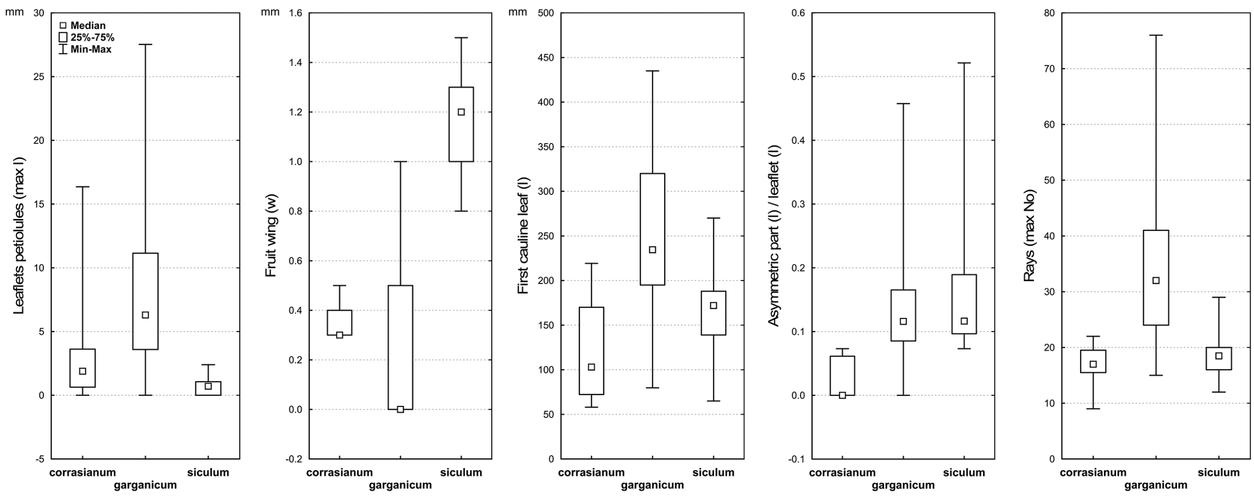

Fig. 14. Box-and-whisker plots showing variation of five selected diagnostic characters important to the differentiation of *Siler montanum* subsp. *corrasianum*, subsp. *garganicum* and subsp. *siculum*.

iate analysis (Fig. 3), it could be concluded that all these taxa are conspecific, except maybe the type, *Siler zernyi*. Because additional analyses showed the existence of two primary groups (Fig. 4–6), we concluded that it was most appropriate to treat them as separate and already known species: *S. zernyi*, which includes three subspecies (subsp. *zernyi*, subsp. *laeve* and subsp. *ochridanum*), and *S. montanum*, which includes seven subspecies (subsp. *montanum*, subsp. *apuanum*, subsp. *corrasianum*, subsp. *garganicum*, subsp. *ogliastrinum*, subsp. *siculum* and subsp. *stabianum*). *Siler zernyi* includes known Balkan endemic taxa that we propose to be treated as subspecies. Due to its robustness, the type subspecies (subsp. *zernyi*) is clearly different from *S. montanum*, while the other two subspecies share some traits with representatives of *S. montanum*: *S. zernyi* subsp. *laeve* with *S. montanum* subsp. *garganicum* and *S. zernyi* subsp. *ochridanum* with *S. montanum* subsp. *siculum*. Therefore, due to the observed convergence between these three taxa, the analysis of the entire set of common morphological data can blur the picture of the proposed classification, which is especially true for *S. zernyi* subsp. *ochridanum* (Fig. 3, PCA and not shown CDA plot). However, the common diagnostic features, primarily in terms of the "architecture" of the leaves, are quite sufficient for their connection to *S. zernyi* (Fig. 4–6), although due to their smaller size and other traits it does not seem so at first glance. It should be noted that all three subspecies of *S. zernyi* are geographically close (30–70 km apart), which could indicate their genetic similarity (which has yet to be verified). Based of the recent morphological similarity with *S. montanum* subsp. *garganicum*, we speculate that *S. zernyi* subsp. *laeve* originated in the process of parapatric (sub)speciation with *S. montanum* subsp. *garganicum*, with which it once had an introgression zone. Further diversification of *S. zernyi* subsp. *laeve* resulted in subsp. *ochridanum* and subsp. *zernyi*. There is also the possibility that subsp. *ochridanum* represents a separate hybridogenous species resulting from hybridization of *S. zernyi* and *S. montanum* subsp. *garganicum*, which requires karyological and molecular evidence. Although this taxon was originally described as a species (Micevski 1981), we prefer to classify it within *S. zernyi* for now. The presence of four taxa in the SE part of the Balkan Peninsula, as opposed to only one in the W part (*S. montanum* subsp. *garganicum*), is in line with previous studies of Balkan endemics (Stevanović & al. 2007). Higher environmental stability in S and E parts of the Balkan Peninsula throughout the Pleistocene and Holocene contributed to the survival and further divergence of several evolutionary lineages and to a richer diversity. Although there are many published records (Dimopoulos & al. 2013), it is highly disputable whether *S. montanum* subsp. *garganicum* (as the only Balkan representative of the species) is really present in the S Balkan Peninsula (North Macedonia, Greece) or actually these data refer to *S. zernyi* subsp. *laeve*. According to Micevski (2005), all North Macedonian literature data for *Laserpitium garganicum* correspond to *L. siler* var. *balcanicum*, which according to our taxonomic treatment in this paper is a synonym of *S. zernyi* subsp. *laeve*. Our observations also confirm the parapatric pattern in the distribution of *S. zernyi* and *S. montanum* subsp. *garganicum* with a natural barrier between the two species in the Drim River Basin, which separates the Dinaric and Scardo-Pindic mountains, as in the case of the vicarious *Dianthus lakusicii* (Wraber) Niketić and *D. scardicus* Wettst., *Viola elegantula* Schott and *V. latisepala* Wettst., *Veronica saturejoides* Vis. and *V. thessalica* Benth., etc.

The greatest diversity of the group was observed in Italy. A single variable species, *Siler montanum*, with seven subspecies occurred: *S. montanum* subsp. *montanum* from the Alps, with narrowly elliptic leaflets with the margin entire; subsp. *apuanum* endemic to the Apuan Alps, with narrowly elliptic leaflets with the margin serrulate-denticulate; subsp. *stabianum* endemic to the C and S Apennines, with leaflets elliptic to narrowly elliptic, ovate to obovate, smaller than subsp. *apuanum*, with the margin serrulate-denticulate and with less acute apex angles; the amphi-Adriatic subsp. *garganicum* confirmed only in Gargano (Apulia), with leaflets elliptic, ovate to obovate, with entire to slightly eroded margins; subsp. *siculum* endemic to Sicily, with leaflets elliptic, ovate to obovate, with entire to slightly eroded margins, with fruit wings wider than in subsp. *garganicum*; and the Sardinian endemics subsp. *corrasianum*, with ovate to obovate leaflets with eroded or partially eroded margins, and subsp. *ogliastrinum*, with elliptic to narrowly elliptic leaflets with entire margins. Compared to the previous taxonomic treatment, we re-evaluate *S. montanum* subsp. *stabianum*, previously regarded as a synonym of *S. montanum* subsp. *siculum* (Santangelo & al. 2002; Conti & al. 2005), and we describe three subspecies new to science: *S. montanum* subsp. *apuanum*, *S. montanum* subsp. *corrasianum* and *S. montanum* subsp. *ogliastrinum*.

Taxonomic treatment

Siler zernyi (Hayek) Thell. in Monde Pl. 26: 4. 1925 subsp. ***zernyi*** ≡ *Laserpitium zernyi* Hayek in Oesterr. Bot. Z. 70: 17. 1921 ≡ *Laserpitium siler* subsp. *zernyi* (Hayek) Tutin in Feddes Repert. 74: 31. 1967 ≡ *Siler zernyi* (Hayek) F. Conti & al. in Phytotaxa 278: 171. 2016, isonym. – Protologue citation: “In pratis subalpinis lapidosis declivum meriditionali-occidentalium montis Paštrik, ca. 15–1600 m. s.m., leg. H. Zerny”. – Lectotype (designated by Conti & al. 2016: 171): Albania, “Steinige, subalpine Wiesen am Südwestabhange des Pashtrik”, 1500–1600 m, 5 Jul 1918, *Zerny s.n.* (W 1958-0010094 [digital photo!]).

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (5–)8.25–12.25(–13) mm. Basal leaves very large, (36.7–)43.55–63(–68) × (19.5–)28–32.5(–44) cm, petiolate; petiole (8–)13.85–16.5(–18.2) cm long; lamina ovate-triangular in outline, 2–3-pinnate; lower primary and secondary leaflets decurrent for (9.5–)17.9–35(–45.9) mm, usually with conspicuous asymmetric base, asymmetry (4–)9.5–19.8(–27.5) mm long; petiolule 0–10.3(–39.1) mm long, leaflets oblong to narrowly oblong, oblong-ovate or oblong-obovate, larger ones of basal leaf (5.5–)10.1–13.3(–22) × (1.8–)3–4.5(–5.4) cm, ratio length / width larger leaflets (1.9–)2.7–3.8(–5.2), uppermost lobe (4.51–)7.02–11.09(–13.43) cm long, lateral adjacent lobe (3.07–)4.75–6.73(–10.97) cm long, ratio uppermost / lateral lobe length (1–)1.3–1.5(–2.7), leaflets ± apiculate with acute to rounded apex, median angle of apex (68.7°–)108°–124.1°(–157.1°), max. angle of apex (109.6°–)114°–141.1°(–157.1°), with a scarious entire, regular margin, main and secondary veins prominent on abaxial surface, whitish, cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 4–8 cm long). Larger leaflets of cauline leaf (5.8–)7.15–10.7(–13.5) × (1.6–)2.75–3.6(–4) cm, ratio length / width larger leaflets (2.1–)2.5–3.3(–4.5). Bracts 7–12, (8–)10.2–16(–19) mm long. Rays 12–41, (3–)4.5–6.5(–9) cm long, subequal, glabrous to papillose-hairy on inner side. Bracteoles 4–10, (4–)5.1–9(–10) mm long, with wide scarious margin and a filiform apex. Secondary rays 12–37, (2–)8–11(–17) mm long, glabrous to papillose-hairy on inner side. Petals (1–)1.5–1.8(–2) mm long. Fruits (5–)7.7–10.6(–14) × (2–)2.9–5.2(–8) mm, with lateral wings (0.3–)1–2.2(–3) mm wide; style 2–4 mm long.

Phenology — Flowering May to June; fruiting June to August.

Distribution — S part of the Balkan Peninsula: Albania, Serbia/Kosovo, North Macedonia and Greece (Hand 2011; Tomović & al. 2014; Barina & al. 2018). The species is confirmed for Greece, where it was previously doubtfully recorded from Mt Tymfi (Hartvig 1986).

Habitat — Cliffs, rocky slopes and screes in open woodland and pastures, on limestone, marble, silicate and ultramafite, at elevations of 1300–2300 m, usually in montane and subalpine zones of *Fagus sylvatica* L., *Picea abies* (L.) H. Karst. and *Pinus heldreichii* Christ.

Siler zernyi subsp. ***laeve*** (Halácsy) Niketić, F. Conti, D. Lakušić & Bartolucci, **comb. nov.** ≡ *Laserpitium garganicum* var. *laeve* Halácsy, Consp. Fl. Graec. 1: 620. 1901 ≡ *Laserpitium siler* subsp. *laeve* (Halácsy) Hartvig in Strid, Mount. Fl. Greece 1: 732. 1986. – Protologue citation: "in mt. Olympo ad Hagios Dionysios (Orph.) [cited specimens: Exsicc.: Orph. herb. n. 3721; Sint. et Bornm. it. turc. n. 1253]". – **Lectotype (designated here):** Greece, "in Monte Olimpo Thessaliae supra Hagios Dionysios", 17 Jul 1857, *Orphanides 3721* (WU 0076569 [digital photo!]).

= *Laserpitium garganicum* var. *scabrum* Halácsy, Consp. Fl. Graec. 1: 620. 1901, **syn. nov**. – Protologue citation: "Aetolia: mt. Korax (Heldr.); mt. Kiona (Reiser), mt. Parnassus (Orph.); Euboea: mt. Dirphys (Sibth.); Achaia: mt. Kyllene pr. Phlamburitza et Trikala (Heldr.)" [cited specimens: "Exsicc.: Heldr. herb. n. 1871, it. gr. septentr. a. 1879"]. – **Lectotype (designated here):** Greece, "In monte Korax Aetoliae adjectae. In regione abietina media et superiori, alt. 4500'–5500''", 23 Jul 1879, *Heldreich s.n.* (WU 0076582 [digital photo!]).

= *Laserpitium garganicum* var. *balcanicum* Stojanov in Oesterr. Bot. Z. 74: 202. 1925, **syn. nov.** ≡ *Laserpitium siler* [subsp. *garganicum*] subvar. *balcanicum* (Stojanov) Hayek in Repert. Spec. Nov. Regni Veg. Beih. 30(1): 1047. 1927. – Protologue citation: "Auf Kalkfelsen des Ali Botuš-Gebirges; 13. August 1920. In Schluchten des Kozjak['Kosek']-Gebirges (Mazedonien) unweit von Trojaci; 10. Juni 1918, Leg. T. Nikoloff". – **Lectotype (designated here):** North Macedonia, "Na zapad ot selo Trojaci po dlboki dolovi iz gori", 10 Jul 1918, *Nikoloff s.n.*, det. Stojanov (SOA 14391 [digital photo!]).

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf 3–4(–5) mm. Basal leaves large, (16.3–)27.5–47(–51) × (15.5–)18.5–27(–39) cm, petiolate; petiole (4.5–)10.3–21.5(–24.5) cm long; lamina ovate-triangular in outline, 2–3 pinnate; leaflets decurrent for (4–)8.8–12.4(–26.4) mm, with conspicuous asymmetric base, asymmetry (2.9–)6.7–10.3(–19.2) mm long; petiolule (0–)4.4–18.2(–58.2) mm long, leaflets ovate to obovate, elliptic to oblong, larger ones of basal leaf (4.06–)6.35–8.25(–10) × (1.6–)2.35–2.85(–4.9) cm, ratio length / width larger leaflets (2–)2.4–3(–3.5), uppermost lobe (2.95–)4.19–7.01(–10.01) cm long, lateral adjacent lobe (2.15–)2.89–6.66(–9.67) cm long, ratio uppermost / lateral lobe length (0.8–)1–1.5(–1.8), leaflets ± apiculate with acute to rounded apex, median angle of apex (83.2°–)105.8°–131°(–157.6°), max. angle of apex (85.7°–)121.5°–142.3°(–160.5°), with a scarious entire to slightly eroded margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 2–3.5 cm long). Larger leaflets of cauline leaf (2.7–)2.9–3.6(–4.6) × 1.1–1.6(–1.8) cm, ratio length / width larger leaflets (1.7–)2.4–2.7. Bracts 5–8, (7–)9.2–13(–20) mm long. Rays 5–31, (4.1–)5–6.5(–7.5) cm long, subequal, usually glabrous to more rarely papillose hairy on inner side. Bracteoles 4–9, (4–)5–6(–10) mm long, with wide scarious margin and a filiform apex. Secondary rays 12–24, (5–)6–9(–12) mm long, usually glabrous to more rarely papillose hairy on inner side. Petals c. 1.5 mm long. Fruits (6–)7–8.1(–11) × (3–)3.5–4.6(–5) mm, with lateral wings (0.5–)0.9–1.1(–1.7) mm wide; style 2–4 mm long.

Phenology — Flowering May to June; fruiting June to August.

Distribution — Greece (Hartvig 1986; Hand 2011). According to Hartvig (1986), it was doubtfully present in former Yugoslavia and Bulgaria. We confirm its occurrence for North Macedonia. Based on the protologue of *Laserpitium garganicum* var. *balcanicum* (Stojanov 1925), it is probably present in SW Bulgaria (Mt Slavjanka ["Ali Botuš"]), which should be checked.

Habitat — Cliffs, rocky slopes and ravines in open woodland and pastures, mainly on limestone, marble and ultramafite, at elevations of 1000–2500 m, in montane and subalpine zones of *Abies borisii-regis* Mattf., *A. cephalonica* Loudon, *Fagus sylvatica* and *Pinus heldreichii*.

Additional original material seen — North Macedonia: *Laserpitium garganicum* var. *laeve*, Iter Turcicum, 30 Jul 1891, *Sintenis & Bornmüller 1253*, det. Halácsy (WU 0076570 [digital photo!], syntype of *L. garganicum* var. *laeve*). — Greece: Kiona, 2512 m, 15 Jul 1894, *Reiser s.n.* (WU 0076580 [digital photo!], syntype of *L. garganicum* var. *scabrum*); In faucibus m. Kyllenes Achaiae, Jul 1871, *Heldreich s.n.* (WU 0076581 [digital photo!], syntype for the name *L. garganicum* var. *scabrum*).

Siler zernyi subsp. ***ochridanum*** (Micevski) Niketić, F. Conti, D. Lakušić & Bartolucci, **comb. & stat. nov.** ≡ *Laserpitium ochridanum* Micevski in Godišen Zborn. Biol. Fak. Univ. Kiril i Metodij 34: 26. 1981. – Holotype:

North Macedonia, M. Galičica, Stara Galičica, in saxosis calcareis, 2010 m, 16 Jul 1968, *Micevski s.n.* (SKO [digital photo!]).

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (1.9–)2.9–4(–5) mm. Basal leaves large (13.46–)17.89–27.2(–37) × (9.15–)12.62–17.75(–26.5) cm, petiolate; petiole (4.3–)4.86–10.5(–12.5) cm long; lamina ovate-triangular in outline, 2–3 pinnate; leaflets decurrent for (3.3–)7.1–9.2(–14.9) mm, with asymmetric base, asymmetry (1.1–)1.5–5.5(–13.5) mm long; petiolule 0(–4) mm long, leaflets elliptic, oblong ovate to obovate, larger ones (1.81–)2.48–4.3(–5.3) × (0.68–)0.7–1.14(–1.8) cm, ratio length / width larger leaflets (2.3–)2.5–3.7(–5.2), uppermost lobe (1.97–)2.27–3.87(–4.69) cm long, lateral adjacent lobe (1.13–)1.56–2.43(–3) cm, ratio uppermost / lateral lobe length (1.1–)1.3–1.7(–2.3), leaflets ± apiculate with acute to rounded apex, median angle of apex (74.4°–)77.1°–95.6°(–107.3°), max. angle of apex (76.4°–)92.4°–124.1°(–143°), with a scarious entire to eroded margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 1.7–4.5 cm long). Larger leaflets of cauline leaf (1.83–)2.32–3.25(–3.6) × (0.54–)0.64–1(–1.3) cm, ratio length / width larger leaflets (2.7–)2.8–3.6(–4.5). Bracts 6–11, (5.9–)7–9(–12) mm long. Rays 9–31, (2.61–)3.65–4.61(–5.67) cm long, subequal, scabrid all around or on inner side. Bracteoles 5–8, (2.7–)4.8–6 mm long, with wide scarious margin and a filiform apex. Secondary rays 12–24, (4–)6–7(–9.6) mm long, scabrid all around or on inner side. Petals 1.4–1.5 mm long. Fruits 4–7(–8) × (1–)1.5–3.6(–4.3) mm, with lateral wings (0–)0.2–1(–1.2) mm wide; style 2–3 mm long.

Phenology — Flowering June to July; fruiting July to August.

Distribution — North Macedonia in Mt Galičica (Micevski 1981); Albania in Prespa National Park (Shuka & Tan 2013).

Habitat — Rocky slopes on limestone, at elevations of 1600–2000 m.

Siler montanum Crantz, Stirp. Austr. Fasc. 3: 60. 1767 subsp. ***montanum*** ≡ *Laserpitium siler* L., Sp. Pl. 1: 249. 1753 ≡ *Laserpitium montanum* Lam., Fl. Franç. 3: 415. 1779 ≡ *Laser siler* (L.) Druce in Rep. Bot. Soc. Exch. Club Brit. Isles 7: 835. 1926. – Protologue citation: "Austria, Helvetia, Gallia". – Lectotype (designated by Reduron & Jarvis in Jarvis & al. 2006: 213): Herb. Clifford: 96, *Laserpitium* 3 (BM 000558289 [digital photo!]).

= *Siler lancifolium* Moench, Methodus: 85. 1794. – Protologue citation: none. – Type: not traced.

= *Laserpitium lineatum* Tausch in Flora 14: 668. 1831. – Protologue citation: "von Hrn. Sieber, und ist wahrscheinlich in Oesterreich gesammelt". – Type: not traced.

Description — Plant perennial, glabrous, rarely with scabrous or ciliate leaves. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (4–)4.5–7(–7.5) mm. Basal leaves (14.5–)27.82–44.05(–54.5) × (8.4–)16.32–25.8(–37) cm, petiolate; petiole (3.25–)5.55–10.85(–17) cm long; lamina ovate-triangular in outline, 3–4(–5) pinnate; leaflets decurrent for (3.4–)5.6–8(–10.4) mm, usually with asymmetric base, asymmetry (0–)1.2–3.3(–7) mm long; petiolule (0–)2.2–7.9(–10.8) mm long, leaflets narrowly elliptic, larger ones of basal leaf (2.62–)3.25–4.86(–5.91) × (0.48–)0.58–0.94(–1.27) cm, ratio length / width larger leaflets (3.5–)4.5–6.5(–8.6), uppermost lobe (2.87–)3.43–4.59(–5.44) cm long, lateral adjacent lobe (2.14–)2.79–3.26(–4.75) cm long, ratio uppermost / lateral lobe length (1.13–)1.16–1.37(–1.6), leaflets ± apiculate with acute to rounded apex, median angle of apex (32.3°–)52.2°–69.8°(–109.7°), max. angle of apex (37.2°–)70°–86.3°(–124.8°), with a scarious entire, regular margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 2.5–9.2 cm long). Larger leaflets of cauline leaf (2.39–)3.41–4.26(–5.6) × (0.41–)0.52–0.92(–1.16) cm, ratio length / width larger leaflets (3–)4.3–7.3(–9). Bracts 7–18, (5.5–)9.8–15.6(–42.8) mm long. Rays 21–61, (4.21–)4.94–7.57(–12) cm long, subequal, glabrous to usually papillose-hairy on inner side. Bracteoles 7–11, (3.6–)5.4–7.1(–8.5) mm long, with wide scarious margin and a filiform apex. Secondary rays 17–35, (6–)8.1–10(–11.6) mm long, glabrous to usually papillose-hairy on inner side. Petals (1.7–)2–2.2(–2.6) mm long. Fruits (4.9–)6.9–9(–10.3) × (1.9–)2.6–3.8(–4.3) mm, with lateral wings 0–0.6(–1.4) mm wide; style 2–3 mm long.

Phenology — Flowering June to July; fruiting July to August.

Distribution — Alps, SW and C Europe (Spain, France, Italy, Switzerland, Austria and Germany); also recorded from Latvia (Kuusk & al. 1996; Hand 2011).

Habitat — Rocky slopes, screes, open woodland, mainly on limestone in montane and even in supramediterranean and subalpine belt up to 2500 m. Rarely on granites and schists. For more detailed phytosociological information see Reduron (2007).

Siler montanum subsp. ***apuanum*** F. Conti & Bartolucci, **subsp. nov.**

Holotype: Italy, Toscana, Garfagnana, Alpi Apuane, presso lo sbocco del rio Levigliese, lungo la Turrite di Gallicano, Fabbriche di Vergemoli (Lucca), pendii rupestri, 340 m, 29 Jun 2016, *F. Conti & F. Bartolucci s.n.* (APP no. 63425! [Fig. 15]).

Diagnosis — Similar to subsp. *stabianum* in having leaflets with scarious, serrulate-denticulate margin, vs scarious, entire margin in subsp. *montanum* and subsp. *ogliastrinum*, and entire to eroded margin in subsp. *corrasianum*, subsp. *garganicum* and subsp. *siculum*. Ratio of larger leaflets of basal leaves (3.1–)3.9–4.7(–6.2), similar to subsp. *montanum* [(3.5–)4.5–6.5(–8.6)] and subsp. *ogliastrinum* [(2.1–)2.6–3.4(–5.2)], vs lower values in subsp. *corrasianum* [(1.6–)1.9–2.3(–2.4)], subsp. *garganicum* [(1.5–)2.1–2.7(–4.4)], subsp. *siculum* [(1.8–)2.1–2.4(–3)] and subsp. *stabianum* [(1.3–)2–2.8(–5.4)]. Leaflets sessile, vs petiolule (0–)0.9–3.1(–16.4) mm long in subsp. *corrasianum* and 0–27 mm long in the other taxa. Maximum number of rays (17–)25–30(–32), similar to subsp. *garganicum* [(15–)24–41(–76)] and subsp. *montanum* [(23–)30–39(–61)], vs lower numbers in subsp. *corrasianum* [(9–)15.7–19.2(–22)], subsp. *ogliastrinum* [(9–)15–17.7(–20)], subsp. *siculum* [(12–)16.2–19.7(–29)] and subsp. *stabianum* [(4–)11–18(–38)]. Fruit (7–)7.9–9(–10.2) mm long, similar to subsp. *montanum* [(4.9–)6.9–9(–10.3) mm long], vs shorter in subsp. *corrasianum* [(3.8–)7.5–8.6(–10.2) mm long], subsp. *garganicum* [(2.5–)5.3–8(–10.5) mm long], subsp. *ogliastrinum* [(3.2–)3.7–4.7(–5.2) mm long], subsp. *siculum* [(4.1–)5.2–8.5(–9) mm long] and subsp. *stabianum* [(2.7–)5.5–8.5(–10.1) mm long].

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (2.1–)3.5–5.9(–7.2) mm. Basal leaves large (20.32–)29–43(–59.3) × (9.75–)11.75–17.75(–25) cm, petiolate; petiole (1–)5.62–9.5(–12) cm long; lamina ovate-triangular in outline, 3(–4) pinnate; leaflets decurrent for (0–)2.6–5.9(–7.4) mm, sometimes with asymmetric base, asymmetry 0–0.9(–1.5) mm long; petiolule 0 mm long, leaflets narrowly elliptic, larger ones (1.6–)2.4–3.3(–4.3) × (0.3–)0.5–0.8(–1) cm, ratio length / width larger leaflets (3.1–)3.9–4.7(–6.2), uppermost lobe (2.05–)2.68–3.26(–3.31) cm long, lateral adjacent lobe (1.62–)2.11–2.47(–2.74) cm long, ratio uppermost / lateral lobe length (1.1–)1.2–1.4, leaflets ± apiculate with acute apex, median angle of apex (51.5°–)54°–60.5°(–72.6°), max. angle of apex (51.5°–)61.2°–73°(–78.7°), with a scarious serrulate-denticulate margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 1.6–5.72 cm long). Larger leaflets of cauline leaf (1.45–)2.77–3.33(–3.8) × (0.39–)0.65–0.85(–0.96) cm, ratio length / width larger leaflets (3.2–)3.5–4.5(–5.6). Bracts 6–13, (7.9–)9.7–14.3(–20) mm long. Rays 17–32, (5–)5.88–7.55(–8.2) cm long, subequal, papillose hairy on inner side. Bracteoles 5–11, (3.8–)6–7(–9.1) mm long, with wide scarious margin and a filiform apex. Secondary rays 19–32, (5.5–)9.7–12(–14) mm long, papillose hairy on inner side. Petals 1.2–1.6(–1.8) mm long. Fruits (7–)7.9–9(–10.2) × (2.3–)3–3.6(–4.8) mm, with lateral wings (0.2–)0.5–0.7(–1.2) mm wide; style 1.8–3.1 mm long.

Etymology — The specific epithet refers to the Apuan Alps.

Phenology — Flowering May to June (to July); fruiting June to August.

Distribution — Endemic to the Apuan Alps (Tuscany, Italy). In the N Apennines, individuals with characters intermediate between *S. montanum* subsp. *montanum* and *S. montanum* subsp. *apuanum* were observed.

Habitat — Rocky slopes, screes, open woodland, mainly on limestone.

Siler montanum subsp. ***corrasianum*** Bacch., Congiu, F. Conti & Bartolucci, **subsp. nov.**
Holotype: Italy, Sardinia, Su Thuttureli, Pradu, Oliena (Nuoro), 19 Jul 2007, *G. Bacchetta, A. Congiu, G. Fenu, F. Gorian & E. Mattana 87/07* (CAG! [Fig. 16]).

= *Laserpitium siler* var. *ovalifolium* Moris, Fl. Sardoa 2: 252. 1840–1843. – Protologue citation: "In rupestribus praeruptisque montis Oliena, loco dicto Orto camino. Fl. junio". – **Lectotype (designated here):** Italy, Sardinia, "in calcareis rupestribus montis Oliena loco dicto orto camino", Jun 1840, *Moris s.n.* (TO in Herb. Moris 618 [digital photo!]).

Diagnosis — Leaflets with entire to eroded margin, similar to subsp. *garganicum* and subsp. *siculum*, vs entire margin in subsp. *montanum* and subsp. *ogliastrinum*, and serrulate-denticulate margin in subsp. *apuanum* and subsp. *stabianum*. Ratio of larger leaflets of basal leaves (1.6–)1.9–2.3(–2.4), similar to subsp. *garganicum* [(1.5–)2.1–2.7(–4.4)], subsp. *siculum* [(1.8–)2.1–2.4(–3)] and subsp. *stabianum* [(1.3–)2–2.8(–5.4)], vs higher values in subsp. *apuanum* [(3.1–)3.9–4.7(–6.2)], subsp. *montanum* [(3.5–)4.5–6.5(–8.6)] and subsp. *ogliastrinum* [(2.1–)2.6–3.4(–5.2)]. Maximum number of rays (9–)16–19(–22), similar to subsp. *ogliastrinum* [(9–)15–17.7(–20)], subsp. *siculum* [(12–)16.2–19.7(–29)] and subsp. *stabianum* [(4–)11–18(–38)], vs higher numbers in subsp. *apuanum* [(17–)25–30(–32)], subsp. *garganicum* [(15–)24–41(–76)] and subsp. *montanum* [(23–)30–39(–61)]. Fruit (3.8–)7.5–8.6(–10.2) mm long, similar to subsp. *garganicum* [(2.5–)5.3–8(–10.5) mm long], subsp. *ogliastrinum* [(3.2–)3.7–4.7(–5.2) mm long], subsp. *siculum* [(4.1–)5.2–8.5(–9) mm long] and subsp. *stabianum* [(2.7–)5.5–8.5(–10.1) mm long], vs longer in subsp. *apuanum* [(7–)7.9–9(–10.2) mm long] and subsp. *montanum* [(4.9–)6.9–9(–10.3) mm long].

Fig. 15. Holotype of *Siler montanum* subsp. *apuanum* (APP no. 63425).

Fig. 16. Holotype of *Siler montanum* subsp. *corrasianum* (CAG).

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (2.4–)2.8–4.9(–6.1) mm. Basal leaves large (16.41–)18.2–25.13(–30.07) × (9.2–)11.7–18.81(–22.4) mm, petiolate; petiole (1.13–)2.85–9.61(–10.51) mm long; lamina ovate-triangular in outline, (2–)3 pinnate; leaflets longest petiolule (0–)0.9–3.1(–16.4) mm long; lamina decurrent for (2.4–)3.5–9.4(–14.5) mm; sometimes with asymmetric base, asymmetry 0–1.4(–2.2) mm long; lobes ovate to obovate, larger ones (2.63–)2.76–3.46(–4.05) × (1.08–)1.45–1.69(–1.84) cm, ratio length / width larger leaflets (1.6–)1.9–2.3(–2.4), uppermost lobe (2.34–)2.69–3.41(–4.08) cm long, lateral adjacent lobe (1.67–)2.09–2.52(–2.98) cm long, ratio uppermost / lateral lobe length (1.1–)1.2–1.4(–1.6), apiculate to mucronate with acute apex, median angle of apex (71.1°–)85.5°–111.5°(–126.1°), max. angle of apex (74.9°–)108.4°–125.8°(–155.9°), with a scarious eroded, partially eroded to entire margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 20–60 mm long). Larger leaflets of cauline leaf (2.35–)2.93–3.47(–6.19) × (0.8–)1.34–1.67(–1.89) cm, ratio length / width larger leaflets (1.6–)1.9–2.7(–3.9). Bracts (7–)8–9.5(–11), (7.9–)8.7–13.1(–18.1) mm long. Rays 9–22, (2.27–)3.26–5.64(–7.01) cm long, subequal, glabrous to papillose hairy on inner side. Bracteoles 4–10, (3.2–)3.7–7(–9.8) mm long, with wide scarious margin and a filiform apex. Secondary rays 10–21, (3.8–)4.8–8.4(–10.8) mm long, papillose hairy on inner side. Petals (1.2–)1.3–1.5(–1.6) mm long. Fruits (3.8–)7.5–8.6(–10.2) × (1.3–)3–3.6(–3.9) mm, with lateral wings 0.3–0.4(–0.5) mm wide; style 1.8–3.6 mm long.

Etymology — The specific epithet refers to Mt Corrasi (1463 m), the highest peak of the calcareous Supramonte mountain range of central E Sardinia.

Phenology — Flowering June to July; fruiting July to August.

Distribution — This endemic species is restricted to the upper part of Supramonte di Oliena, where it is found in particular on Mt Corrasi. Arrigoni (2013) reported *Laserpitium siler* subsp. *garganicum* also for Mt Albo and Tavolara. We were not able to trace any herbarium specimen or other literature records from these localities, and specific field researches have not been successful.

Habitat — *Siler montanum* subsp. *corrasianum* is a chasmophyte growing on Mesozoic dolomitic limestones, at an elevation of 1270–1450 m. It favours cliffs, colonizing the shady crevices. The species is a member of a rupestral plant community rich in Sardinian and Cyrno-Sardinian endemics, such as *Aquilegia cremnophila* Bacch. & al., *Armeria morisii* Boiss., *Campanula forsythii* (Arcang.) Bég. and *Hieracium hypochoeroides* subsp. *supramontanum* (Arrigoni) Greuter.

Siler montanum subsp. ***garganicum*** (Ten.) Iamonico & al. in Phytotaxa 268: 89. 2016 ≡ *Ligusticum garganicum* Ten., Fl. Napol. 1(2): XIX. 1811 ≡ *Laserpitium garganicum* (Ten.) Bertol., Fl. Ital. 3(4): 399. 1838 ≡ *Laserpitium siler* subsp. *garganicum* (Ten.) Arcang., Comp. Fl. Ital.: 302. 1882 ≡ *Siler garganicum* (Ten.) Thell. in Monde Pl. 26(153): 4. 1925. – Protologue citation: none. – **Lectotype (designated here):** *Ligusticum garganicum*, Gargano, s.d., *Tenore s.n.* (NAP [digital photo!]).

Notes — In the protologue, Tenore (1811) did not quote any collection locality but cited the illustration "tav. 39. fig. 1" in Catalogus plantarum Horti Pisani (Tilli 1723), which can be considered part of the original material and useful for the purpose of lectotypification (Turland & al. 2018: Art. 9.4(a)). Furthermore, we were able to trace one specimen in NAP ("*Ligusticum garganicum* / Gargano"), in which Tenore's herbarium is preserved. This specimen, probably collected by Tenore, as stated in a second label by Grande on the sheet, can also be considered original material under Art. 9.4(a) and is accordingly selected as the lectotype.

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (3.1–)5–6.7(–9) mm. Basal leaves large (19.9–)31.2–43.75(–66) × (10.6–)19.5–26(–31.6) cm, petiolate; petiole (3–)6.5–13.22(–31.5) cm long; lamina ovate-triangular in outline, (2–)3(–4) pinnate; leaflets decurrent for (2.8–)4.5–7.4(–14.6) mm, usually with asymmetric base, asymmetry (0–)2.4–4.3(–11) mm long; petiolule (0–)3.6–11(–27.5) mm long, leaflets elliptic, ovate to obovate, larger ones (2–)3–4.37(–6.74) × (0.6–)1.31–1.87(–3) cm, ratio length / width larger leaflets (1.5–)2.1–2.7(–4.4), uppermost lobe (1.82–)2.92–4.24(–6.5) cm long, lateral adjacent lobe (0.89–)2.25–3.25(–5.67) cm long, ratio uppermost / lateral lobe length (1–)1.2–1.4(–2), leaflets ± apiculate with acute to rounded apex, median angle of apex (69.4°–)87.7°–102.3°(–126.8°), max. angle of apex (74.4°–)102.9°–121.2°(–159.1°), with a scarious entire to slightly eroded margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 2–10 cm long). Larger leaflets of cauline leaf (2.2–)2.99–4.08(–6.5) × (0.9–)1.4–1.92(–2.7) cm, ratio length / width larger leaflets (1.2–)1.9–2.6(–3.6). Rays 11–76, (2.3–)4.62–7.5(–11) cm long, subequal, glabrous to papillose hairy on inner side. Bracteoles 5–12, (3–)4–6(–8) mm long, with wide scarious margin and a filiform apex. Secondary rays 15–38, (4–)6.4–10(–14) mm long, glabrous to papillose hairy on inner side. Petals 1–1.7(–2) mm long. Fruits

(2.5–)5.3–8(–10.5) × (1–)2–3.2(–4.5) mm, with lateral wings 0–0.5(–1) mm wide; style 0.5–3.1 mm long.

Phenology — Flowering April to June (to July); fruiting June to August.

Distribution — C and S Italy (Apulia, not confirmed in Abruzzo), Balkan Peninsula (Slovenia, Croatia, Bosnia and Herzegovina, Albania, Montenegro, Serbia/Kosovo, Bulgaria). Records for Greece and North Macedonia (Hartvig 1986; Micevski 2005) refer to *Siler zernyi* subsp. *laeve*.

Habitat — Rocky slopes, cliffs, screes, open woodland, on limestone and ultramafite, at elevations of 200–2300 m, from hills to subalpine areas.

Siler montanum subsp. ***ogliastrinum*** Bacch., F. Conti & Bartolucci, **subsp. nov.**
Holotype: Italy, Sardinia. Punta Margiani Pubusa, Seui (Sud Sardegna), 9 Jun 2001, *G. Bacchetta, S. Brullo, M. Casti, P. Català & G. Giusso 184/01* (CAG! [Fig. 17]).

Diagnosis — Leaflets with entire margin, similar to subsp. *montanum*, vs entire to eroded margin in subsp. *corrasianum*, subsp. *garganicum* and subsp. *siculum*, vs serrulate-denticulate margin in subsp. *apuanum* and subsp. *stabianum*. Ratio of larger leaflets of basal leaves (2.1–)2.6–3.4(–5.2), similar to subsp. *apuanum* [(3.1–)3.9–4.7(–6.2)] and subsp. *montanum* [(3.5–)4.5–6.5(–8.6)], vs lower values in subsp. *corrasianum* [(1.6–)1.9–2.3(–2.4)], subsp. *garganicum* [(1.5–)2.1–2.7(–4.4)], subsp. *siculum* [(1.8–)2.1–2.4(–3)] and subsp. *stabianum* [(1.3–)2–2.8(–5.4)]. Maximum number of rays (9–)15–18(–20), similar to subsp. *corrasianum* [(9–)16–19(–22)], subsp. *siculum* [(12–)16–20(–29)] and subsp. *stabianum* [(4–)11–18(–38)], vs higher numbers in subsp. *apuanum* [(17–)25–30(–32)], subsp. *garganicum* [(15–)24–41(–76)] and subsp. *montanum* [(23–)30–39(–61)]. Fruit (3.2–)3.7–4.7(–5.2) mm long, similar to subsp. *corrasianum* [(3.8–)7.5–8.6(–10.2) mm long], subsp. *garganicum* [(2.5–)5.3–8(–10.5) mm long], subsp. *siculum* [(4.1–)5.2–8.5(–9) mm long] and subsp. *stabianum* [(2.7–)5.5–8.5(–10.1) mm long], vs longer in subsp. *apuanum* [(7–)7.9–9(–10.2) mm long] and subsp. *montanum* [(4.9–)6.9–9(–10.3) mm long].

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (1.7–)2–2.7(–3.5) mm. Basal leaves large, (12.04–)15.92–21.79(–24.49) × (3.82–)8.37–12.5(–26.8) cm, petiolate; petiole (1.23–)2.11–3.94(–5.42) cm long; lamina ovate-triangular in outline, (2–)3 pinnate; leaflets decurrent for (2.6–)4.4–6.8(–10.5) mm, with asymmetric base, asymmetry 0(–3) mm long; petiolule 0–1.7(–3.6) mm long, lobes elliptic to narrowly elliptic, larger ones (1.51–)2.65–3.34(–4.46) × (0.59–)0.85–1.15(–1.71) cm long, ratio length / width larger leaflets (2.1–)2.6–3.4(–5.2), uppermost lobe (1.69–)2.2–2.87(–3.02) cm, lateral adjacent lobe (1.25–)1.74–2.16(–2.29) cm, ratio uppermost / lateral lobe length (1.1–)1.2–1.3(–1.6), leaflets ± apiculate with acute to rarely rounded apex, median angle of apex (45.7°–)53.4°–59°(–69.1°), max. angle of apex (45.7°–)64.6°–78°(–91.2°), with a scarious entire margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 1–6 cm long). Larger leaflets of cauline leaf (2.12–)2.56–3.22(–3.88) × (0.67–)0.71–1.13(–1.42) cm, ratio length / width larger leaflets (2.1–)2.5–3.3(–5). Bracts (5–)7–8(–11), (3.9–)4.9–8.4(–10.8) mm long. Rays 9–20, (2.19–)2.67–3.55(–4.11) cm long, subequal, glabrous to papillose hairy on inner side. Bracteoles 5–9, (2.8–)3.2–5.2(–6.7) mm long, with wide scarious margin and a filiform apex. Secondary rays 10–18, (2.4–)5.8–8(–9) mm long, glabrous to papillose hairy on inner side. Petals (0.9–)1–1.1(–1.3) mm long. Fruits (3.2–)3.7–4.7(–5.2) × 1.4–1.5(–1.6) mm, with lateral wings 0.4 mm wide; style 0.6–2.6 mm long.

Etymology — The specific epithet refers to Ogliastra, the name of the region of central E Sardinia, where the plant grows.

Phenology — Flowering May to June; fruiting June to July.

Distribution — Endemic to the Tacchi d'Ogliastra region, central E Sardinia.

Habitat — *Siler montanum* subsp. *ogliastrinum* is a chasmophyte linked to calcareous substrates such as limestone and conglomerate, where it grows preferentially on vertical cliffs at elevations of 985–1190 m. It is a member of chasmophytic, endemic plant communities characterized by *Potentilla caulescens* subsp. *nebrodensis* (Strobl ex Zimmeter) Arrigoni, *Saxifraga pedemontana* subsp. *cervicornis* (Viv.) Engl. and *Sesleria insularis* subsp. *barbaricina* Arrigoni.

Siler montanum subsp. ***siculum*** (Spreng.) Iamonico & al. in Phytotaxa 268: 89. 2016 ≡ *Laserpitium siculum* Spreng., Syst. Veg. 1: 918. 1824 ≡ *Siler siculum* (Spreng.) Thell. in Monde Pl. 26(153): 4. 1925 ≡ *Laserpitium garganicum* subsp. *siculum* (Spreng.) Pignatti in Giorn. Bot. Ital., n.s., 111: 48. 1977 ≡ *Laserpitium siler* subsp. *siculum* (Spreng.) Santang. & al., Annot. Checkl. Ital. Vasc. Fl.: 20. 2005. – Protologue citation: "Sicil." – Type: not traced.

– *Laserpitium nebrodense* Jan ex DC., Prodr. 4: 205. 1830, nom. inval. (Turland & al. 2018: Art. 36.1(b)), pro syn. sub *Laserpitium siculum* Spreng.

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf 3.8–5.1 mm. Basal leaves large (11.6–)20.92–27.12(–29) × (7.5–)8.8–14.75(–18) cm, petiolate;

Fig. 17. Holotype of *Siler montanum* subsp. *ogliastrinum* (CAG).

petiole (3.2–)4.86–8.5(–14.5) cm long; lamina ovate-triangular in outline, 3 pinnate; leaflets decurrent for (2.9–)4.8–7.8(–10.4) mm; with asymmetric base, asymmetry (1.1–)1.5–3(–7.7) mm long; petiolule 0–1(–2.4) mm long, leaflets elliptic, ovate to obovate, larger ones (1.34–)1.82–2.2(–2.7) × (0.69–)0.78–0.98(–1.3) cm, ratio length / width larger leaflets (1.8–)2.1–2.4(–3), uppermost lobe (1.24–)1.96–2.57(–3.23) cm long, lateral adjacent lobe (1.16–)1.54–1.78(–2.04) cm long, ratio uppermost / lateral lobe length (1.07–)1.24–1.46(–1.78), leaflets ± apiculate with acute to rounded apex, median angle of apex (80.7°–)92.8°–123.8°(–134.8°), max. angle of apex (91.5°–)114.8°–136.6°(–163.6°), with a scarious entire to eroded margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 1.7–4.3 cm long). Larger leaflets of cauline leaf (1.55–)1.81–2.6(–3.4) × (0.77–)0.97–1.32(–1.7) cm, ratio length / width larger leaflets (1.4–)1.8–2.3(–2.4). Bracts 6–10, (5.1–)11.1–14.9(–22) mm long. Rays 9–29, (2.7–)4–5.5(–6.4) cm long, subequal, usually glabrous to more rarely papillose hairy on inner side. Bracteoles 4–11, (4.1–)5.6–7.8(–9) mm long, with wide scarious margin and a filiform apex. Secondary rays 12–25, (5.5–)7.7–10.1(–15) mm long, usually glabrous to more rarely papillose hairy on inner side. Petals (1.3–)1.6–2 mm long. Fruits (4.1–)5.2–8.5(–9) × (2.3–)2.9–4.5(–5) mm, with lateral wings (0.8–)1–1.3(–1.5) mm wide; style 2.3–4.1 mm long.

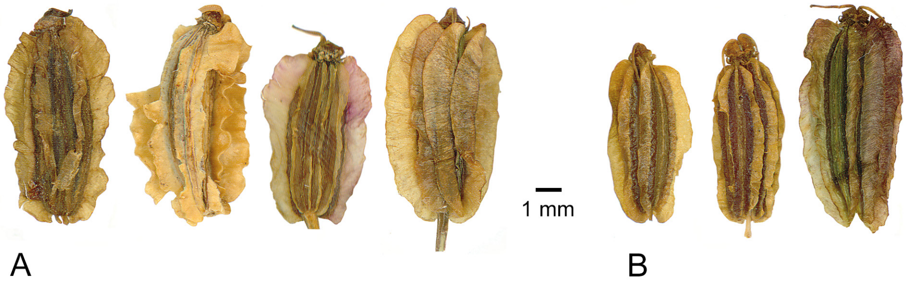

Fig. 18. Ripe fruits – A: left to right, *Siler zernyi* subsp. *zernyi* (Mt Paštrik), *S. zernyi* subsp. *laeve* (Kozjak), *S. zernyi* subsp. *ochridanum* (Mt Galičica) and *S. zernyi* subsp. *laeve* (Mt Olympus); B: *S. montanum* subsp. *garganicum* (Mt Prokletije).

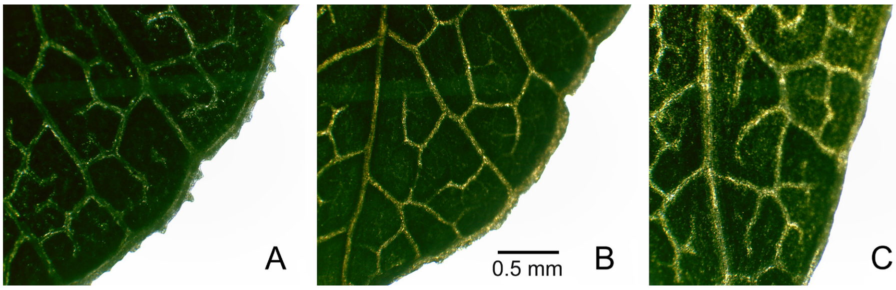

Fig. 19. Leaflet margin – A: serrulate-denticulate (*Siler montanum* subsp. *apuanum*); B: eroded (*S. montanum* subsp. *siculum*); C: entire (*S. montanum* subsp. *montanum*).

Phenology — Flowering April to June; fruiting June to August.

Distribution — Endemic to Sicily. Previous records for C and S Italy (Santangelo & al. 2002; Bartolucci & al. 2018) refer to *Siler montanum* subsp. *apuanum* in the Apuan Alps and to *S. montanum* subsp. *stabianum* in the C and S Apennines.

Habitat — Rocky slopes, screes, open woodland, mainly on limestone.

Siler montanum subsp. ***stabianum*** (Lacaita) F. Conti & Bartolucci, **comb. & stat. nov.** ≡ *Laserpitium siculum* var. *stabianum* Lacaita in Bull. Orto Bot. Regia Univ. Napoli 3: 279. 1913 ≡ *Laserpitium garganicum* var. *stabianum* (Lacaita) Pignatti in Giorn. Bot. Ital., n.s., 111: 48. 1977. – Protologue citation: "M. S. Angelo di Castellammare". – **Lectotype (designated here):** Italy, "Ravello. rocks of Montalto c. 2500'", 13 Jun 1883, *Lacaita s.n.* (BM 000752055 [digital photo!]).

Notes — We were able to trace only one specimen, kept in BM, collected by Lacaita in the area surrounding the type locality but not cited by the author in the protologue. This specimen was labelled by Lacaita "*Laserpitium siculum* Sprg var. *stabianum mihi*" and "13.6.83" (i.e. 13 June 1883), hence it was collected before the description of *L. siculum* var. *stabianum* in 1913. It therefore belongs to the original material for the name (Turland & al. 2018: Art. 9.4(a)) and is accordingly selected as the lectotype.

Description — Plant perennial, glabrous. Stock with abundant fibres. Stem terete, finely ridged, with few divaricate branches, diameter of stem 1 cm below first cauline leaf (1.2–)2.4–4(–7.2) mm. Basal leaves large (4.83–)11.81–23.5(–64.5) × (3.5–)7.9–14(–28.5) cm, petiolate; petiole (2.4–)3.3–10.45(–37.3) cm long; lamina ovate-triangular in outline, (2–)3(–4) pinnate; leaflets decurrent for (0–)1.2–3.3(–7.8) mm, sometimes with asymmetric base, asymmetry (0–)0.5–1.4(–3.3) mm long; petiolule 0–1(–4.5) mm long; leaflets elliptic to narrowly elliptic, ovate to obovate, larger ones (0.58–)1.25–2.28(–3.7) × (0.24–)0.54–0.97(–1.91) cm, ratio length / width larger leaflets (1.3–)2–2.8(–5.4), uppermost lobe (0.84–)1.24–2.08(–3.02) cm long, lateral adjacent lobe (0.63–)1.17–1.67(–2.53) cm long, ratio uppermost / lateral lobe length (0.9–)1.1–1.3(–1.8), leaflets ± apiculate with acute to rounded apex, median angle of apex (56.5°–)69°–85.2°(–104.4°), max. angle of apex (53.4°–)80.5°–105.3°(–123.2°), with a scarious serrulate-denticulate margin, main and secondary veins prominent on abaxial surface, whitish. Cauline leaves sessile or shortly petiolate on a sheathing base (sheaths of first cauline leaf 0.76–5.5 cm long). Larger leaflets of cauline leaf (0.64–)1.3–2.2(–4.21) × (0.29–)0.4–0.9(–1.97) cm, ratio length / width larger leaflets (1–)2–3.1(–7.1). Bracts 3–19, (4.3–)8–12.2(–21.2) mm long. Rays 4–38, (1.62–)3.2–4.47(–9.5) cm long, subequal, glabrous to papillose hairy on inner side. Bracteoles 1–11, (2.2–)4.4–6.5(–11.4) mm long, with wide scarious margin and a filiform apex. Secondary rays 8–35, (2.4–)5.4–8.7(–13.9) mm long, glabrous to papillose hairy on inner side. Petals (0.7–)1.3–1.9(–2.8) mm long. Fruits (2.7–)5.5–8.5(–10.1) × (0.9–)2.4–3.8(–

5.5) mm, with lateral wings (0.1–)0.3–0.7(–1.9) mm wide; style 1.1–3.3 mm long.

Phenology — Flowering May to June; fruiting June to August.

Distribution — Endemic to the C and S Apennines in Marche, Umbria, Abruzzo, Lazio, Molise, Campania, Basilicata and Calabria.

Habitat — Rocky slopes, screes, open woodland, mainly on limestone.

Key to investigated taxa of *Siler zernyi* and *S. montanum*

1. Lower leaves 2–3-pinnate; some leaflets conspicuously adnate or decurrent on petiolule [min. to 9.2(–14.9) mm (*S. zernyi* subsp. *ochridanum*), max. to 35(–45.9) mm (*S. zernyi* subsp. *zernyi*)], and/or with strongly asymmetric base [(1.1–)2.3–19.8(–27.5) mm, to 1/4–1/3(–1/2) as long as leaflet]; terminal leaflets usually of different sizes and shapes; lateral wings of ripe fruit usually conspicuously undulate (Fig. 18A) (*S. zernyi*) **2**
– Lower leaves (2–)3(–5)-pinnate; leaflets not or shortly decurrent on petiolule [min. to 3.3(–7.8) mm (*S. montanum* subsp. *stabianum*), max. to 7.4(–14.6) mm (*S. montanum* subsp. *garganicum*)], with no or slightly asymmetric base [(0–)0.5–4.3(–11) mm, usually to (1/20–)1/10(–1/5), very rarely to 1/2 as long as leaflet]; terminal leaflets of similar sizes and shapes; lateral wings of ripe fruit not to slightly undulate (Fig. 18B), less often undulate (*S. montanum* subsp. *stabianum*, *S. montanum* subsp. *siculum*) (*S. montanum*) **4**
2. Leaflet margin slightly eroded (Fig. 19B); basal leaves smaller [to 27(–37) × 18(–26.5) cm], with smaller, ± acute, almost sessile leaflets [(1.8–)2.5–4.3(–5.3) × 0.7–1.1(–1.8) cm]; bracts to 9(–12) mm long; rays to 4.6(–5.7) cm long . . . . ***S. zernyi*** subsp. ***ochridanum***
– Leaflet margin entire (Fig. 19C), rarely slightly eroded (*S. zernyi* subsp. *laeve*); basal leaves larger [to 47(–68) × 27(–44) cm], with larger, obtuse, usually petiolulate leaflets [(4–)6.3–8.2(–10) × (1.6–)2.3–2.8(–4.9) cm]; bracts to 13(–20) mm long; rays to 6.5(–9) cm long **3**
3. Plants robust, with stem diameter to 12(–13) mm; basal leaves larger [to 63(–68) × 32(–44) cm]; cauline leaves leaflets (5.8–)7.1–10.7(–13.5) cm long, oblong to oblong-lanceolate, decurrent on petiolule to 1/3(–1/2); bracts to 12; rays to 40(–42) . . . . ***S. zernyi*** subsp. ***zernyi***
– Plants less robust, with stem diameter to 4(–5) mm; basal leaves smaller [to 47(–51) × 27(–39) cm]; cauline leaves leaflets (2.7–)2.9–3.6(–4.6) cm long, oblong, elliptic, obovate or orbicular-obovate, decurrent on petiolule to 1/8(–1/4); bracts to 8; rays to 20(–31) . . . . ***S. zernyi*** subsp. ***laeve***
4. Leaflet margin serrulate-denticulate (Fig. 19A) . . . **5**
– Leaflet margin entire or eroded (Fig. 19B, C) **6**
5. Max. number of rays (17–)25–30(–32); rays (5–)5.9–7.5(–8.2) cm long; secondary rays (5–)9.7–12(–14) cm long; basal leaf leaflets (1.6–)2.4–3.3(–4.3) cm long . . . . ***S. montanum*** subsp. ***apuanum***
– Max. number of rays (4–)11–18(–38); rays (1.62–)3.2–4.5(–9.5) cm long; secondary rays (2.4–)5.5–8.5(–10.1) cm long; basal leaf leaflets (0.58–)1.2–2.2(–3.7) cm long . . . . ***S. montanum*** subsp. ***stabianum***
6. Basal leaves leaflets narrowly elliptic to more rarely elliptic [(2.1–)3.2–5.3(–8.6) × as long as wide], acute to rarely obtuse [with max. apex angle (37–)65–81(–125)°] **7**
– Basal leaves leaflets elliptic, obovate or orbicular-obovate [(1.5–)2.1–2.5(–4.4) × as long as wide], acute to obtuse [with max. apex angle (74–)103–124(–164)°] **8**
7. Plants relatively robust, with stem diameter (4–)4.5–7(–7.5) mm; leaves 3–4(–5)-pinnate; uppermost leaflets (2.9–)3.4–4.6(–5.4) cm long; cauline leaves leaflets oblong-lanceolate to lanceolate, (3–)4.3–7.3(–9) × as long as wide; petiolule (0–)2.2–7.9(–10.8) mm long; rays (21–)30–39(–61); fruit (4.9–)6.9–9(–10.3) mm long . . . ***S. montanum*** subsp. ***montanum***
– Plants small, with stem diameter (1.7–)2–2.7(–3.5) mm; leaves (2–)3-pinnate; uppermost leaflets (1.7–)2.2–2.9(–3) cm long; cauline leaves leaflets oblong to oblong-lanceolate, (2.1–)2.5–3.3(–5) × as long as wide; petiolule 0–1.7(–3.6) mm long; rays (9–)12–18(–20); fruit (3.2–)3.7–4.7(–5.2) mm long . . . . ***S. montanum*** subsp. ***ogliastrinum***
8. Leaflets petiolule 0–1(–2.4) mm long; fruit wings (0.8–)1–1.3(–1.5) mm wide, to 30%(–40%) as wide as fruit . . . . ***S. montanum*** subsp. ***siculum***
– Leaflets petiolule (0–)1–11(–27.5) mm long; fruit wings (0–)0.3–0.5(–1) mm wide, to 10%(–30%) as wide as fruit **9**
9. Leaflet margin entire, rarely slightly eroded; basal leaves (20–)31–44(–66) cm long; max. number of rays (15–)24–41(–76); rays (2.3–)4.6–7.5(–11) cm long . . . . ***S. montanum*** subsp. ***garganicum***
– Leaflet margin eroded or partially eroded, rarely entire; basal leaves (16–)18–25(–30) cm long; max. number of rays (9–)16–19(–22); rays (2.3–)3.3–5.6(–7) cm long . . . . . ***S. montanum*** subsp. ***corrasianum***

Author contributions

Conceptualization and methodology: all authors; biometric analyses: FC, GB and RP; statistical analyses: MN; writing original manuscript: FC; supervision: FC and MN; revising and editing manuscript: all authors.

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Appendix 1. Specimens seen and studied for the morphometric analyses.

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