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# Taxonomical notes on the Sicilian populations of *Asperula gussonei* (Rubiaceae): *A. peloritana* sp. nov.

by

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## Abstract

Brullo, C., Brullo, S., Giusso del Galdo, G.P. & Scuderi, L. 2009. Taxonomical notes on the Sicilian populations of *Asperula gussonei* (Rubiaceae): *A. peloritana* sp. nov. *Anales Jard. Bot. Madrid* 66(1): 000-000.

Taxonomical investigation on *Asperula gussonei*, a rare Sicilian endemism, allowed us to verify that the Madonie population is well differentiated from the Mt. Scuderi one. These two populations are here treated as distinct species: *A. gussonei* Boiss. from Madonie and *A. peloritana* sp. nov. from Mt. Scuderi. The main morphological and ecological differences between the two species are pointed out. Their iconographies and relationships with the allied species are given too.

**Keywords:** Rubiaceae, endemism, *Asperula*, Sicily, taxonomy.

## Introduction

The aim of this work is the taxonomical survey of *Asperula gussonei* Boiss., a species circumscribed to some mountain stands of Sicily. It was firstly identified by Gussone (1827) as *A. nitida*, species described by Sibthorp & Smith (1806) on Greek material. Afterward, Gussone (1843) attributed these populations to *A. suberosa* Sibth. & Sm., highlighting that the Sicilian plant is very different from *A. nitida*. Later, Boissier (1849) considered the specimens referred by Gussone to *A. suberosa* as a distinct species, named *A. gussonei*. As concern the distribution in Sicily of this species, it was collected for the first time by Gussone (1827, 1843) on some mountains of the Madonie massif (Scalone, Quacella, Mufara) and on the Peloritani Range (Mount Scuderi), where it occurs

## Resumen

Brullo, C., Brullo, S., Giusso del Galdo, G.P. & Scuderi, L. 2009. Notas sobre la taxonomía de la población en Sicilia de *Asperula gussonei* (Rubiaceae): *A. peloritana* sp. nov. *Anales Jard. Bot. Madrid* 66(1): 000-000 (en inglés).

Una investigación taxonómica sobre *Asperula gussonei*, especie rara endémica de Sicilia, nos permitió comprobar que la población de las Madonias se diferencia bien de la de Mt. Scuderi. Estas dos poblaciones son consideradas aquí como especies diferentes: *A. gussonei* Boiss. de las Madonias y *A. peloritana* sp. nov. del Mt. Scuderi. Se indican las principales diferencias morfológicas y ecológicas entre las dos especies. Se muestran también sus iconografías y relaciones con las especies afines.

**Palabras clave:** Rubiaceae, endemismo, *Asperula*, Sicilia, taxonomía.

so far. According to literature, herbarium investigations and field surveys, this species grows exclusively on the Madonie and Mt. Scuderi, where it is represented by small and few-numbered populations. An in-depth macro- and micro-morphological analysis on living material coming from these localities allowed to verify that the Mt. Scuderi population is very different from that one occurring in the Madonie. The main differences regard the vegetative and reproductive structures such as the leaves, inflorescences, flowers and fruits. As a consequence of this, it was necessary to deal with the lectotypification of *A. gussonei*. In particular, basing on the protologue of Gussone (1843) and Boissier (1849), the morphological features listed are the same of those observed in the specimens coming from the Madonie. Therefore, we choose as lectotype

one of the syntypes preserved in the Gussone Herbarium (NAP-GUSS), in particular the specimen collected by himself at Mt. Scalone (Madonie), while the population of Mt. Scuderi is here described as a species new to science, named *Asperula peloritana*.

## Material and methods

The morphological study was carried out on living plants coming from Madonie and Mt. Scuderi, as well as on herbarium material (CAT, FI, G and NAP). The micro-morphology of the mericarp outer coat was studied on dried material with the aid of a scanning electron microscope (SEM) Leica Cambridge LEO 420. The preparation of the seeds for SEM observation was done according to the protocol of Huttunen & Laine (1983).

## Results and discussion

Within the populations previously referred to *Asperula gussonei* by Strobl (1878), Nicotra (1878), Cesati & al. (1884), Arcangeli (1882, 1894), Tanfani (1887), Lojacono-Pojero (1902), Beguinot (1903), Fiori (1927), Ehrendorfer & Krendl (1976), Ehrendorfer (1982), and Giardina & al. (2007), it is possible to distinguish two morphologically well differentiated taxa which have to be treated as distinct species. They are: *A. gussonei* Boiss. s.str., circumscribed to the Madonie massif, and *A. peloritana* sp. nov., exclusive of Mt. Scuderi (Peloritani).

***Asperula gussonei* Boiss.**, Diagn. Pl. Or. Nov. 2(10): 63. 1849 (Figs. 1, 3A)

*A. nitida* Guss., Fl. Sicul. Prod. 1: 168. 1827, non Sibth. & Sm. 1806

*A. suberosa* Guss., Fl. Sic. Syn. 1: 180. 1843, non Sibth. & Sm. 1806

*A. gussoneana* Boiss., Fl. Orient. 3: 88. 1875, *nom. nud.*

*A. cynanchica* var. *gussonei* (Boiss.) Fiori, Nuov. Fl. Italia 2. 503. 1927

Plant caespitose, densely pulvinate, glabrous, glaucous pruinose. Stems 3-9 cm long, very branched, with internodes 1-4 mm long, shorter than leaves. Leaves 3-8 mm long, 1-1.8 mm wide, narrowly elliptical, often weakly incurved, acute to apiculate at the apex, with midrib robust, 0.4-0.6 mm wide, and margin flat, thickened, 0.15-0.25 mm wide, minutely serrulate-hispid. Inflorescence thyrsoïd, compact, few-flowered, arranged in terminal cluster of 6-15 flowers. Leaf-like bracts 2-3 mm long, 0.5-0.7 mm wide. Pedicel 0.8-1.8 mm long. Corolla 6-8 mm long, hypocrateriform to narrowly infundibuliform, pink to dark pink, glabrous, smooth; tube 4.5-5 mm long; lobes

1.8-2.5 mm long, ovate-oblongate, thickened at the margin and appendiculate at the apex. Stamen filaments almost completely decurrent along the tube; anthers purplish, 1.5-1.7 mm long not reaching the throat. Ovary globose-ellipsoid 1.2-1.4 mm long, slightly striate-sulcate, with a short coronule at the tip. Style bifid, 1.2-1.5 mm long, with 2 stigmas globose-papillose. Mericarp 1.5-2.5 mm long, glabrous, minutely striate-sulcate.

Lectotype: Madonie, all'ovest del Monte Scalone, 30-VI, *Gussone s.n.* (NAP-GUSS), here designated.

*Etymology.* The species is named after G. Gussone (1787-1866), Neapolitan botanist who collected and described this species.

*Distribution.* On the basis of literature data and herbarium investigations, *Asperula gussonei* is localized on some mountain stands of the Madonie (Mt. Mufara, Mt. Scalone, Mt. Quacella, and Mt. Pomieri) where it is represented by few-numbered, scattered populations at an altitude of 1400-2000 m (Fig. 4).

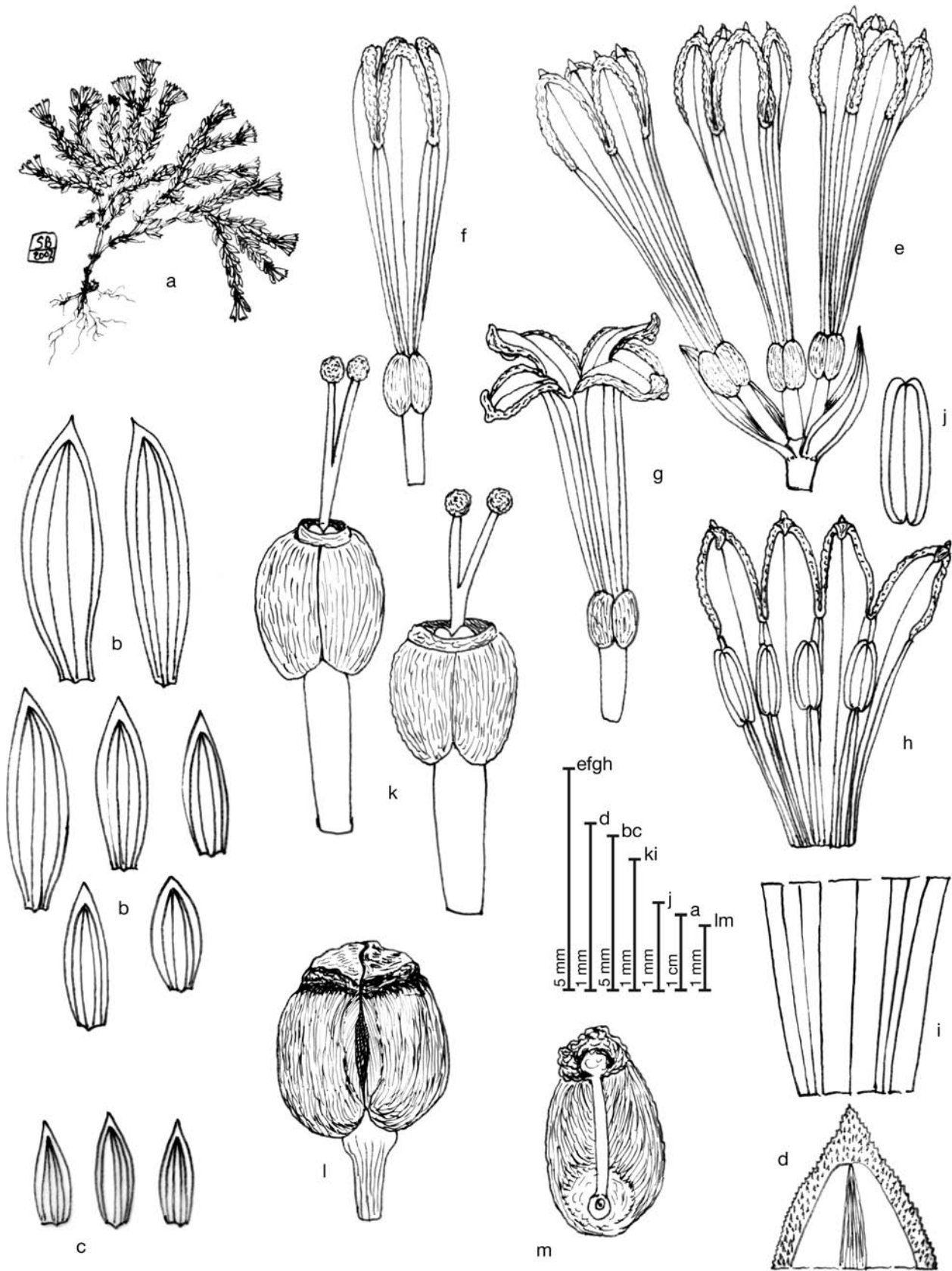
*Habitat.* *Asperula gussonei* is a chasmophilous orophyte growing on Mesozoic limestones and dolomites (Fig. 5). It is a member of a rupestrian plant-community represented by *Asperuletum gussonei* Brullo 1984, association of the *Saxifragion australis* Pedrotti ex Brullo 1984, alliance belonging to the class *Asplenieta trichomanis* (Br.-Bl. in Mayer & Br.-Bl. 1934) Oberd. 1977. This coenosis is particularly rich in rare endemics, such as *Helichrysum nebrodense* Heldr., *Draba olympicoides* Strobl, *Hieracium symphytifolium* Froel., *Aubrieta deltoidea* subsp. *sicula* (Strobl) Phitos, *Edraianthus siculus* Strobl, *Saxifraga australis* Moric., *Silene saxifraga* subsp. *lojaconoi* (Lacaita) Mazzola & Raimondo, *Potentilla nebrodensis* Strobl ex Zimmetter, *Minuartia graminifolia* subsp. *rosani* (Ten.) Mattf., and *Arenaria grandiflora* L. (Brullo, 1984; Brullo & al., 2004).

*Phenology.* Flowering July to August.

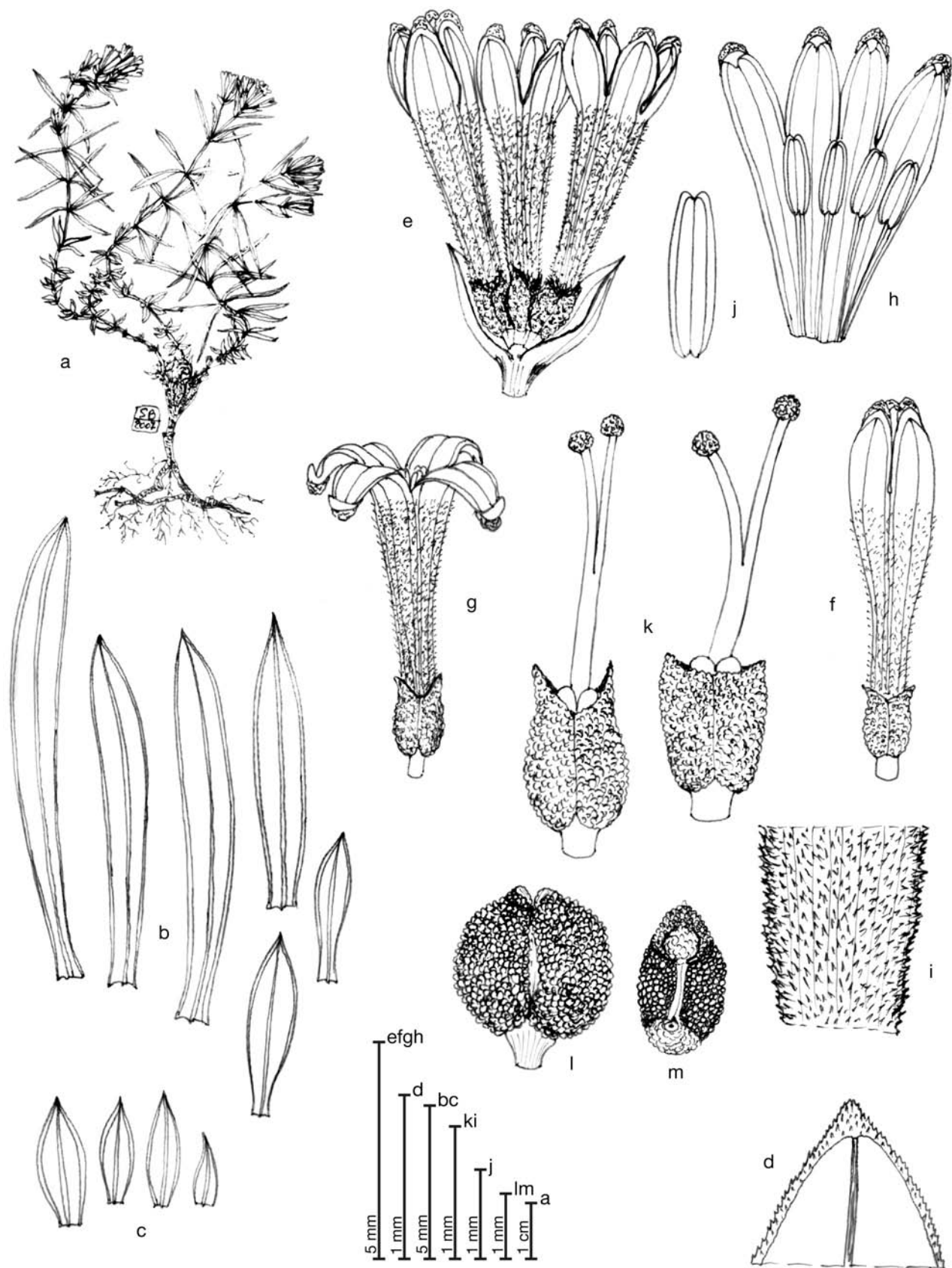
*Conservation status.* According to Conti & al. (1997), *Asperula gussonei* is considered a plant at low risk of extinction (LR), probably because it grows on rupestrian stands which are habitats usually less affected by human activities. Due to its rarity and few number of individuals, it should be better to consider this species as vulnerable (VU).

*Taxonomic remarks.* For some morphological features chiefly regarding the leaf size, corolla glabrous, and mericarp minutely striate-sulcate, *Asperula gussonei* seems to be taxonomically quite isolated. Nevertheless, due to its compact pulvinate habit, robust leaf midrib, *Asperula gussonei* shows a certain similarity with *Asperula pumila* Moris from Sardinia, rather than with *Asperula peloritana*.

***Asperula peloritana* Brullo C., Brullo, Giusso & Scuderi, sp. nov.** (Figs. 2, 3B)



**Fig. 1.** *Asperula gussonei*: **a**, habit; **b**, leaves; **c**, leaf-like bracts; **d**, leaf apex; **e**, inflorescence; **f**, flower bud; **g**, flower; **h**, open corolla; **i**, basal part of the corolla tube (outer face); **j**, anther; **k**, pistils; **l**, fruit; **m**, mericarp (tangential face) [C. da Pomieri, *Brullo C., Brullo S., Scuderi s.n.* (CAT)].



**Fig. 2.** *Asperula peloritana*: **a**, habit; **b**, leaves; **c**, leaf-like bracts; **d**, leaf apex; **e**, inflorescence; **f**, flower bud; **g**, flower; **h**, open corolla; **i**, basal part of the corolla tube (outer face); **j**, anther; **k**, pistils; **l**, fruit; **m**, mericarp (tangential face) [form type material].

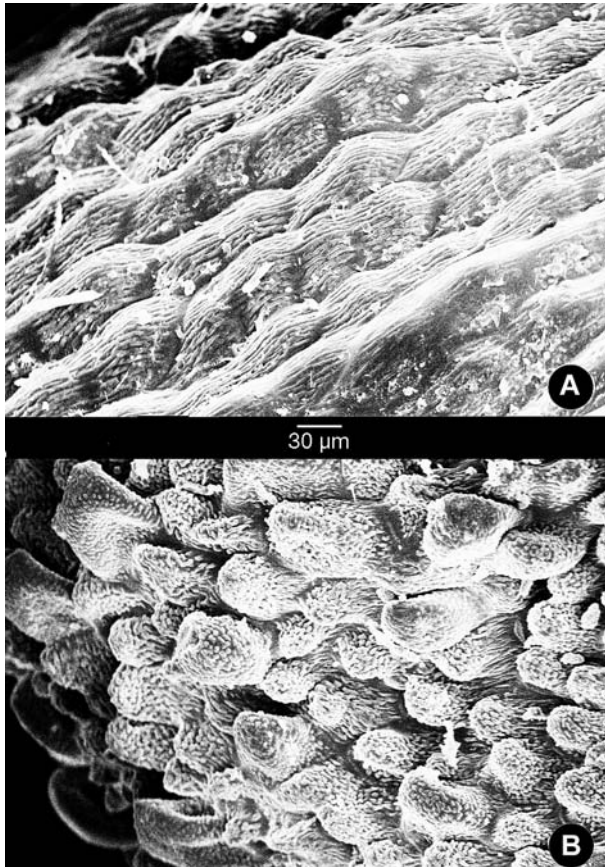


Fig. 3. Mericarp outer coat: **A**, *Asperula gussonei*; **B**, *A. peloritana*.

*A. Asperula gussonei* habito laxe pulvinato, prostrato, caulibus 5-12 cm longis, paucis ramosis, internodiis 4-10 mm longis, inferioribus folio longioribus, superioribus folio brevioribus, foliis inferioribus 3-6 × 1-1,5 mm, foliis superioribus late linearibus 8-18 × 1,1-1,4 mm, costa foliorum subtili, 0,1-0,15 mm lata, margine foliorum 0,05-0,1 mm lato, bracteis 0,7-1,4 mm latis, pedicellis 0,3-0,5 mm longis, tubo corollae piloso-hispido, lobis corollae glabris non nisi ad apicem incrassatis, antheris aureo-luteis, fauce attingentibus, ovario dense tuberculato-papilloso, 4-dentato apice, stilo 2-2,3 mm longo, mericarpio dense tuberculato-papilloso differt.

Plant caespitose, laxly pulvinate-prostrate, glabrous, glaucous-pruinose. Stems 5-12 cm long, few branched, with internodes 4-10 mm long, the lower ones longer than leaves, the upper ones shorter than leaves. Lower leaves 3-6 mm long, 1-1.5 mm wide, lanceolate to obovate-lanceolate, acute at apex. Upper leaves, broadly linear, often weakly incurved, acute to apiculate at the apex, 8-18 mm long, 1.1-1.4 mm wide, with midrib thin, 0.1-0.15 mm wide, and margin flat, thickened, 0.05-0.1 mm wide, minutely serrulate-hispid. Inflorescence thyrsoid, loosely branched, few-

flowered, arranged in terminal cluster of 6-15 flowers. Leaf-like bracts oblanceolate, 2-4 mm long, 0.7-1.4 mm wide. Pedicel 0.3-0.5 mm long. Corolla 6-7 mm long, hypocrateriform to narrowly infundibuliform, pink to dark pink, hairy-hispid in the tube and glabrous in the lobes; tube 4.5-5 mm long; lobes 2-2.5 mm long, ovate-oblanceolate, thickened and appendiculate at the apex. Stamen filaments almost completely decurrent along the tube; anthers gold-yellow 1.5-1.7 mm long, reaching the throat. Ovary ellipsoid 1-1.5 mm long, densely tuberculate-papillose, with 4 teeth at the apex. Style bifid, 2-2.3 mm long, with 2 stigmas globose-papillose. Mericarp 1.8-2.2 mm long, glabrous, densely tuberculate-papillose.

**Holotype:** Sicily, Peloritani, Monte Scuderi, lungo il versante settentrionale, tra 900 e 1200 m di quota, 29-V-2007, *Brullo C.*, *Brullo S.*, *Scuderi L. s.n.* (CAT; isotypes, CAT, FI, MA).

**Etymology.** The specific epithet refers to “Peloritani”, the mountain range of north-eastern Sicily where the species occurs.

**Distribution.** This species is exclusive of the northern slopes of Mt. Scuderi (1253 m a.s.l.), a quite isolated peak of the Peloritani range (Fig. 4). In this area, it is represented by a population with several individuals (more than 300).

**Habitat.** *Asperula peloritana* grows on rocky sites characterized by Palaeozoic impure marble outcrops on north-facing, rather steep slopes (Fig. 6). It is a member of an orophilous dwarf-shrub community belonging to the *Cerastio-Astragalion nebrodensis* Pignatti & Nimis ex Brullo 1984, alliance of the *Rumici-Astragaletea siculi* Pignatti & Nimis 1980 class. According to Brullo & al. (2005), *A. peloritana* must be

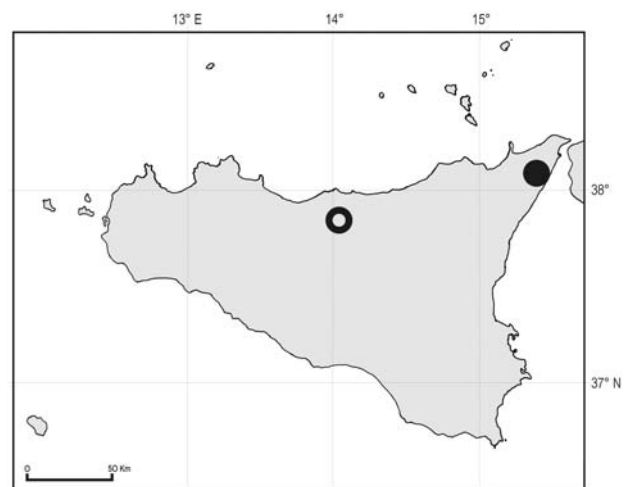


Fig. 4. Distribution map of *Asperula gussonei* (empty circle) and *A. peloritana* (full circle).



**Fig. 5.** Habit of *Asperula gussonei* (Mt. Quacella, Madonie).



**Fig. 6.** Habit of *Asperula peloritana* (Mt. Scuderi, Peloritani).

considered as characteristic species of the *Plantagini humilis-Asperuletum peloritani* Brullo & Guarino 2005 nom. corr. (= *Plantagini humilis-Asperuletum gussonei* Brullo & Guarino in Brullo & al. 2005). This association is exclusively found on the cacuminal area of Mt. Scuderi at an altitude of 1100-1250 m, within the supra-Mediterranean lower humid bioclimatic belt. Floristically it is characterized by the occurrence of many rare or endemic orophytes, such as *Plantago humilis* Guss., *Linum punctatum* C. Presl, *Pimpinella tragium* var. *glauca* Guss., *Onosma canescens* C. Presl, *Acinos alpinus* var. *nebrodensis* (Kern. & Strobl) Pignatti, *Minuartia grandiflora* C. Presl, *Dianthus arrostii* C. Presl, *Cerastium tomentosum* L., *Centaurea parlatoris* Heldr., *Arabis rosea* DC., etc.

*Phenology.* flowering May to early July.

*Conservation status.* For its restricted localization (ca. 15 ha) and for the intensive grazing (horses, cows and sheep) affecting the area at issue, *Asperula peloritana* requires the adoption of protective measures. In fact, for this serious threat and for the low number of individuals, we propose to include this species in the "Regional List of the Threatened Species" as critically endangered (CR). Based on the criteria adopted by IUCN (2001, 2003, 2005), it is proposed its inclusion in the following category: CR B1ab(ii, iii)+2ab(i, ii, iii).

*Taxonomic remarks.* For some morphological features, such as the leaf dimorphism, long internodes, hairy corolla, ovary and mericarp turbeculate-papillose, *Asperula peloritana* shows close relationships with *A. suberosa* Sibth. & Smith, rare endemism of Mt. Athos in N Greece (see Schonbeck-Temesy & Ehrendorfer, 1991). Therefore, these two species can be considered as endemo-vicariants, probably originated from the long geographical isolation of the Peloritani populations.

To conclude, on the basis of some morphological features and ecology, *Asperula gussonei* and *A. peloritana* belong to a group of species occurring in the mountain belt of many Mediterranean territories. On the whole, this group is represented by typical orophytes with a compact pulvinate habit localized on rocky places, and having normally a punctiform or very circumscribed distribution. In particular, they are *Asperula suberosa* Sibth. & Sm. (Mt. Athos), *A. idaea* Halácsy (Crete), *A. samia* Christod. & Georgiadis (Samos), *A. malevonensis* Ehrend. & Schönb.-Tem. (Mt. Parnon), *A. abbreviata* (Halácsy) Rech. fil. (Naxos, Amorgos, and Evvia), *A. pulvinaris* (Boiss.) Heldr. ex Boiss. (Attica), *A. nitida* Sibth. & Sm. (Lesbos, and W Anatolia), and *A. pumila* Moris (Sardinia). In order to emphasize the main morphological differences among the Sicilian and the closely related species, a comparative table is given too (Table 1). These species can be considered as paleoendemisms, likely arising from a common ancestor as a consequence of the speciation processes favoured by the geographical isolation. As concerns *A. gussonei* and *A. peloritana*, their remarkable morphological differences, such as their mericarp outer coat (Fig. 3), allow to hypothesize a different origin for the two species. In particular, they are probably linked to the existence of paleo-geographical land connections with the Balkan region as concern *A. peloritana*, and with the Sardo-Maghrebian territories with regard to *A. gussonei*.

## Representative specimens

### *Asperula gussonei*

**Sicily:** in elatioribus montosis, Madonie, s.d., *Todaro 31* (FI); Madonie, s.d., *Gussone s.n.* (G-BOISS); Serra Cavallo, s.d., 1200-1500 m, *Ricci s.n.* (FI), in glareosis calcareis elatioribus montosis, Madonie, VII, *Citarda 1431* (FI); in glareosis Serracavallo, Nebrod.,

**Table 1.** Comparative scheme of the morphological characters of *Asperula gussonei*, *A. peloritana* and allied species.

Characters	<i>A. gussonei</i>	<i>A. peloritana</i>	<i>A. pumila</i>	<i>A. nitida</i>	<i>A. suberosa</i>
Stern	3-9 cm long	5-12 cm long	2-8 cm long	2-10 cm long	5-15(25) cm long
Internodes	1-4 mm long, shorter than leaves	4-10 mm long, the lower longer than leaves and the upper shorter than leaves	1-6 mm long, the lower shorter than leaves and the upper longer than leaves	4-10 mm long, shorter than leaves	2-15 mm long, longer than leaves
Leaves	3-8 x 1-1.8 mm	the lower 3-6 x 1-1.5 mm and the upper 8-18 x 1.1-1.4 mm	1-5 x 0.5-0.8 mm	the lower 3-4 x 0.4-1 mm and the upper 6-12(16) x 0.5-1 mm	4-12 x 0.5-1 mm
Leaf indumentum	glabrous	glabrous	hairy	glabrous to hairy	glabrous to densely hispid
Leaf colour	glacous-pruinose	glacous-pruinose	green	glacous-pruinose	glacous-pruinose
Leaf shape	narrowly elliptical	the lower lanceolate to obovate-lanceolate and the upper broadly linear	the lower ovate to ovate-oblong and the upper lanceolate to linear	the lower lanceolate-oblong to oblong and the upper linear	linear
Leaf apex	acute to apiculate	acute to apiculate	apiculate	aristate	obtuse to acuminate
Leaf midrib	0.4-0.6 mm wide, robust	0.10-0.15 mm wide, thin	0.3-0.5 mm wide, robust	0.35-0.75 mm wide, robust	0.3-0.7 mm wide, robust
Leaf margin	minutely serrulate-hispid	minutely serrulate-hispid	ciliate	ciliate	scabrid
Bract	2-3 x 0.5-0.7 mm	2-4 x 0.7-1.4 mm	2-2.8 x 0.4-0.6 mm	3-4 x 0.7-1.4 mm	2-6 x 1-1.5 mm
Inflorescence	compact, 6-15-flowered	± loose, 6-15-flowered	± loose, 2-6-flowered	compact, 2-10-flowered	loose, 5-9-flowered
Pedicel	0.8-1.8 mm long	0.3-0.5 mm long	0.2-0.4 mm long	0.3-0.5 mm long	1-2 mm long
Corolla	6-8 mm long	6-7 mm long	4-5 mm long	5-7 mm long	5-10 mm long
Corolla indumentum	glabrous, smooth	hairy, hispid in the tube	hairy	glabrous, smooth	glabrous, hispid
Corolla colour	pink to dark-pink	pink to dark-pink	pink to pink-purplish	pink	brownish-purple
Corolla tube	4.5-5 mm long	4.5-5 mm long	3-3.5 mm long	4-5 mm long	5-6 mm long
Corolla lobes	1.8-2.5 mm long, ovate-oblancoolate, thickened at the margin	2-2.5 mm long, ovate-lanceolate, thickened at the apex	1.5-2 mm long, ovate-lanceolate, thickened at the apex	1-2.3 mm long, triangular	2-3 mm long, oblong
Anther	purplish, not reaching the throat	gold-yellowish, reaching the throat	purplish, not reaching the throat	purplish, exerted from the throat	purplish, exerted from the throat
Mericap	1.5-2.5 mm long	1.8-2.2 mm long	1.5-2 mm long	2.5-2.7 mm long	2-2.5 mm long
Mericap outer coat	glabrous, minutely striate-sulcate	glabrous, densely tubercolate-papillose	papillose, sparsely hairy	papillose	tubercolate-hispid to verrucose



27-VI-1855, 1200-1500 m, *Huet du Pavillon s.n.* (FI, G-BOISS); in glareosis elatioribus Madonie Serra dei Cavalli, VI-1883, *Lojacono s.n.* (FI); *ibid.*, VI-1880, *Lojacono s.n.* (FI); *ibid.*, VII-1877, *Lojacono s.n.* (G-BOISS); Madonie, a Monte Scalone, VII, *Gussone s.n.* (NAP-GUSS); in Monte Scalone, supra Polizzi, solo calc., 22-VII-1874, *Strobl s.n.* (G-BOISS), Madonie, C. da Pomieri, 18-VI-2007, *Brullo C.*, *Brullo S.*, *Scuderi s.n.* (CAT); in Nebrodoum, M. Quacedda, inter lapides deciduas, 23-VI-1840, alt. 5000' circ., *Heldreich s.n.* (G-BOISS); Rupi di Quacella (Madonie), 2-VIII-1990, *Bartolo*, *Brullo*, *Pulvirenti*, *Scelsi & Spampinato s.n.* (CAT); Madonie, Quacella, 13-VII-1973, *Brullo s.n.* (CAT).

### *Asperula peloritana*

**Sicily:** Monte Scuderi, 13-VI-1828, *Gussone s.n.* (NAP-GUSS); Monte Scuderi, 13-VI-1990, *Bartolo*, *Brullo*, *Scelsi & Spampinato s.n.* (CAT).

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## References

- Arcangeli, G. 1882. *Compendio della Flora Italiana*, Ed. 1. Ermano Loescher. Torino, Roma.
- Arcangeli, G. 1894. *Compendio della Flora Italiana*, Ed. 2. Ermano Loescher. Torino, Roma.
- Béguinot, A. 1903. Rubiaceae. In: A. Fiori & G. Paoletti (eds.), *Flora Analitica d'Italia*, 3: 102-123. Tipografia del Seminario. Padova.
- Boissier, E. 1849. *Diagnoses Plantarum Orientalium Novarum*, 10. A. Ascher & Co. Parisiis.
- Brullo, S. 1984. Contributo alla conoscenza della vegetazione delle Madonie (Sicilia settentrionale). *Bollettino Accademia Gioenia Scienze Naturali* 16: 351-420.
- Brullo, S., Marcenò, C. & Siracusa, G. 2004. La classe Asplenietea trichomanis in Sicilia. *Colloques Phytosociologiques* 28: 467-538.
- Brullo, S., Cormaci, A., Giusso del Galdo, G., Guarino, R., Minissale, P., Siracusa, G. & Spampinato, G. 2005. A taxonomical survey of the Sicilian dwarf shrub vegetation belonging to the class Rumici-Astragaletea siculi. *Annali di Botanica (Roma)* 5: 57-104.
- Cesati, V., Passerini, G. & Gibelli, G., 1884. *Compendio della flora italiana*. Antica Casa editrice Dott. F. Vallardi. Milano.
- Conti, F., Manzi, A. & Pedrotti, F. 1997. *Liste rosse regionali delle piante d'Italia*. Centro Interdipartimentale audiovisivi e stampa. Camerino.
- Ehrendorfer, F. 1982. *Asperula* L. In: S. Pignatti (ed.), *Flora d'Italia* 2: 355-359. Edagricole. Bologna.
- Ehrendorfer, F. & Krendl, F. 1976. *Asperula* L. In: T.G. Tutin & al. (eds.), *Flora Europaea* 4: 4-14. University Press. Cambridge.
- Fiori, A. 1927. *Nuova Flora Analitica d'Italia*. Vol. 2. Tipografia di M. Ricci, Firenze.
- Giardina, G., Raimondo, F.M. & Spadaro, V. 2007. A catalogue of plants growing in Sicily. *Bocconea* 20: 5-582.
- Gussone, G. 1827. *Florae Siculae Prodrumus*. Vol. 1. Regia Typographia. Neapoli.
- Gussone, G. 1843. *Florae Siculae Synopsis*. Vol. 1. Typis Tramater. Neapoli.
- Huttunen, S & Laine, K. 1983. Effects of air-born pollutants on the surface wax structure of Pinus sylvestris needles. *Annales Botanici Fennici* 20: 79-86.
- IUCN, 2001. *IUCN Red List Categories and Criteria: Version 3.1*. IUCN Species Survival Commission. IUCN. Gland & Cambridge.
- IUCN, 2003. *Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0*. IUCN Species Survival Commission. IUCN. Gland and Cambridge.
- IUCN, 2005. *Guidelines for Using the IUCN Red List, Categories and Criteria*. IUCN Standards and Petitions Subcommittee. Gland & Cambridge.
- Lojacono-Pojero, M. 1902. *Flora Sicula*. Vol. 2(1). Scuola Tip. Boccone del Povero. Palermo.
- Nicotra, L. 1878. *Prodrumus Florae Messanensis*. Typis Ribera. Messanae.
- Schonbeck-Temesy, E. & Ehrendorfer, F. 1991. *Asperula* L. In: A. Strid & K. Tan (eds.), *Mountain Flora of Greece*. 2: 281-300. Edinburgh University Press. Edinburgh.
- Sibthorp, J. & Smith, J.E. 1806. *Florae Graecae Prodrumus*. 1(1) Richardi Taylor et Socii. Londinii.
- Strobl, G. 1878. *Flora der Nebroden*. Neubauer'sche Buchdruckerei. Regensburg.
- Tanfani, E., 1887. Rubiaceae. In: F. Parlatore (ed.), *Flora Italiana* 7: 8-102. Tipografia dei successori di Le Monnier. Firenze.

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