



The taxonomy of *Galium crespianum* J.J. Rodr. (Rubiaceae), a Balearic Islands endemic revisited

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Galium crespianum J.J. Rodr. is a perennial plant inhabiting cliffs and crevices on the Balearic Islands. Although it was described from the mountains of Mallorca, several populations from the islands of Eivissa and Formentera have been traditionally considered as belonging to the same species. A careful comparison of specimens from the western and eastern Balearics revealed several discriminant features in gross morphology (robustness and habit of the stems, presence or absence of hairs at the internodes and leaves, waxiness of stems and leaves, shape of the inflorescence, flower colour and scent) and stem anatomy. In addition, several mutations in the ribosomal ITS sequences distinguished western and eastern plants. It is proposed that the plants from Eivissa and Formentera previously subsumed under *G. crespianum* be recognized at the specific level as *G. friedrichii* N. Torres, L. Sáez, Mus & Rosselló **nom. nov.** The new species is tetraploid ($2n=44$) and shares morphological features with *G. crespianum* or with several taxa in the *G. glaucum* complex from the south east Iberian peninsula, to which it is most probably related.

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INTRODUCTION

With nearly one hundred vascular endemic plants (excluding apomictic taxa), the Balearic archipelago is one of the most species-rich areas of the western Mediterranean basin. One noteworthy feature of this endemic element is that most taxa live in small areas which are restricted to single islands. Interestingly, a low number of taxa are shared between the western (Eivissa and Formentera: Pytiusic Islands) and the eastern Balearics (Mallorca, Menorca and Cabrera: Gymnesic Islands). These are two groups of islands with a different palaeographic history (Alcover, Seguí & Bover, 1999), and constitute what are believed to be the remnants of an old flora which developed *in situ* (Contandriopoulos & Cardona, 1984).

One of the species present in both the Gymnesic and Pytiusic Islands is *Galium crespianum* J.J. Rodr.,

described from the mountains of Mallorca (Rodríguez, 1879) and later reported from the Pytiusic Islands (Eivissa and Vedrà islet) by Knoche (1922). Knoche (1922) identified the Mallorcan *G. crespianum* with *Rubia laevis* Poirét, an earlier name described from Algeria (Poirét, 1789), and placed it under *G. firmum* Tausch [as *G. firmum* f. *laevis* (Poir.) Knoche], at present considered as an endemic element restricted to the western Balkan peninsula (Ehrendorfer, Krendl & Puff, 1976). The populations of *G. crespianum* from Eivissa and the surrounding islets were described by Knoche (1922) as *G. firmum* f. *balearicum* Knoche and were characterized as having longer leaves. This author also reported the presence of such a form in two localities from Mallorca. This treatment was followed by Malagarriga (1973) who granted the Pytiusic plant a subspecific rank under *G. firmum*. The specific status of *G. crespianum*, and its circumscription to the Balearic archipelago, was credited again by Ehrendorfer *et al.* (1976) who did not recognize any infraspecific variant. This view was also followed by

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Cardona & Sierra-Rafols (1979) when dealing with the systematic relationships of the Balearic plant.

Field observations made of populations of *G. crespianum* revealed conspicuous and fixed differences involving vegetative and floral features among Gymnesic and Pytiusic plants. These were later confirmed by a close examination of herbarium specimens. Therefore, we studied the morphology, anatomy, cytology and molecular differentiation of eastern and western Balearic plants in order to substantiate the degree of taxonomic differentiation within *G. crespianum*. Morphological and molecular gaps were strongly correlated with geographic boundaries and showed that the populations of *G. crespianum* from the western Balearics clearly differ from those inhabiting the eastern islands. Contrary to the observations made by Knoche (1922), we have not seen any specimen from Mallorca (even at the reported populations) resembling the Pytiusic plants. Evidence is presented below that the degree of population differentiation merits the recognition of two separate species. Accordingly, the plants from Eivissa and Formentera are ascribed to a new species, *Galium friedrichii*.

MATERIAL AND METHODS

MORPHOLOGY

Specimens of *G. crespianum* and other related taxa of the *G. glaucum* L. group (*G. murcicum* Boiss. & Reuter in Boiss., *G. pruinosum* Boiss., *G. festivum* Krendl) were studied at or borrowed from the following herbaria: BC, M, MA, MAF, MPU, W (abbreviations according to Holmgren, Holmgren & Barnett, 1990), and Jardí Botànic de Sóller (JBS; Mallorca). Relevant sheets of the herbarium of J. J. Rodríguez (now held at the Ateneu de Maó, Balearic Islands), were studied at his birthplace through the kindness of the Rodríguez family. Representative herbarium material examined is listed in the Appendix. In addition, field observations were made on individuals of *G. crespianum* from several populations of Mallorca (including the type locality), Eivissa and Formentera. Wax depositions on the cuticles of leaves and fruits were studied under the SEM.

ANATOMY

Individuals of *G. crespianum* from single populations of Mallorca (Coma de n'Arbona), Eivissa (Cingles d'en Racó) and Formentera (La Mola) were collected in the field and fixed in glycerine-alcohol-water (1:1:1). Fixation was followed by a thorough rinse in running water for 24 h. Median portions of leaves and stems were cut and 5 µm sections stained with Bismarck Brown using standard techniques.

KARYOLOGY

Floral buds from individuals from Mallorca (Alfàbia, Come de n'Arbona, Randa) and Eivissa (Talaia de Sant Josep) were fixed in ethanol:glacial acetic acid (3:1). This material was sent to F. Ehrendorfer (Vienna) who kindly made the chromosome counts.

NUCLEAR RIBOSOMAL ITS SEQUENCES

Total DNA from *G. crespianum* plants from Mallorca (Formentor) and Eivissa (Talaia de Sant Josep) was extracted from 20 mg of silica gel-dried tissue using a slightly modified CTAB protocol (Doyle & Doyle, 1987). The region including ITS-1, 5.8 S and ITS-2 was amplified using the primer pair ITS-5/ITS-4 (sequences in White *et al.*, 1990). Double-stranded amplifications were sequenced using the ddNTPs fluorescent dye terminator method on an Automated Applied Biosystems 373 DNA Sequencer.

RESULTS

COMPARATIVE MORPHOLOGY

Plants of *G. crespianum* from Mallorca (Fig. 1) showed contrasting morphologies when compared to individuals of *G. friedrichii*. Plants from the western Balearics are pruinose, with robust, erect stems; leaves are green on the adaxial surface, glaucous beneath, linear-lanceolate, up to 70 mm long, showing smooth margins; internodes are long, (5)25–70(110) mm, with narrow and little prominent keels (0.1–0.25 mm), glabrous; inflorescences are dense (up to 110 flowers) and elongated (length inflorescence/height of the plant: 0.2–0.5); flowers are white and strongly sweetly fragrant. In contrast, plants from Mallorca are pale green, not glaucous, slender, with ascendent or decumbent stems; leaves are concolorous, linear-lanceolate, up to 38 mm long, usually showing 1–2 rows of teeth in the margin (rarely on the adaxial surface); internodes are short, (5)15–25(49) mm, with broad and prominent keels (0.3–0.55 mm), showing in the upper half retrorse hairs (0.10–0.25 mm); inflorescences have fewer flowers (up to 65) and are somewhat contracted (length inflorescence/height of the plant: 0.33–0.66); flowers are yellow and usually odourless. These differences are maintained when plants from Mallorca and Eivissa are cultured side by side in the greenhouse; identical results were obtained looking at the living collections of the Botanical Gardens of Sóller and Valencia, where both plants grow together. The morphology of the plants referred to *G. crespianum* from the western Balearics does not closely match those exhibited by other species of *Galium*. A comparison of the Pytiusic plants with several species from the series *Octonaria* (Klokov) Pobed, namely

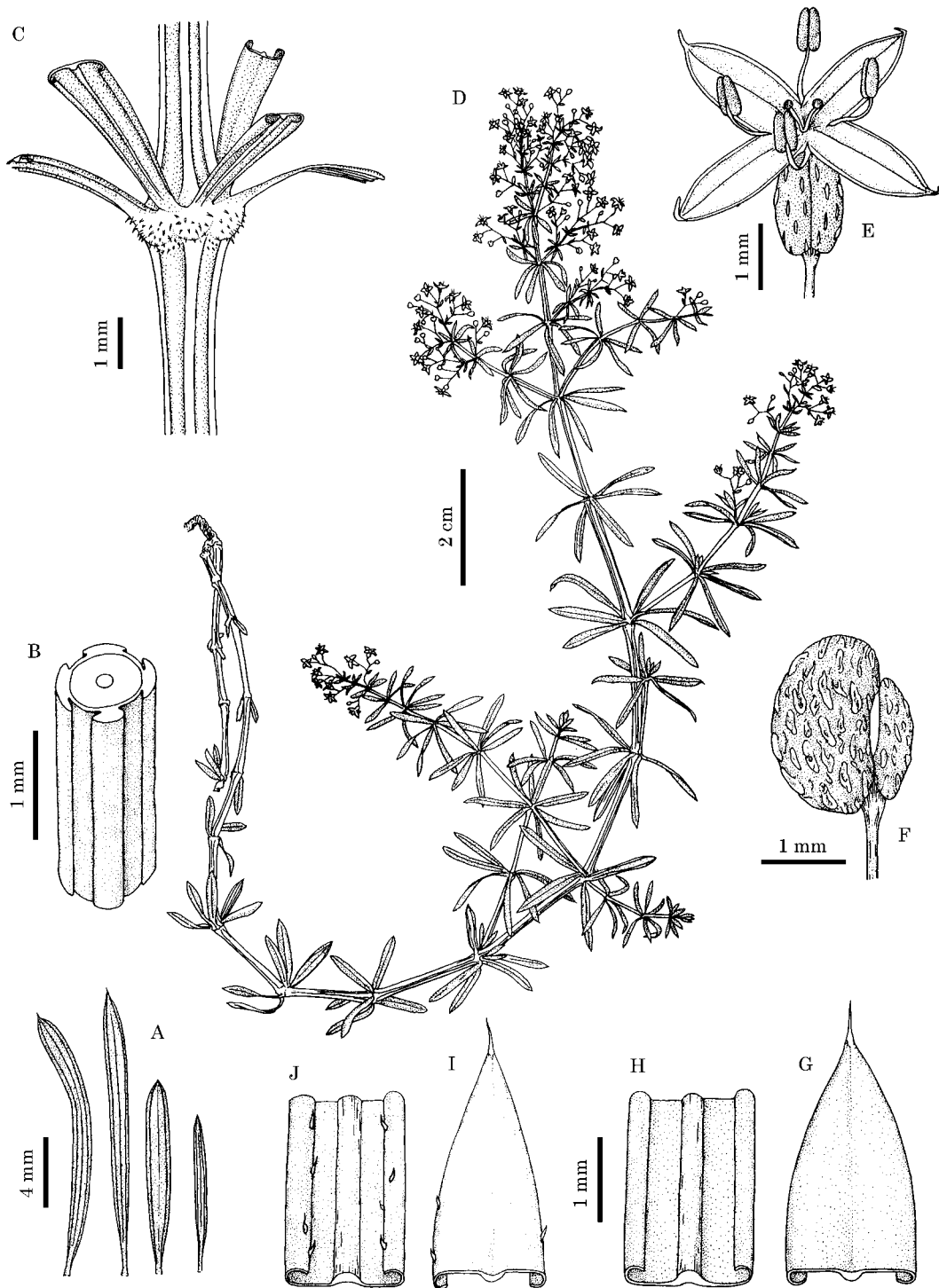


Figure 1. *Galium crespianum*. A–H, Coma de n'Arbona, Mallorca, 18.vi.1920, Gros (BC 112139); I & J, Vertiente N. del Puig de Son Torrella, grietas de peñas calcáreas, 30.vi.1879, A Crespí (BC 649903). A, leaves; B, cross-section of stem; C, stem node; D, habit; E, flower; F, mericarp; G–J, details of abaxial and adaxial leaf surfaces.

from the *G. glaucum* complex inhabiting the mountains of south-east Spain, showed some resemblances in gross morphology, including the overall glaucous

appearance, the erect and robust stems, the lack of hairs on the internodes, the narrow and little prominent keels of the stems, and the white corollas.

Table 1. Main morphological differences between *Galium friedrichii* nom. nov. and related species. Measurements are in mm

	<i>G. pruinatum</i>	<i>G. murcicum</i>	<i>G. friedrichii</i>	<i>G. crespianum</i>
Stem	robust, erect or ascendent	robust, erect	robust, erect to erect-ascendent	decumbent or ascendent
Internodes	7–200 glabrous	15–105 glabrous	(5)25–70(110) glabrous	(5)15–25(49) hair in the upper part
Leaves	10–25 × 3–6 broadly ovate to elliptical; not falcate pruinose; lower and upper surface concolorous margin scabrid	10–45 × 0.5–2 linear-lanceolate; rarely falcate pruinose; lower and upper surface concolorous margin scabrid	15–50(70) × 1.5–4 linear-lanceolate; often falcate pruinose; lower and upper surface not concolorous glabrous	(10)15–(30)38 × 1–2.5 linear-lanceolate; often falcate not pruinose; lower and upper surface concolorous margin scabrid or glabrous
Corolla	infundibuliform; white	infundibuliform; white	rotate; white	rotate; yellow

However, enough vegetative and reproductive features enabled an easy discrimination of the Pytiusic plant from these possibly related entities (Table 1).

ANATOMY

The structure of stems and leaves is very similar in *Galium crespianum* and *G. friedrichii*. Internal differences were mainly observed in the shape of the cross-section of stems. Plants from the Pytiusic Islands show (sub-)quadrangular stems, whereas those from Mallorca are rhombic, with prominent keels (Fig. 2A–D). Stomata are more prominent in the epidermis of the Pytiusic than the Gymnesic plants; also epidermal cells are bigger and wider in the former (Fig. 2E,F).

KARYOLOGY

Plants from a single population of *G. friedrichii* have a chromosome number of $n=22$. The same number was found in three populations of *G. crespianum* from Mallorca. These results suggest that both species are tetraploid. This sharply contrasts with previous counts of *G. crespianum* from Mallorca which showed $2n=66$ (Cardona, 1976).

RIBOSOMAL DNA SEQUENCES (ITS)

The two internal transcribed spacers located within the ribosomal cistron were amplified from single *G. crespianum* and *G. friedrichii* samples. Both sequences were virtually identical at the ITS-1 spacer, but divergence was found at 12 positions from the ITS-2 region (Table 2). All mutations were base substitutions and no insertion/deletion events were

inferred from sequence comparisons. Currently, no ITS sequences for any *Galium* species are available at the molecular databases (GenBank, EMBL); unfortunately, this prevents further comparison of the level of sequence divergence present among congeneric *Galium* taxa.

Galium friedrichii nom. nov.

Galium friedrichii N. Torres, L. Sáez, Mus & Roselló, **nom. nov.**

≡ *Galium firmum* f. *balearicum* Knoche, *Fl. Balear.*, 2: 420 (1922) [syn. subst.].

≡ *G. firmum* subsp. *balearicum* (Knoche) Malag., *Subsp. Var. Geogr.*: 13 (1973), non *G. balearicum* Briq. — *G. crespianum* auct., non J.J. Rodr.

Ind. loc. “IVICE: lj D7. Isla de Vedra (Font!)”.

Lectotype. (designated here). Cala Aubarca, exp. N, 75 m, 21.v.1908, *Knoche 2493* (MPU-Knoche).

Etymology. Friedrich Ehrendorfer, in recognition of his outstanding work on the taxonomy of *Galium* and other Rubiaceae.

Illustration. Figure 3.

PERENNIAL, usually robust, erect or erect-ascendent, glabrous, glaucous. Rootstock with slender stolons. STEMS (15)25–60(90) cm, clearly pruinose, subquadrangular in cross-section, ribs 0.1–0.25 mm wide, scarcely prominent; internodes (5)25–70(110) mm,

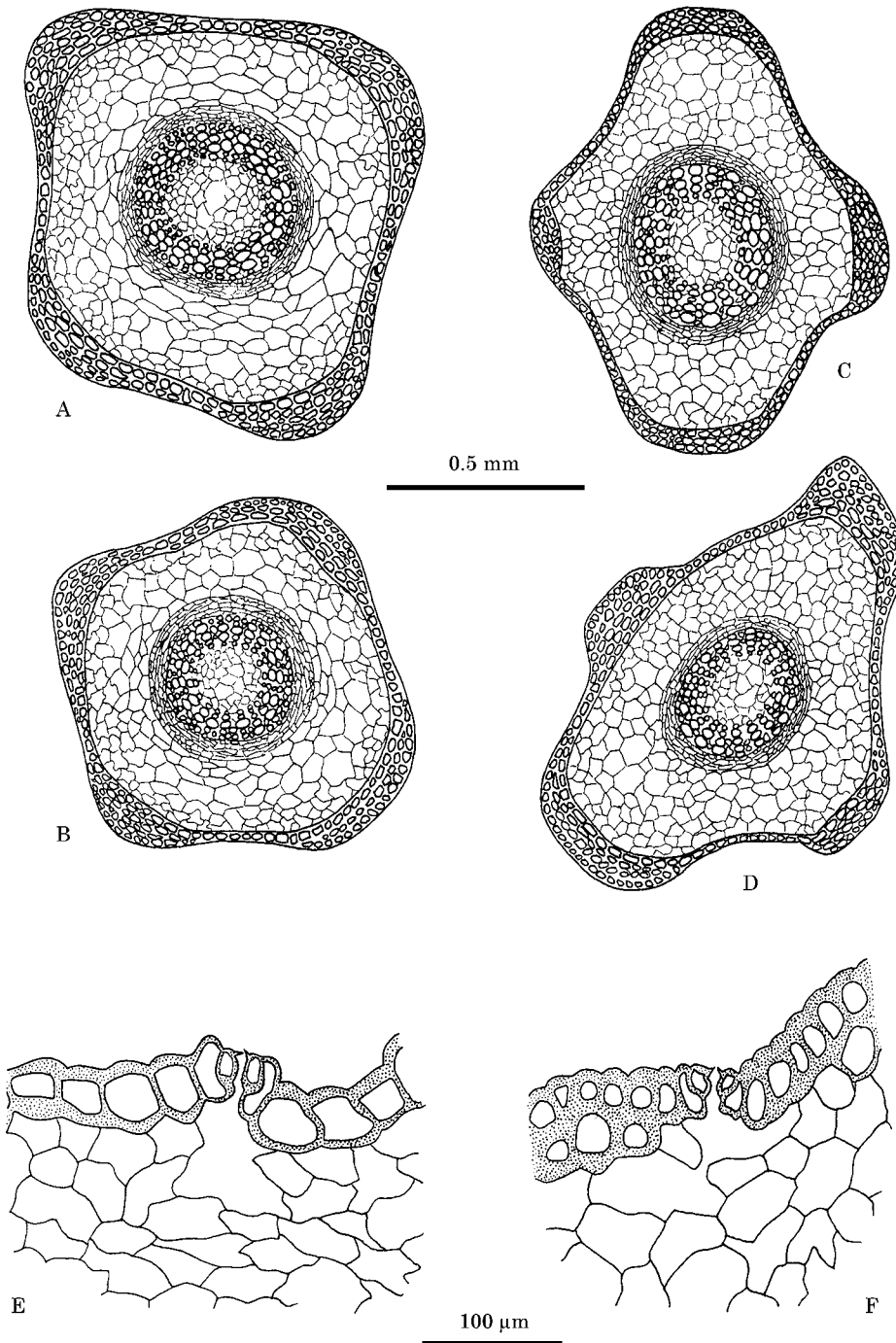


Figure 2. Cross-sections of stems of *Galium friedrichii* nom. nov. (A, B, E) and *G. crespianum* (C, D, F).

glabrous. LEAVES in whorls of (6)8(15), linear-lanceolate, often falcate, 15–50(70) × 1.5–4.0 mm, with revolute margins, green on the adaxial side, glaucous on the abaxial; mucronate, with a hyaline apex 0.4–0.9 mm; marginal aculeolate hairs absent. INFLORESCENCE occupying 1/4–1/2 of the stem, very dense (up to 110 flowers), ovoid; PEDICELS glabrous,

1.1–4 × 0.4–0.9 mm at post-anthesis; partial inflorescences to 3.7 cm, usually shorter than or equalling the adjacent stem internode; bracts 1.5–4 mm. FLOWERS very fragrant, white; COROLLA rotate 4–5 (5.5) mm diam., lobes 1.8–2.5 × 0.7–1.3 mm, ovate, mucronate. STAMINAL FILAMENT 0.9–1.1 mm, anthers 0.45–0.6 mm, oblong. OVARY glabrous, style

Table 2. Polymorphic ITS-2 sites between *Galium friedrichii* nom. nov. and *G. crespianum*. Site number refers to aligned sequences from the two species

	1	1	1	1	1	1	1	1	2	2	2
	9	0	0	2	4	7	7	8	8	0	1
	8	7	9	0	3	0	5	6	8	4	4
<i>G. crespianum</i>	G	A	G	C	T	A	G	G	C	C	G
<i>G. friedrichii</i>	A	G	A	T	G	G	A	A	T	A	C

0.3–0.5 mm, STIGMA 0.1–0.2 mm diam., globose, black. MERICARPS 1.6–2.1 × 1.1–1.5 mm, often solitary, sub-reniform, glabrous, waxy, irregularly cristate when dry.

Material examined. EIVISSA: Cala de les Torretes, 15.vi.1918, *Gros* (BC 107324); *Ibid.*, 8.vii.1920, *Gros* (BC 106999); Ses Torretes, 11.iii.1920, *Gros* (BC 112144); Punta de la Creu, a S. Miquel, 19.v.1919 *Font Quer* (BC 27177); Ses Coves Negres, barranc de la cala Llentrisca, 15.iii.1920, *Gros* (BC 112141); Cala Llentrisca, 24.vi.1987, *N. Torres* (herb. N. Torres); Cala d'Albarca, 30.iv.1920, *Font Quer* (BC 106961); *Ibid.*, 5.vii.1920, *Gros* (BC 107004); *Ibid.*, 4.vii.1977, *A. Cardona & E. Velasco* (BC 625562); *Ibid.*, 2.vii.1988, *N. Torres* (herb. N. Torres); Cala d'Albarca, Puig d'en Pereta, 20.vii.1986, *N. Torres* (herb. N. Torres); Cap des Mossons, 10.x.1992, *N. Torres* (herb. N. Torres); Font des Margalló, 29.vi.1986, *N. Torres* (herb. N. Torres); Penyal des s'Àguila, 8.vi.1996, *N. Torres* (herb. N. Torres); Cingles des Clots Negres, 29.v.1993, *N. Torres* (herb. N. Torres); Na Xamena, 28.vi.1997, *N. Torres* (herb. N. Torres); Cala de les Balandres, 9.vii.1920, *Gros* (BC 107003); *Ibid.*, 15.vi.1996, *N. Torres* (herb. N. Torres); Ses Roques Altes, 2.v.1920, *Gros* (BC 107034); *Ibid.*, 30.v.1989, *N. Torres* (herb. N. Torres); *Ibid.*, 6.vi.1992, *N. Torres* (herb. N. Torres); Puig des Savinar, 21.xii.1991, *N. Torres* (herb. N. Torres); Cala d'en Damià, 10.vii.1920, *Gros* (BC 112112); Cap des Jueu, 7.vii.1977, *A. Cardona & E. Velasco* (BC 625562); Cingles d'en Racó, 5.vi.1988, *N. Torres* (herb. N. Torres); *Ibid.*, 16.vi.1990, *M. Mayol & al.* (JBS); Sa Talaia de Sant Josep, 17.vi.1990, *M. Mayol & al.* (JBS); illa del Vedranell, 5.vii.1920, *Gros* (BC 107033); *Ibid.*, 7.v.1920, *Gros* (BC 107035); illa del Vedrà, 7.v.1920, *Gros* (BC 107033); *Ibid.*, 19.v.1920, *Gros* (BC 27178); *Ibid.*, 19.vii.1920, *Gros* (BC 112143); without specified locality, cultured at the Botanical Garden of Sóller, 27.vii.1989, *M. Mus* (JBS); *Ibid.*, 6.vii.1991, *M. Mus* (JBS); *Ibid.*, 9.vi.1991, *N. Torres & J.A. Rosselló* (JBS).

FORMENTERA: La Mola, 24.iv.1920, *Gros* (BC 107007); Peñas de la Mola, 24.vii.1920, *Gros* (BC 107736); Far de la Mola, 28.vi.1987, *N. Torres* (herb. N. Torres); *Ibid.*, 26.vi.1993, *N. Torres* (herb. N. Torres); Torrent

de sa Fontanella, 4.viii.1991, *N. Torres* (herb. N. Torres); Racó de la Xindria, 26.vi.1993, *N. Torres* (herb. N. Torres).

Habitat and distribution. *Galium friedrichii* grows on shady calcareous cliffs mainly located along the coasts of the major Pytiusic islands and islets. At Eivissa its populations are centred around two nuclei at the north-west and south-west sites, whereas at Formentera it is known from scattered sites on the east of the island (Fig. 4). The populations of *G. friedrichii* can be found at 10–450 m. Most associated plants are Balearic or Iberian endemic elements such as *Diploaxis ibicensis* (Pau) Gómez-Campo, *Asperula pauii* Font Quer, *Biscutella ebusitana* Rosselló *et al.*, *Thymus richardii* Pers. subsp. *ebusitanus* (Font Quer) Jalas, *Avenula crassifolia* (Font Quer) Holub, and *Hippocrepis grosii* (Pau) L. Llorens *et al.* *Galium friedrichii* flowers from May to July, but occasionally it can also flower in the autumn or early winter.

DISCUSSION

With some exceptions all previous authors dealing with *G. crespianum* have apparently overlooked or underestimated the conspicuous differences present when comparing plants from the western and eastern Balearics, and all populations have been considered as belonging to a single species. In our opinion this is an untenable taxonomic point of view. The number and quality of the external discriminant features (vegetative and reproductive) so far found (Table 1), which do not revert in culture, the lack of intermediate specimens linking the extreme morphotypes, and the allopatric distribution of their populations, strongly support the view that the Pytiusic populations of *G. crespianum* should neither be included within this circumscription nor within any related species of the *G. glaucum* complex. The splitting of *G. crespianum* into two taxa is also warranted by the limited molecular evidence gained from the non-coding ribosomal ITS sequences which also support the genetic distinctiveness of the two entities. However, the comparison of diagnostic features between *G. friedrichii* and putative allied species could not specifically address the question as to which species it is most closely related. In its robust and erect habit, the glaucous appearance of the whole plant, the lack of retrorse hairs at the internodes, the wide ribs of the stems, and the white colour of the corolla *G. friedrichii* clearly resembles several taxa from the series *Octonaria* inhabiting the Iberian peninsula, mainly *G. pruinatum* and *G. murcium*. However, the misidentification of *G. friedrichii* with *G. crespianum* (belonging to the series *Erecta* Pobed) could have been prompted by their sharing narrowly linear-lanceolate leaves, which are often

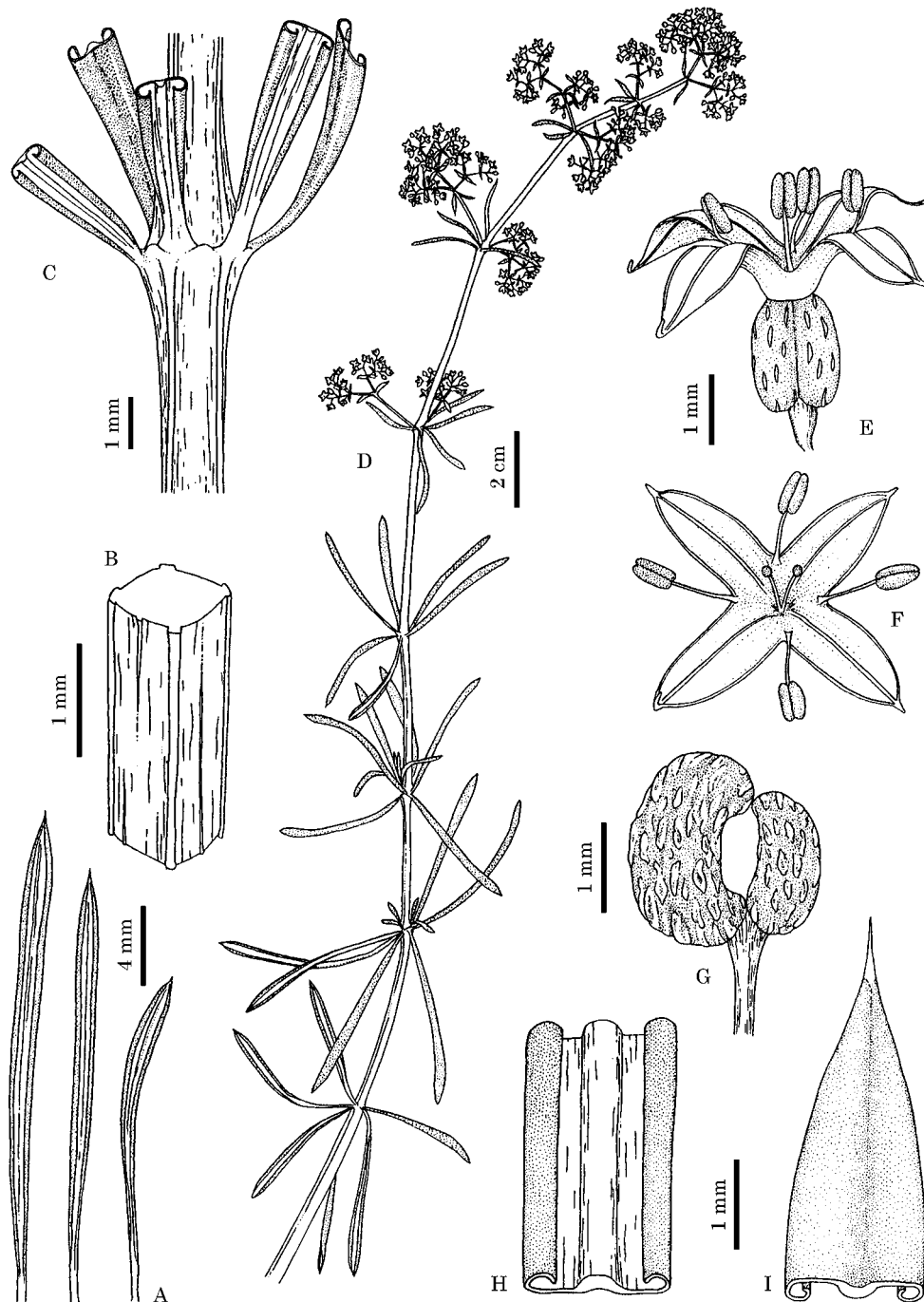


Figure 3. *Galium friedrichii* nom. nov. A–H, Cingles d'en Recó, 16.vi.1990, M. Mayol & al. (JBS). A, leaves; B, cross-section of stem; C, stem node; D, habit; E, F, flower; G, mericarp; H, I, details of abaxial and adaxial leaf surfaces.

falcate, and rotate corolla, two features which are absent in the Iberian relatives of *G. friedrichii*. In addition, the presence of discoloured leaves and the absence of aculeate hairs on the leaves of *G. friedrichii* – two discriminant characters which are absent in *G. crespianum* and in the Iberian members of the *G.*

glaucum complex – further support the originality of the former species rather than reveal its taxonomic affinities. Chromosome number alone is of little help to elucidate the taxonomic relationships of the new species. *G. friedrichii* is tetraploid, in contrast to the diploid level found in the related *G. prinosum* (Fer-

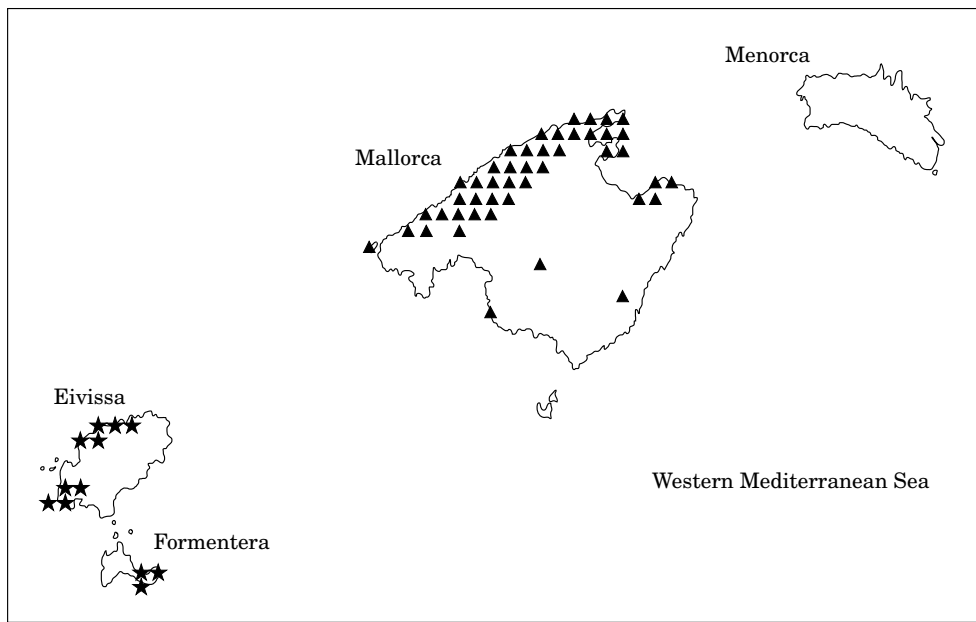


Figure 4. Distribution of *Galium friedrichii* nom. nov. (★) and *G. crespianum* (▲) based on herbarium specimens and field records. Each record corresponds to the presence of the plants within a UTM grid of 5 × 5 km.

nández Casas, 1977; Krendl, 1979), *G. muricicum* and *G. festivum* (Krendl, 1979). The cytological work made by F. Ehrendorfer (*in litt.*) has shown that, despite earlier claims supporting the hexaploid level of *G. crespianum* (Contandriopoulos & Cardona, 1984), tetraploid populations are present within this species. The existence of several cytotypes differing in ploidy level has been documented within several species of *Galium* (cf. Samuel, Pinsker & Ehrendorfer, 1996; Ehrendorfer, Samuel & Pinsker, 1996), and apparently there is no reason to deny that infraspecific polyploidy is also present in the insular endemic *G. crespianum*. However, this should be substantiated by a future, more detailed, cytogenetic survey. Cardona (1976) stated that the chromosome counts of *G. crespianum* were made on mitotic plates from floral buds. The voucher specimen (BC 616937) effectively belongs to *G. crespianum*. However, the plant not only lacks flowers and floral buds but does not show any trace of inflorescence development, suggesting that this specimen was not the fixed specimen used for cytological work. Thus, the possibility that some labelling mistake could have occurred during field work should not be ruled out. At Formentor, the place where *G. crespianum* was fixed (Cardona, 1976), a population of *Rubia balearica* (Willk.) Porta occurs, a Balearic endemic which has the same chromosome number ($2n = 66$; Cardona, 1973, 1984) as that reported for the *Galium* species.

The ascription of the Pytiusic populations of *G. crespianum* to a new species agrees with the perception that really very few plant endemic taxa are shared between the western and eastern Balearic islands.

Previous works have shown that substantial morphological differentiation was present between Pytiusic and Gymnesic populations of several Balearic endemics, viz. *Cephalaria squamiflora* (Sieber) Greuter subsp. *balearica* (Willk.) Greuter (Mus *et al.*, 1990), *Hippocrepis balearica* (Mus, *et al.* 1990; Llorens, Gil & Boira, 1995), *Teucrium cossonii* D. Wood (Mus, 1992), *Thymus richardii* Pers. (Jalas, 1971) and *Allium antonii-bolosii* P. Palau (Rosselló *et al.*, 1993), thus warranting a separate taxonomic placement. A molecular study involving *Hippocrepis balearica* has recently shown that western and eastern Balearic populations previously included under the same species have fixed divergent nuclear ribotypes (ITS sequences) and described several chloroplastic RFLP markers that diagnosed them (Rosselló, unpublished data). This study failed to strongly support the alleged sister nature of Pytiusic and Gymnesic populations of the *H. balearica* group. These sharp molecular discontinuities suggest a long time of divergence for the biotas of western and eastern sub-archipelagos. Classical palaeogeographic parameters estimated that the last terrestrial connection between Eivissa and Formentera and the remaining Balearics occurred during the Messinian dessication of the Mediterranean Sea, about 5.3 Mya (Gautier *et al.*, 1994). This long biogeographic isolation period could thus explain morphological and molecular divergence so far found among several Pytiusic and Gymnesic relatives. Unfortunately, phylogeographic studies using molecular markers are lacking to support the hypothesis of the cladogenetic splitting of western and eastern populations since Miocene times.

With the data currently available, tracing the origins of *G. friedrichii* is still speculative. Morphological discriminant features, if not embedded within a phylogenetic framework, are useless for predicting genealogical relationships. Certainly, overall morphology suggests a closer similarity between *G. friedrichii* and some taxa of the *G. glaucum* group from south-east Spain than with the Balearic *G. crespianum*. However, this could be simply due to convergence or to the retention of symplesiomorphic characters. In contrast, the shared chromosome number shows that the two insular species could be more closely related than morphological features suggest. However, there is no reason to believe that the tetraploid level could have not independently been obtained from ancestors belonging to independent lineages. Unfortunately, the reported taxonomic affinities of *G. crespianum* are highly speculative (Burnat & Barbey, 1882; Cardona & Sierra-Ràfols, 1979; Contandriopoulos & Cardona, 1984). The species has been related to *G. foliosum* Munby or to the *G. album* complex, but without a sound basis. This merits further studies tracing the relationships of *G. crespianum* in a phylogenetic context, an important task given the high number of species reported from the Mediterranean basin and surrounding areas.

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APPENDIX

Galium crespianum J.J. Rodr., Anales Soc. Esp. Hist. Nat., 8: 55 (1879).

Ind. loc. "Coma den Arbona sobre Bonnave, en las grietas de peñas calcáreas, á unos 600 metros. En flor".

Type material. Coma de'n Arbona, 16.vi.1877, *J.J. Rodríguez* (herb. Rodríguez!).

PERENNIAL, decumbent to curved-ascendent, glabrous, light green. Rootstock with stolons. STEMS up to 50 cm, not pruinose, subrhombic in cross-sections, with prominent ribs 0.3–0.55 mm wide; internodes (5)15–25(49) mm, with hairs 0.1–0.25 mm in the upper part. LEAVES (10)15–30(38) × 1–2.5 mm, linear-lanceolate to linear, often falcate, with revolute margins, in whorls of 4–8; green on both sides, glabrous or with marginal bristles 0.1–0.25, mucronate, with hyaline apex 0.4–1 mm. INFLORESCENCE occupying (1/3) 1/2–2/3 of the stem, dense (up to 65 flowers), oblong to ovoid; unicellular hairs (0.10–0.25 mm) present at the internodes; PEDICELS glabrous or glabrescent, 1.1–3.5 × 0.2–0.4 mm at post-anthesis; partial inflorescences up to 3.3 cm, shorter than or equalling (rarely longer) the adjacent stem internode; bracts 1.3–3.2 mm. FLOWERS not fragrant, yellow; corolla rotate, 2.7–3.9 mm diameter; lobes 1.8–2 × 0.7–1 mm, ovate, mucronate. Staminal FILAMENTS 0.9–1 mm; ANTHERS 0.35–0.5 mm, oblong. OVARY glabrous, style 0.3–0.6 mm, stigma 0.15–0.2 mm diam., globose, black. MERICARPS 1.5–2 × 1.5 mm, often solitary, ovoid to subreniform, glabrous, shining, not waxy, irregularly crestate when dry.

Material examined. MALLORCA: Sierra Norte de Mallorca, 20.xi.1947, *P. Palau* (MA 117345); Puig de'n Enric, Andratx, 31SDD4580, fisuras de rocas calizas, 2.i.2000, *M. Mayol & L. Sáez* (BC 836614, MA); Galatzó, 16.iv.1920, *Gros* (BC 112142); Mola de Planícia, 29.vii.1991, *M. Mus* (JBS); Puntals, 25.vi.1920, *Gros* (BC 107006); Valldemossa, versus el Teix, 27.vi.1954, *O.*

Bolòs (BC 135900); Castell d'Alaró, 24.vi.1989, *M. Mus* (JBS); Coma de'n Arbona, 16.vi.1877, *J.J. Rodríguez* (herb. Rodríguez); *Ibid.*, 13.vi.1986, *A. Orell & J. Orell* (MA 463582); *Ibid.*, prop del Puig Major, 1000 m, 1.vii.1976, *A. Bonner* (BC 644494), Vertiente N. Del Puig de Son Torrella, 1400 m, grietas de peñas calcáreas, 17.vi.1878, *A. Crespi* (BC 27171); *Ibid.*, 30.vi.1879, *A. Crespi* (BC 649903); *Ibid.*, 18.vi.1920, *Gros* (BC 112139); Montagnes de Sóller, 200–1000 m, 4.vii.1912, *Bianor, F. Sennen Pl. Espagne 1503* (BC 27176, BC 27179, MA 117536, MA 117537); Sóller, 3.v.1920, *Gros* (BC 107002); Salt des Ca, Mallorca, 15.vi.1920, *Gros* (BC 107000); Alfàbia, 27.vii.1989, *M. Mayol & al.* (JBS); Cúber, 900 m, in rupestris calc., 1.vi.1970, *O. Bolòs, J. Vigo & al.* (BC 605753); Morro d'Almallutx, 22.xi.1986, *J.A. Rosselló* (JBS); Tossals Verds, 3.vii.1990, *M. Mus* (JBS); Es Gorg Blau, 12.x.1977, *J.A. Rosselló & al.* (BC 625560); Torrent de Pareis, 15.viii.1950, *P. Palau* (MA 156433); Sa Calobra, 8.vii.1990, *M. Mus* (JBS); Escorca, 3.vii.1990, *M. Mus* (JBS); Lluc, versus Clot d'Albarca, 500 m, 10.vii.1956, *A. & O. Bolòs* (BC 137070); Salt de La Bella Dona, 3.vii.1990, *M. Mus* (JBS); Font de Sa Mata, 8.vii.1990, *M. Mus* (JBS); Sommet du Puig Major de Massanella, 9.ix.1852, *G. Vigineix* (MPU); *Ibid.*, in Potentillo-Pimpinellatum balearicae, 1200 m, exp. N, 12.vii.1956, *A. & O. Bolòs* (BC 137152); *Ibid.*, Masanella, 1200 m, 20.vi.1949, *P. Palau* (BC 112738, MA 340036, MA 117534, MAF 50003); *Ibid.*, s.d., *P. Palau* (BC 634364); *Ibid.*, 1.vii.1951, *Cañigüeral* (BC 118704); L'Avanor, 10.vi.1990, *M. Mus* (JBS); Puig des Ca, 6.vii.1991, *G. Alomar & M. Mus* (JBS); *Ibid.*, 9.vii.1991, *M. Mus* (JBS); Penyal Fumat, 11.vi.1989, *M. Mayol & al.* (JBS); paret esquerra del túnel de Formentor (escales), 9.v.1974, *A. Cardona & R.M. Masalles* (BC 616937); Mal Pas, 1.viii.1986, *J.A. Rosselló* (JBS); Cap Pinar, 11.vi.1989, *M. Mayol & al.* (JBS); Artà, penyals de s'Ermita, 1.vi.1922, *Garcias Font* (BC 27158, BC 27159); Sant Salvador, 22.vi.1989, *M. Mus* (JBS); Castell de Santueri, 22.vi.1989, *M. Mus* (JBS); Randa, 9.vi.1990, *M. Mayol & al.* (JBS); Sa Dragonera: Na Pòpia, 3.iv.1991, *M. Mus* (JBS).