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Bituminaria basaltica (Fabaceae), a new species from Italy

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Abstract

Bituminaria basaltica is described and illustrated from Filicudi, an islet of the Aeolian Archipelago (Sicily, Italy). This new species, belonging to a small genus of Fabaceae occurring in the Mediterranean region and the Canary Islands, is morphologically distinct from the other taxa in the following features: leaf shape and size, inflorescence size, petal colour, size and shape of flowers, pods and seeds. Its relationships with the known species of *Bituminaria* are examined and a key to the genus is provided.

Key words: Aeolian Archipelago, endemic flora, fodder grass, Mediterranean Basin, taxonomy

Introduction

Bituminaria Heist. ex Fabricius (1759: 165) is a small genus of Fabaceae occurring in the Mediterranean (including Black Sea territories) and Canary Islands, currently including four species (Stirton 1981a, 1981b, Boulos 1999, Greuter *et al*. 1989). *Bituminaria* was restored by Stirton (1981a), to which he ascribed only two species, previously included in *Psoralea* Linnaeus (1753: 762), *P. bituminosa* Linnaeus (1753: 763) [= *Bituminaria bituminosa* (L.) Stirton (1981a: 318)] and *P. acaulis* Steven ex Bieberstein (1808: 206) [= *Bituminaria acaulis* (Steven ex M.Bieb.) Stirton (1981a: 318)]. Afterwards, Greuter (1986) added two more species of *Psoralea*, *P. flaccida* Náběl ek (1923: 74) and *P. morisiana* Pignatti & Metlesics (1976: 53) to *Bituminaria*. *Bituminaria bituminosa* shows a certain variability mainly in the shape and size of leaves, flowers, pods, as well as the habit and corolla colour (Zohary 1972, Méndez *et al.* 1991, Jahn & Schönfelder 1995). Such morphological features, that are rather variable within the same population, led to the description of several taxa all referring to this species, e.g. *Psoralea palaestina* Gouan (1773: 51), *P. plumosa* Reichenbach (1832: 869), *P. pontica* Khokhrjakov (1997: 52), *P. bituminosa* subsp. *pontica* (A.P. Khokhr.) Zernov (2000: 70), *P. bituminosa* var. *brachycarpa* Feldmann in Zohary (1972: 455), *P. bituminosa* var. *hulensis* Feldmann in Zohary (1972: 455) and *P. bituminosa* var. *prostrata* Zohary, (1972: 455), *Bituminaria bituminosa* var. *palaestina* (Gouan) R.L. Jahn in Jahn & Schönfelder (1995: 28), *B. bituminosa* var. *albomarginata* Méndez *et al.* (1991: 160) and *B. bituminosa* var. *crassiuscula* Méndez *et al.* (1991: 162). In particular, those varieties described by Zohary (1972) and Méndez *et al.* (1991) seem to be taxonomically valid, and therefore they could be considered as subspecies of *B. bituminosa*. However, a proper taxonomic treatment at infra-specific level of this species will require an in-depth analyses in order to verify whether the diacritical characters used for the differentiation of the aforesaid taxa are an expression of the phenotype or are genetically fixed.

During a field trip in the Aeolian Islands, an archipelago of seven volcanic islets off Milazzo (north-eastern Sicily), a peculiar plant, whose pods clearly denoted its attribution to the genus *Bituminaria*, was found at Filicudi. This plant occurs quite frequently in this island, which is the fifth-largest one of the

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archipelago. It grows in dry grasslands dominated by *Hyparrhenia hirta* (L.) Stapf, as well as on secondary stands, such as abandoned fields and roadsides. It is morphologically well-differentiated from the other known species in having smaller cauline leaves with linear leaflets, smaller flowers (11–13 mm) with white corolla petals and smaller pods (9–10 mm).

Based on taxonomic surveys, the taxon closely related to *B. bituminosa* is here described as a new species.

Material and Methods

Morphological analyses were carried out on living plants (20 specimens) coming from the locus classicus of *B. basaltica*, while *B. bituminosa* was surveyed both on living (50 specimens) and dried material (30 specimens) from several Sicilian localities, *B. morisiana* from herbarium specimens (20) from Sardinia, and *B. flaccida* and *B. acaulis* both from literature and herbarium specimens (see additional specimens examined). Seed testa micro-morphology was studied on mature and dried seeds (about 10 for each species) using a scanning electron microscope (SEM) Zeiss EVO LS10, according to the protocol reported by Stork et al. (1980), while terminology of the seed coat sculpturing follows Bartholot (1981) and Gontcharova et al. (2009).

Taxonomic treatment

Bituminaria basaltica Miniss., C. Brullo, Brullo, Giusso & Sciandr., *sp. nov*. (Figs. 1, 2A, 3)

Species Bituminaria bituminosa similis sed foliis brevioribus, linearibus, floribus minoribus, corolla candida, calicem subaequanti vel leviter longiore, stigmate papillato, legumnibus et seminibus brevioribus differt.

Types:—ITALY. Sicily: Filicudi a Pecorini a Mare, praterie steppiche su substrati vulcanici, 38°33’36.28"N, 14°33’58.81"E, 46 m, 15 May 2012, *P. Minissale s.n.* (holotype CAT!, isotypes CAT!, FI!).

Habit erect or ascending perennial, with numerous rigid and striate woody stems, up to 60 cm tall, green, appressed-hirsute, no smelling of pitch. Basal leaf stipules lanceolate-ensiform, adnate to the petiole, 4–6 mm long. Basal leaves long petiolate, 50–100 mm long; leaves digitately 3-foliate, the central leaflet longer and petiolate, the lateral leaflets shorter and subsessile; leaflets rounded-elliptical to linear-lanceolate, hirsute abaxially and glabrous or subglabrous adaxially, the terminal one 11–40 x 7–15 mm, and petiole 4–12 mm long. the lateral ones 8–38 mm x 5–12 mm and petiole 1–2 mm long. Stipules of cauline 3–5 mm long; cauline leaves smaller than basal ones; petiole 40–50 mm long; leaflets linear, the terminal one 35–55 x 2–6 mm and petiole 6–8 mm long, the lateral ones 25–45 mm x 2–5 mm and petiole 1–2 mm long. Raceme subcapitate, 10–16 mm long, 6–12(–16)–flowered; bracts, upper part of peduncles and calyces, covered with white and black hairs; peduncles 100–160 mm long, longer than the leaf. Bracts 6–8 mm long, 1–3-toothed. Calyx 10–13 mm long, 10-nerved with unequal triangular-subulate teeth; tube 4–5 mm long; lower tooth 6–9 mm long; lateral teeth 4–6 mm long. Corolla 11–13 mm long, subequal to slightly longer than the calyx, purely white; standard spathulate, rounded to obtuse at the apex, 11–13 x 5–6 mm, claw slightly tinged with pale lilac; wings 10–11 mm long, with limb 2.5–3.0 mm wide; keel 7.5–8.5 mm long, with limb 1.5–1.8 mm wide, having a dark violet spot above. Staminal tube 7–8 mm long; anthers 0.5–0.6 mm long. Pistil 6–7 mm long, hairy on the ovary and lower part of the style; stigma with numerous papillae. Pod indehiscent, included in the calyx, 9–10 mm long (beak included), with corpus densely covered by setaceous hairs, 0.5–2.0 mm long, mixed to some rigid black prickles; beak flat, falcate, 5.5–6 mm long, glabrous, ciliate only at the margin. Seed adherent to pericarp, laterally compressed, subreniform, 3.5–4 x 2–2.2 mm, blackish-brown.

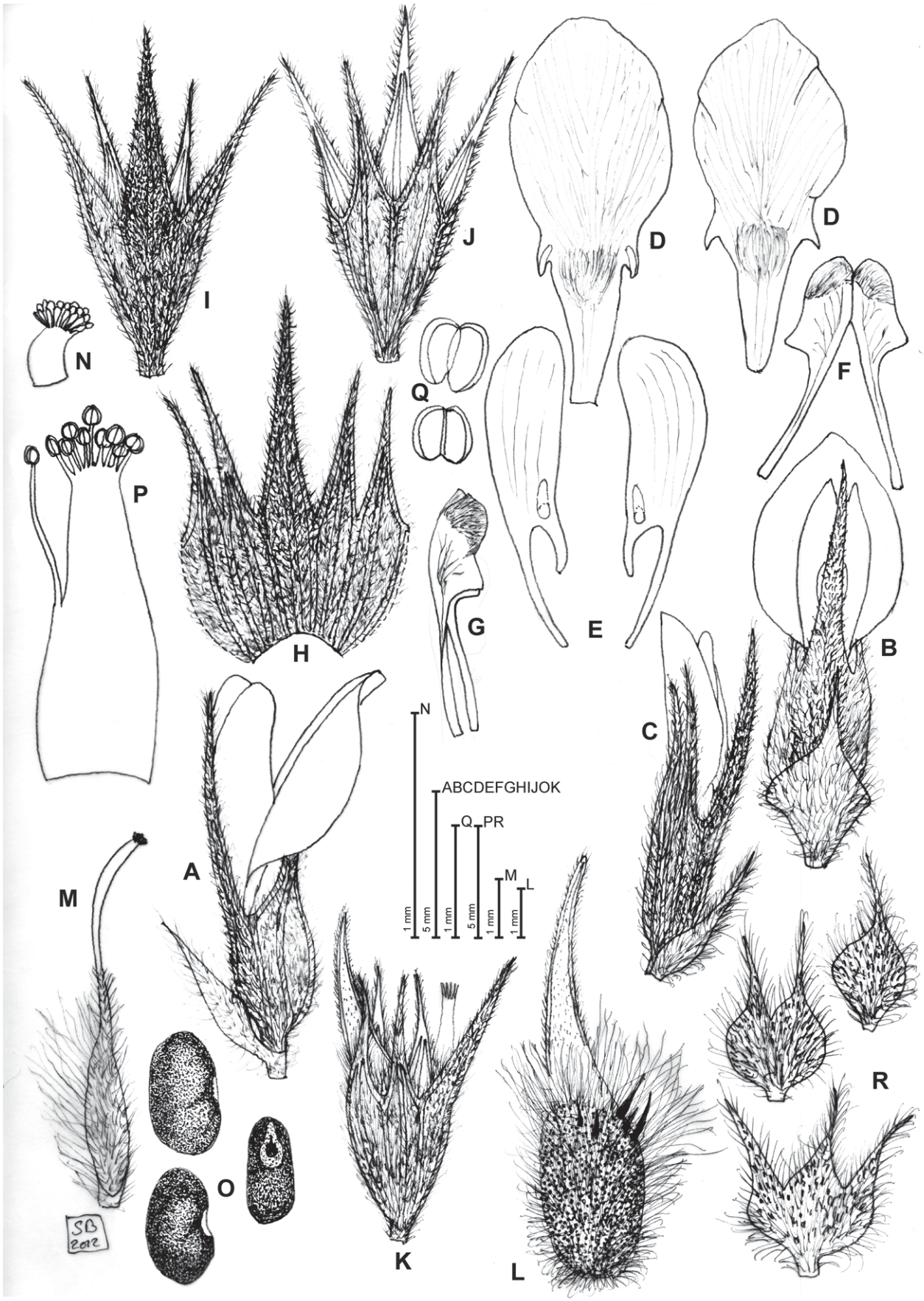

FIGURE 1. Diagnostic features of *Bituminaria basaltica*. **A.** Flower (lateral view). **B.** Flower (ventral view). **C.** Bud. **D.** Standards. **E.** Wings. **F.** Keel (open). **G.** Keel (lateral view). **H.** Calyx (open). **I.** Calyx (ventral view). **J.** Calyx (dorsal view). **K.** Calyx and immature pod. **L.** Calyx and mature pod. **M.** Pistil. **N.** Stigma. **O.** Seeds. **P.** Staminal tube. **Q.** Anthers. **R.** Bracts. Illustration by Salvatore Brullo based on *Minissale s.n.* (CAT).

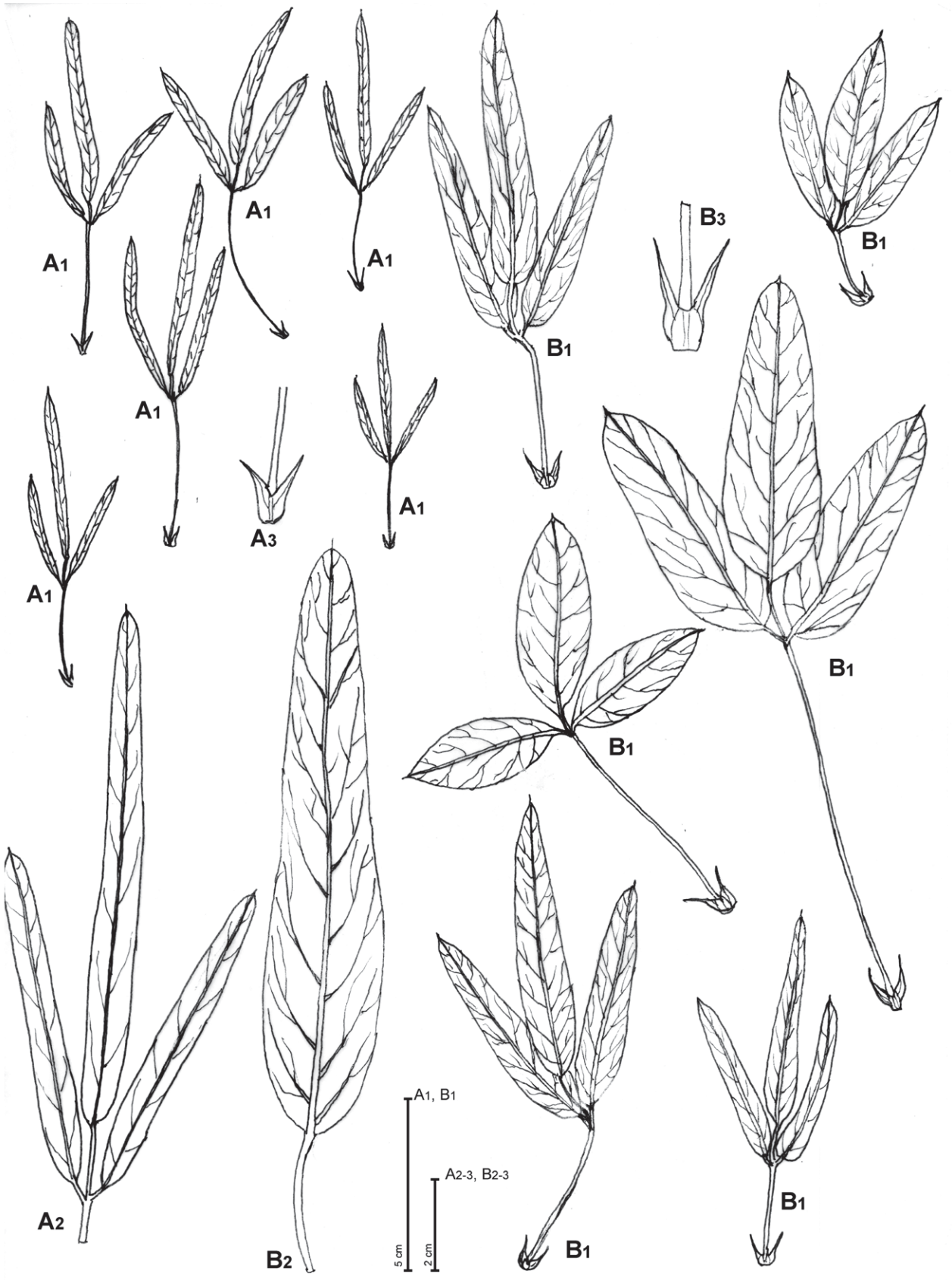

FIGURE 2. Variability in leaf and stipule shape of *Bituminaria basaltica* (**A1–3**) and *B. bituminosa* (**B1–3**). Illustration by Salvatore Brullo based on *Minissale s.n.* (CAT) for **A** and "Catania" *Brullo s.n.* (CAT) for **B**.

FIGURE 3. Holotype of *Bituminaria basaltica* (CAT).

Seed and pod micro-morphology:—As suggested by literature, the exomorphic features of seed testa, based on scanning electron microscopy (SEM), can be used as an additional character for the identification of a given taxon (Barthlott 1981, Koul *et al.* 2000, Fitsch *et al.* 2006, Kasem *et al.* 2011, Celep *et al.* 2012). Several studies on the seed coat micro-morphology of the legume taxa were performed by various authors (Murthy and Sanjappa 2002, Kirkbride *et al.* 2003, Salimpour *et al.* 2007, Al-Ghamdi *et al.* 2010, Bacchetta & Brullo 2010, Fawzel 2011, Gandhi *et al.* 2011, Brullo *et al.* 2011a, Brullo *et al*. 2013), who used several characters to resolve systematic problems. In fact, seed sculptures are usually considered as a conservative and stable character, having relevant taxonomical and phylogenetic implications.

The seed coat of *B. basaltica* shows a fine and undulate reticulum bounding the single cells, which are irregularly polygonal and 2–5 μm wide. The anticlinal walls are raised, with minutely rugose-undulate tops, while the periclinal walls are flat with epidermis finely reticulate-rugose (Fig. 4, A1–2). In order to elucidate the relationships with the allied *B. bituminosa,* its seed testa was also examined. Actually, the seeds of *B. bituminosa* are well differentiated from the new species in having, apart from the size (give the measurements), coat with a reticulum always more or less irregualar, with bigger cells, 5–9 μm wide, bounding by straight to curved furrows. The anticlinal walls are incised-depressed, while the periclinal walls are weakly convex, with epidermis uniformly sulcate by curved and concentric grooves (Fig. 4, B1–2).

Other significant differences can be observed in the pod indumentum. In particular, *B. basaltica* has hairs basally that are 22–27 μm wide and a longitudinal furrow broadly widened at the hair base (Fig. 4, A3), while in *B. bituminosa* hairs are 12–17 μm wide at the base and the longitudinal furrow is uniformly narrowed (Fig. 4, B3).

Habitat:—*Bituminaria basaltica* grows on volcanic soils, at an elevation of 20–100 m. The plant is mainly localized on dry grasslands dominated by *Hyparrhenia hirta*, abandoned fields and roadsides (Fig. 5) where hemichryptophytes are also abundant. From the bioclimatic viewpoint (Rivas-Martinez 2004), Filicudi falls within the Mediterranean Pluviseasonal Oceanic bioclimate, and the growing sites of *B. basaltica* are always south-facing with mean annual precipitations of ca. 500 mm and mean annual temperatures of 18°C (thermomediterranean upper dry bioclimatic belt).

Distribution:—Based on many field investigations carried out in the Aeolian Archipelago, *B. basaltica* seems to be endemic of Filicudi. No other *Bituminaria* species has been recorded from the other islands of this archipelago (Lojacono-Pojero 1878, Ferro & Furnari 1968a, 1968b, 1970, Di Benedetto 1973).

Etymology:—The specific epithet refers to the bedrock of the dwelled sites, which is represented by basaltic rocks.

Phenology:—Flowering April to early June, fruiting June to August.

Conservation status:—According to De Rosa *et al.* (2003), the age of the oldest exposed lavas on Filicudi is about 219 ka. Filicudi with an area of 9.5 km2 is the fifth-largest of the seven islets of the Aeolian Archipelago, which is located ca. 45 km off NE Sicily. The highest point is Monte Fossa delle Felci at 774 m of elevation. The long-lasting human exploitation, whose occurrence is dated back to the Neolithic, about 6000 years ago (Bernabò Brea & Cavalier 1991) has heavily altered the natural vegetation. Both husbandry and coppicing led to the almost complete disappearance of woodlands suddenly replaced by crops, shrubby vegetation, dry grasslands, and abandoned fields. Therefore, the current spread of *B. basaltica* on the island has been likely favoured by the human disturbance, being a species rather linked to disturbed and ruderal habitats. Considering that the new species is circumscribed to a small island and that grazing and fires may significantly reduce the number of individuals, it is suggested to add *B. basaltica* to the Italian Red List as Vulnerable (VU). In particular, based on the IUCN criteria (IUCN 2010), we propose to include this species in the following category: VU B2, C.

Taxonomic remarks:—According to Stirton (1981a), two morphologically well-differentiated subgenera can be recognized within the genus *Bituminaria*: subgen. *Bituminaria*, typified by *B. bituminosa*, and subgen. *Christevenia* Barneby ex Stirton (1981a: 318) typified by *B. acaulis*. The first-mentioned subgenus is caulescent plants with entire leaflets, racemes with axillary peduncles, bracts fused in a toothed blade, calyces ebracteolate and pods with some glabrous spinulose processes, while the last-mentioned subgenus includes

acaulescent plants with denticulate leaflets, racemes with scapiform peduncles, two bracts filiform separate to the base calyces provided at the base of a linear bracteole on each side and pods with soft pubescent processes. The morphological features of *B. basaltica* suggest to include it into the subgen. *Bituminaria*, together with *B. bituminosa*, *B. morisiana* (Pignatti & Metlesics) Greuter (1986: 108) and *B. flaccida* (Náb.) Greuter (1986: 108). Morphologically, *B. basaltica* differs from the other species of this subgenus for shape of cauline leaves, size of of raceme, flower pieces, corolla colour, pods and seeds (see Table 1).

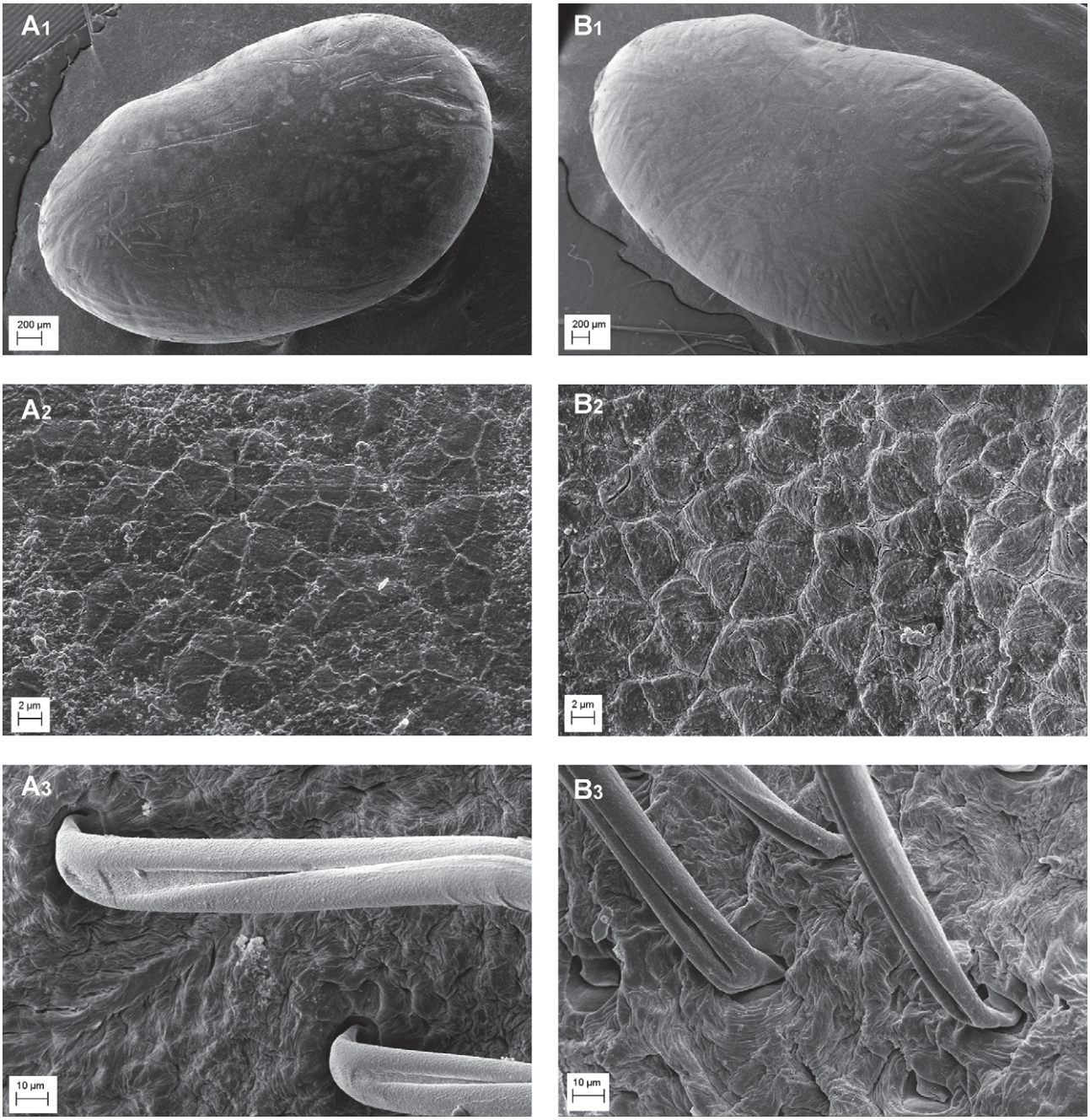

FIGURE 4. SEM micrographs of the seed coats of *Bituminaria basaltica* (**A1–2**) and *B. bituminosa* (**B1–2**) at low magnification (**A1** x 20 and **B1** x 28) and at high magnification (**A2** and **B2** x 2500) and hairs on the pods of *B. basaltica* (**A3**) and *B. bituminosa* (**B3**) at medium magnification (x 700), from material of Filicudi, *Minissale s.n.* (CAT) and Catania *Brullo s.n.* (CAT).

FIGURE 5. Phenological features of *Bituminaria basaltica*. **A.** Natural stands with *Hyparrhenia hirta* dry grassland habitat (Filicudi). **B.** Inflorescence. **C.** Terminal branches with leaves and inflorescences. **D.** Synanthropic stands abandoned fields (Filicudi). **E.** Fructified inflorescence. (Photos by P. Minissale).

TABLE 1. Main diacritic characters of the species of *Bituminaria.*

	B. basaltica	*B. bituminosa*	*B. morisiana*	*B. flaccida*	*B. acaulis*
Life form	hemicriptophyte	hemicriptophyte	chamaephyte	chamaephyte	hemicriptophyte
Ecology	terricolous	terricolous	chasmophyte	chasmophyte	terricolous
Stem habit	erect to ascending-erect	erect, rar. prostrate	erect-ascending	ascending to procumbens	acaule
Stem tool (cm)	up to 60	up to 150	up to 60	up to 40	up to 40
Stipule length (mm)	3–6	4–15	8–11	2–7	15–30
Leaf indumentum abaxial face	hirsute	hirsute	sparsely hairy	hirsute	hirsute
Leaf indumentum adaxial face	glabrous or subglabrous	hirsute	glabrous to subglabrous	hirsute	hirsute
Basal leaf petiole length (cm)	5–10	1.5–13	4–20	2–6.5	6–20
Basal leaflet shape	rounded-elliptical to linear-lanceolate	rounded-elliptical to lanceolate	ovate-lanceolate to elliptical	suburbicular to obovate	ovate to ovate-oblanceolate
Basal leaflet margin	entire	entire	entire	entire	denticulate
Basal leaflet length (mm)	8–40	3–90	27–42	4–15	30–70
Basal leaflet width (mm)	7–15	10–30	15–20	3–10	20–50
Cauline leaf petiole length (cm)	4–5	1.5–15	1.5–8	1–6	absent
Cauline leaflet shape (mm)	linear	elliptical to lanceolate	ovate-lanceolate to lanceolate	obovate to linear-lanceolate	absent
Cauline leaflet length (mm)	30–55	30–60	28–38	8–20	absent
Cauline leaflet width (mm)	2–6	6–22	6–18	2–12	absent
Peduncle raceme length (cm)	10–16	8–22	4–12	2–9	18–25
Raceme shape	capitate	capitate	capitate to ovoid	capitate	ovoid to ellipsoid
Raceme lenght (cm)	1–1.6	2–2.8	2.5–4.5	1.7–2	3–6
Raceme number flower	6–12 (16)	15–30	10–25	5–8	20–50
Bract shape	single, laminar, toothed	single, laminar, toothed	single, laminar, toothed	single, laminar, toothed	two, filiform
Bract length (mm)	6–8	6–15	6–9	3–5	15–22
Calyx bracteoles	absent	absent	absent	absent	present
Calyx length (mm)	10–13	14–18	15–18	9–11	15–18
Calyx tube length (mm)	4–5	6–7	5–7	5–6	7–8
Calyx lower tooth length (mm)	6–9	7–12	7–10	5–6	7–10
Calyx lateral teeth length (mm)	4–6	7–9	6–8	4–5	6–8
Corolla colour	pure white	blue-violet	white-violet	pink	creamy-white
Corolla length (mm)	11–13	15–20	18–23	16–18	15–20
Corolla/calyx ratio	subequalling	longer	longer	longer	longer
Standard shape	spathulate	ovate-elliptic	ovate-lanceolate	ovate-elliptic	obovate-spathulate
Standard apex	rounded to obtuse	emarginated	obtuse	obtuse	obtuse
Standard length (mm)	11–13	15–20	18–23	16–18	15–20
Standard width (mm)	5–6	5–8	6–8	5–6	–
Wing length (mm)	10–11	14–18	16–18	15–16	14–16
Wing limb width (mm)	2.5–3	2–3	3–4	3.3–5	–
Keel length (mm)	7.5–8.5	10–14	11–14	13–14	12–14
Keel limb width (mm)	1.5–1.8	1.8–2.5	2–2.5	1.8–2	–
Staminal tube (mm)	7–8	10–13.5	9–12	11–12	11–13
Pistil length (mm)	6–7	9–12	9–10	–	–
Pod length incl. beak (mm)	9–10	13–26	18–26	10	20
Pod setaceous hairs length (mm)	0.5–2	0,5–3	0,5–3	–	–
Pod beak lenght (mm)	5.5–6	9–19	12–19	5	10
Pod beak face indumentum	glabrous	Pubescent	Pubescent	pubescent	hirsute
Seed lenght (mm)	3.5–4	5–7	5–7	5	10
Seed width (mm)	2–2.2	3–4	3–4	–	–

– : unchecked character

Bituminaria basaltica shows some relationship with *B. bituminosa* in the habit and ecological characters but it is well differentiated in several characters chiefly regarding size and shape of the leaves, inflorescences, flowers, pods, seeds and corolla colour. In fact, *B. bituminosa* has elliptic to lanceolate cauline leaflets, 6–22 mm wide, racemes 2–2.8 cm long, with 15–30 flowers, calyx 14–18 mm long, with teeth 7–12 mm long, corolla blue-violet, 15–20 mm long, longer than calyx, with apex emarginate, staminal tube 10–20 mm long, pistil 9–12 mm long, pods (beak included) 13–26 mm long, beak pubescent in the face, seeds 5–7 mm long (Fig. 6). Moreover, *B. basaltica* is similar to *B. flaccida,* by having very short pods (max. 10 mm), which occurs in Israel, Jordan and Sinai, but several morphological features and ecological requirements allows distinguishing the two species. Actually, *B. flaccida* is a typical chasmophyte, having leaflets completely hirsute, the basal ones suborbicular to obovate, 4–15 mm long, the cauline ones obovate to linear-lanceolate 8–20 mm long, racemes 17–20 mm long, 5–8-flowered, with peduncles 2–9 mm long, calyx 9–11 mm long, corolla pink, 16–18 mm long, longer than calyx, staminal tube 11–12 mm long, and pod beak 5 mm long, completely Pubescent. Lastly, even *B. morisiana* is markedly different from *B. basaltica*, mainly for the chamaephytic habit, wider leaves, bigger and many-flowered racemes, bigger floral pieces, corolla white-violet, pods (beak included) 18–26 mm long, and seeds 5–6 mm long.

Based on the current knowledge, *B. basaltica* seems to be circumscribed to Filicudi, where it is morphologically stable, showing no variability in the wild.

It is worthy to mention that the Aeolian Archipelago hosts several narrow endemics or rare species, such as *Cytisus aeolicus* Gussone (1834: 221), *Silene hicesiae* Brullo & Signorello (1984: 141), *Centaurea aeolica* Gussone ex Candolle (1838: 584), *Genista tyrrhena* Valsecchi (1986:145), *Erysimum brulloi* Ferro (2009: 298), *Eokochia saxicola* (Gussone 1855: 275) Freitag & G. Kadereit in Kadereit & Freitag (2011: 72)*, Dianthus rupicola* Biv. subsp. *aeolicus* (Lojacono-Pojero 1888: 163) Brullo & Minissale (2002: 539), and *Limonium minutiflorum* (Guss.) Kuntze (1891: 395). Therefore, it is possible to consider this archipelago as a micro-hotspot, characterized by very active speciation processes, which is likely a consequence of manifold constraining factors, such as harsh environmental conditions, geological history, and geographical isolation. As in the case of *Eokochia saxicola, Cytisus aeolicus* and *Silene hicesiae*, the Aeolian Archipelago probably acted as a refuge area for otherwise extinct species (Brullo & Signorello 1984, Conte *et al*. 1998, Cristofolini & Conte 2002, Kadereit & Freitag 2011, Santangelo *et al.* 2012). The last recorded endemics confirm the peculiarity of the Mediterranean flora, not only for the high rate of narrow endemics particularly on islands or wherever mountains exceed 1500 m in altitude (cf. Pignatti *et al.* 1980, Greuter 1991, Médail & Quézel 1997, Thompson 2005, Guarino *et al.* 2005, Brullo *et al.* 2001, 2005, Brullo *et al.* 2011b) but also for the peculiar distribution patterns that make the Mediterranean island biogeography so interesting and intriguing (Troia *et al.* 2012).

Finally, *B. basaltica* could also be an interesting species to study for its potential use as a pasture grass and forage plant, similarly to *B. bituminosa* which has increased in agronomical appeal during the last decade (Méndez & Fernández 1990, Gutman *et al.* 2000, Sternberg *et al.* 2006, Walker *et al.* 2006, Real *et al.* 2009, Ventura *et al.* 2004, Gulumser *et al.* 2010, Finlayson *et al.* 2012). The use of *B. bituminosa* as forage species is well known in the Canary Islands for a long time (Méndez 2000), where it is not cultivated but spontaneously grazed by livestock or, more frequently, collected and offered to the livestock as hay, thus removing its typical smell of bitumen which causes the refusal by animals when it is still green. In particular, *B. bituminosa* var. *albomarginata*, which occurs exclusively in Lanzarote (Canary Islands), was introduced to Australia in 2005 (Finlayson *et al.* 2012), in order to experimentally evaluate it for potential release as a commercial forage crop. Its extreme drought tolerance, lower invasiveness together with its ability to produce relatively high quality feed throughout the year, is extremely interesting (Ventura *et al.* 2009). Therefore, the potential use of *B. basaltica* as pasture grass or fodder should be worthy to be tested. In particular, its weak bitumen smell would suggest this legume as fairly good for grazing, and not being a strong colonizer, the risks of becoming a weed are rather low. This potential plant for animal husbandry confirms once more the importance and usefulness of any survey focused on biodiversity, even in areas very explored as the Mediterranean islands.

FIGURE 6. Diagnostic features of *Bituminaria bituminosa*. **A.** Flower (lateral view). **B.** Flower (ventral view). **C.** Bud. **D.** Standard. **E.** Wings. **F.** Keel (open). **G.** Keel (lateral view). **H.** Calyx (open). **I.** Calyx (ventral view). **J.** Calyx (dorsal view). **K.** Fruiting calyx and pod. **L.** Pod. **M.** Pistil. **N.** Stigma. **O.** Seeds. **P.** Staminal tube. **Q.** Anthers. **R.** Illustration by Salvatore Brullo based on specimens from Catania, *Brullo s.n.* (CAT).

Key to the species of *Bituminaria*

1. Plants acaulescent; leaflets sessile, denticulate; racemes ovoid to ellipsoid ..... *B. acaulis*
- Plants caulescent; leaflets petiolate, entire; racemes capitate 2
2. Cauline leaflets linear; corolla purely white; flowers 11–13 mm long ..... *B. basaltica*
- Cauline leaflets wider (not linear); corolla pink to blue-violet or white-violet; flowers 15–20 mm long 3
3. Racemes 5–8 flowered; calyx 9–11 mm long;, corolla pink; pods 10 mm long (including persistent beak) ..... *B. flaccida*
- Racemes 10–30 flowered; calyx 14–18 mm long; corolla white-violet to blue-violet; pods, pod 13–26 mm long (including persistent beak) 4
4. Plants woody at the base;, leaflets glabrous or subglabrous adaxially; racemes 3–4.5 mm long ..... *B. morisiana*
- Plants entirely herbaceous; leaflets hirsute; racemes 2.0–2.8 mm long ..... *B. bituminosa*

Additional specimens examined (paratypes):—ITALY. Sicily: Filicudi a Monte Guardia, praterie steppiche su substrati vulcanici, 38°33’30.47"N, 14°34’36.92"E, 61 m, 29 June 2012, *P. Minissale s.n.* (CAT!); Filicudi a Pecorini a Mare, praterie steppiche su substrati vulcanici, 38°33’36.28"N, 14°33’58.81"E, 46 m, 29 June 2012, *P. Minissale s.n.* (CAT!).

Additional specimens examined (related taxa):

B. acaulis:
TURKEY. Rize: Talus en lisière de sous-bois d’*Abies nordmanniana*, Oviedagi Gocidi, bord de la route 925, 6 kilometres sud Rize, Turquie, 1434 m, 07 July 2007, *P. Rabaute 9431* (Herbier Philippe Rabaute).

B. bituminosa:
ITALY. Sicily: Madonie, 25 April 2001, *S. Brullo* & *S. Sciandrello s.n.* (CAT); Agira (Enna), 09 June 1993, *S. Brullo* & *P. Minissale s.n.* (CAT); Monte Palmeto, 23 April 1971, *S. Brullo s.n.* (CAT); Rosella, Pozzallo, 04 May 1969, *S. Brullo s.n.* (CAT); Monte Cofano, Trapani, May 1975, *S. Brullo s.n.* (CAT); Marsala, 14 April 1985, *S. Brullo s.n.* (CAT); Catania, Tondo Gioeni, 25 May 2012, *S. Brullo s.n.* (CAT).

B. flaccida:
ISRAEL. Negev: Edom, 10 October 1988, *O. Fragman s.n.* (Ori Fragman’s Herbarium-Jerusalem); Edom, 21 April 1989, *O. Fragman s.n.* (Ori Fragman’s Herbarium-Jerusalem).

B. morisiana:
ITALY. Sardinia: S’Enna e Sa Craba, Conca D’Oru, Capoterra (CA), graniti, metaquarziti, 500–655 m, 10 June 1998, *G. Bacchetta* & *S. Brullo s.n.* (CAT); Monte Taddì (vulcaniti), 9 June 2001, *G. Bacchetta, S. Brullo, M. Casti* & *G. Giusso s.n.* (CAT); Rio di Monti Nieddu (CA), 13 June 1998, *G. Bacchetta* & *S. Brullo s.n.* (CAT); San Nicola, Buggerru (CA), 11 June 1998; *G. Bacchetta* & *S. Brullo s.n.* (CAT).

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