Euphorbia Nurae P. Fraga & Rosselló (Euphorbiaceae), a New Species from Minorca (Balearic Islands)

Authors: Fraga-Arguimbau, Pere, and Rosselló, Josep A.

Source: Candollea, 66(1) : 181-190

Published By: The Conservatory and Botanical Garden of the City of Geneva (CJBG)

URL: https://doi.org/10.15553/c2011v661a20

Euphorbia nurae P. Fraga & Rosselló (Euphorbiaceae), a new species from Minorca (Balearic Islands)

Pere Fraga-Arguimbau & Josep A. Rosselló

Abstract

FRAGA-ARGUIMBAU, P. & J. A. ROSSELLÓ (2011). Euphorbia nurae P. Fraga & Rosselló (Euphorbiaceae), a new species from Minorca (Balearic Islands). *Candollea* 66: 181-190. In English, English and French abstracts.

Euphorbia nurae P. Fraga & Rosselló (*Euphorbiaceae* sect. *Cymatospermum* (Prokh.) Prokh.) is described as a new species from coastal sites of Minorca (Balearic Islands). Morphological features suggest that *Euphorbia exigua* L., *Euphorbia dracunculoides* Lam. and *Euphorbia sulcata* Loisel. are the most closely related taxa, but the new species can be easily discriminated by several morphological characters.

Key-words

EUPHORBIACEAE – Euphorbia – Minorca – Balearic Islands – Therophyte – Taxonomy

Résumé

FRAGA-ARGUIMBAU, P. & J. A. ROSSELLÓ (2011). Euphorbia nurae P. Fraga & Rosselló (Euphorbiaceae), une nouvelle espèce de Minorca (Iles Baléares). *Candollea* 66: 181-190. En anglais, résumés anglais et français.

Euphorbia nurae P. Fraga & Rosselló (*Euphorbiaceae* sect. *Cymatospermum* (Prokh.) Prokh.) est décrite comme une nouvelle espèces des sites côtiers de Minorque (Iles Baléares). Les traits morphologiques de cette nouvelle espèce montrent qu'*Euphorbia exigua* L., *Euphorbia dracunculoides* Lam. et *Euphorbia sulcata* Loisel. en sont les taxons les plus proches, ne différant que par quelques traits morphologiques.

Addresses of authors: PFA: Consell Insular de Menorca, plaça de la Biosfera, 5, 07703 Maó, Menorca, Balearic Islands, Spain. Email: **pere.fraga@gmail.com**

JAR: Jardí Botànic, Universitat de València, c/ Quart, 80, 46008 Valencia, Spain; Marimurtra Bot. Garden, Carl Faust Fdn., PO Box 112, 17300 Blanes, Catalonia, Spain.

Submitted on January 12, 2010. Accepted on November 11, 2010. Edited by P. Bungener

ISSN: 0373-2967 *Candollea* 66(1): 181-190 (2011)

Introduction

Euphorbia L. is a world wide distributed genus comprising more than 2000 species showing an astonishing diversity in life forms (Webster, 1994). Native European species mostly belong to subgen. *Esula* Pers. (Benedí & al., 1997). Within this subgenus sect. *Cymatospermum* (Prokh.) Prokh. comprises exclusively annual species. Overall morphology between taxa is similar and discriminating characters used to identify species are mainly based on seed features, including seed size and episperm ornamentation (Molero & al., 1996).

The Balearic Islands harbour 22 species of genus *Euphorbia* including narrow endemic taxa like *E. fontqueriana* Greuter, *E. maresii* Knoche and *E. margalidiana* Kühbier & Lewej. (Benedí & al., 1997). Most of the non-endemic *Euphorbia* diversity found in the archipelago is from Minorca, where 15 species have been recorded (Fraga & al., 2004), of which four entities (*E. exigua* L., *E. falcata* L., *E. medicaginea* Boiss., and *E. peplus* L.) belong to sect. *Cymatospermum*. Only *Euphorbia exigua* and *E. peplus* are relatively common in the island whereas *E. falcata* and *E. medicaginea* have been recorded from a few localities (Fraga & al., 2004). In Minorca and elsewhere in the distribution area, *E. exigua* shows, a remarkable polymorphism regarding vegetative features (e.g., branching pattern and leaf shape) (Pignatti, 1982; Meikle, 1985; Bolòs & Vigo, 1990; Benedí & al., 1997). Some extreme morphotypes have been recognized (e.g., var. *acuta* L., var. *retusa* L., var. *truncata* W. D. J. Koch; see Willkomm & Lange, 1880; Fiori, 1925; Vindt, 1953; Bonafè, 1979; Meikle, 1985), but there is not evidence that these variants correlate with the variation detected in seminal features (Molero & al., 1996).

During field work aimed to increasing the floristic knowledge of Minorca we have observed several coastal populations of annual plants that were related to *Euphorbia exigua* but showed conspicuous differences in plant height, branching pattern, leaf arrangement, female inflorescence, seed size and testa ornamentation. Comparison of these forms with herbarium specimens of *E. exigua* from non-Balearic sites corroborated their unique nature. They are presented in this paper as a new species, *E. nurae.*

Material and methods

Morphological observations were made from living plants (in the field and from cultivated plants) and from herbarium specimens (MA, BC, and the personal herbarium of Fraga-Arguimbau). Further, information from taxonomic and floristic sources covering sect. *Cymatospermum* (Molero & al., 1996), or dealing with the genus *Euphorbia* in western Mediterranean areas (Moris, 1859; Battandier & Trabut, 1888; Coste, 1903; Fiori, 1925; Vindt, 1953; Quezel & Santa, 1963; Smith & Tutin, 1968; Pignatti, 1982; Meikle 1985; Bolòs & Vigo, 1990; Benedí & al., 1997; Jeanmonod & Gamisans, 2007) was compiled for comparative purposes. The shape and ornamentation of the seeds were observed using stereoscope and scanning electron microscopes (SEM). For SEM they were mounted on stubs with double-sided carbon adhesive tape, gold coated and observed under Jeol Scanning Electron Microscope at 10 kV accelerating voltage. The method of Molero & al. (1996) was used to assess the presence of mucilage compounds on the seed episperm.

Results

Euphorbia nurae P. Fraga & Rosselló, **spec. nova** (Fig. 1A, 1B, 1C-5)

Typus: Balearic Islands. Minorca: Es Berrecks de Santa Anna, Ciutadella de Menorca (31SEE807212), ephemeral pastures on thin, limestone soils, 30 m, 31.III. 1996, *P. Fraga s.n.* (holo-: VAB [202781]) (Fig. 1A,1B, 1C, 2).

Planta annua, minuta (ad 0.5-2.5 cm alta), at Euphorbia exigua, E. dracunculoides et E. sulcata similis, sed prostrata, folia imbricata, pauci carnosa, cyathiis parvulis (usque ad 1 mm); stylus circa 0.2 mm longus, adpresus; semina 0.3-0.6 × 0.6-0.8 mm, parce tuberculata, sine elaiosoma differt.

Annual plant, 0.5-1.5(-2.5) cm high, glabrous, light green to glaucous up to anthesis, turning reddish or orange at fruiting. Usually with a single *stem* or multi-stemmed, with a few radial branches starting at the base; stems prostrate (except at fruiting), 0.5-5 cm long, 0.2-0.5 mm thick, usually sinuate. Caulinar *leaves* 0.4-0.8 × 0.8-2(-3) mm, densely imbricate, sessile, slightly carnosulate, linear to linear-spatulate, widest towards the apex; leaf blade carinate at the apex, apex rounded to obtuse, margin entire. *Pleiochasial bracts* 0.6-0.9 × 2-3.5 mm, linear-lanceolate, attenuate at the apex, apex obtuse to subacute, not rounded, limb plane, margin entire. *Dichasial bracts* free, 0.9-1.5 × 1.3-3.8 mm, narrowly triangular to triangular-lanceolate, apex obtuse to rounded, margin entire. Dichasial *cymes* 1-3, up to 5(-10) mm long, not bifurcating. Cyathia *glands* small (up to 1mm long), glabrous, each cyathium comprising two oblong and two semicircular yellowish to red nectaries, appendiculate; nectaries with parallel to slightly divergent, short appendages (up to 0.2 mm long), obtuse and rounded at the apex. *Carpels* with short stigmas (up to 0.2 mm long), bifurcate, usually recurved and appressed. *Capsule* pedicelated (pedicel up to 0.5 mm long, recurvate), 3-angular, ca. 1.1-1.4 × 1.2-1.5 mm, subovoid, sulcate, glabrous; cocci smooth, slightly granulose near the keels. *Seeds* whitish-grey, not mucilaginous, 0.6-0.8 × 0.3-0.6 mm, ovoid or subglobose, with a very marked longitudinal furrow, papillate, with poorly differentiated tubercles; caruncle completely absent, being only visible the insertion point.

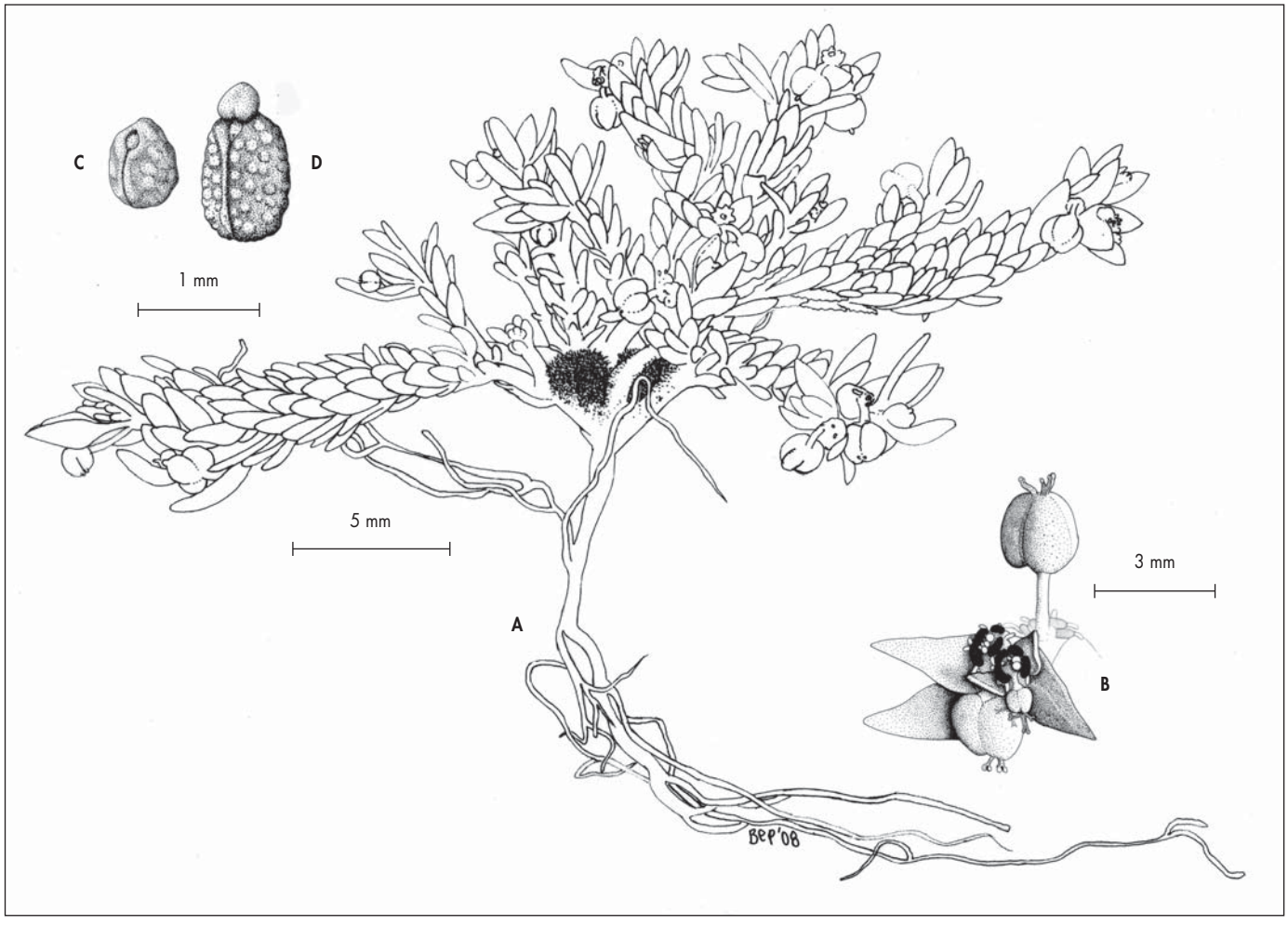

Fig. 1. – *Euphorbia nurae* P. Fraga & Rosselló. **A.** Habit; **B.** Inflorescences; **C.** Seeds; **D.** Representative seed of *E. exigua* L. [**A-C:** *Fraga s.n.,* VAB; **D:** *Fraga s.n.,* MA] [Drawings: J. Quintana]

Etymology. – From Nura, an ancient name of Menorca.

Phenology. – *Euphorbia nurae* flowers between February and April (exceptionally up to mid May) (Fig. 3A). Fruiting individuals have been seen in April and May (Fig. 3B).

Habitat and distribution. – Currently, *E. nurae* is known from the coastal areas of south Minorca and a single population is present in quaternary sandy soils from the north (Fig. 4). It grows in sandy or clayish calcareous soils formed by the dissolution of Miocenic rocks. The low nutrient concentration and scarce hydric content of these soils favour the establishment of ephemeral communities dominated by therophytes and geophytes of small size. There, *E. nurae* shows a patchy distribution (isolated individuals or up to 30 plants per square meter) together with *Valantia muralis* L., *Trifolium scabrum* L., *Plantago weldenii* Rchb., *Senecio rodriguezii* J. J. Rodr., *Medicago littoralis* Loisel., *Medicago minima* (L.) L., *Desmazeria marina* (L.) Druce, *Lagurus ovatus* L., *Hypochoeris achyrophorus* L., *Sagina maritima* G. Don, *Bupleurum semicompositum* L., *Romulea assumptionis* Garcias Font, *Sedum rubens* L., *Filago pyramidata* L., *Valerianella microcarpa* Loisel., *Linum strictum* L., *Sherardia arvensis* L., *Plantago bellardii* All., *Allium chamaemoly* L., *Merendera filifolia* Camb., *Hyoseris scabra* L., *Asteriscus aquaticus* (L.) Less., *Galium murale* (L.) All., and *Campanula erinus* L. Concerning its conservation status, most of the known populations are located within protected areas, mainly included in the Natura 2000 network, and only a few of them are at risk due to landscape transformation by construction of touristic buildings. Nevertheless, its narrow distribution range and small populations suggest a classification as Vulnerable (VU), under criteria D2, according to the criteria of the IUCN Red List (IUCN, 2001).

Fig. 2. – Holotype of *Euphorbia nurae* P. Fraga & Rosselló. [*Fraga s.n.*, VAB]

Specimina visa. – **Minorca:** De Son Xoriguer a Son Saura, 3.V.1999, *P. Fraga s.n.* (MA [625575]); Son Olivaret, 3.V.1999, *P. Fraga s.n.* (MA [624577]); Mallaui, Sa Marjal Nova, 30.III.2004, *P. Fraga s.n.* (Herbarium Fraga-Arguimbau); Binicalaf Nou, 1.IV.2004, *P. Fraga s.n.* (Herbarium Fraga-Arguimbau); Marina de s'Arena, Capifort, 2.IV.2004, *P. Fraga s.n.* (Herbarium Fraga-Arguimbau); Son Saura de Ciutadella, 3.IV.1999, *P. Fraga s.n.* (Herbarium Fraga-Arguimbau).

Notes. – Morphological features (see Fig. 1, 4) suggest that *Euphorbia nurae* is closely related to *E. exigua* L., *E. dracunculoides* Lam., and *E. sulcata* Loisel. from which it can be easily differentiated by a combination of vegetative and reproductive features (Table 1, Appendix 1). The superficial similarity shown between the new species and these widespread Mediterranean species could be related to convergence, or to the retention of plesiomorphic characters. Furthermore, the significant reduction of vegetative features in these annual plants makes their recognition difficult unless key diagnostic characters, like seeds, are present.

Despite the acknowledged polymorphism concerning the shape of caulinar leaves in species of sect. *Cymatospermum* (Molero & al., 1996) we have noted a contrasting leaf shape that is constant in all known populations of *Euphorbia nurae* so far analyzed: they are linear-lanceolate to linear spatulate, slightly carnulose and carinate. By contrast, herbarium specimens from related taxa (Appendix 1) show leaves with different shapes, usually longer and wider, and not fleshy at all, even in the case of the highly variable *E. exigua* (Table 1). Moreover, reproductive features from inflorescence architecture, nectaries, flowers, fruits and, mainly, seeds also discriminate the new species from related taxa. Thus, *E. nurae* always shows simpler and smaller inflorescences, shorter nectaries appendages and stigmas, but relatively larger capsules (excepting *E. exigua*) than their relatives. In this way, all related taxa examined (Appendix 1) show a lower number of longer dichasial rays and longer individual flowers (Table 1). Seed size and episperm ornamentation have been reported to be good taxonomic features in the whole subgen. *Esula* Pers. (Baiges & al., 1991) and in sect. *Cymatospermum* (Molero & al., 1996; Benedí & al., 1997). *Euphorbia nurae* has seeds conspicuously smaller than its relatives, showing a different shape (ovoid to suborbicular, instead of elliptical) and episperm ornamentation (testa surface is poorly tuberculate with small and obtuse protuberances; Fig. 5). All related taxa examined (Appendix 1) have seed surfaces with conspicuous tubercles or are sulcate (Table 1). Moreover, the most reliable character discriminating the new species is the lack of caruncle, which is uniformly present in all species of sect. *Cymatospermum (*Molero & al., 1996).

The reduction or complete disappearance of caruncle seems to have evolved independently several times in *Euphorbia* and it has been reported in other unrelated species from subgenus *Esula* such as *E. pterococca* Brot., *E. aleppica* L. or *E. paralias* L. (Vindt, 1953; Benedí & al., 1997; Baiges & al., 1991). In *Euphorbia* the lack or reduction of seed caruncle has been related to dispersal strategies. The presence of an elaiosome for myrmecochorous dispersal may alter the seed aerodynamics, reducing the distance of explosive dispersal (Beattie & Lyons, 1975). Species showing reduced or lacking caruncles or those whose caruncles are readily shed from the seeds would increase the explosive dispersal distance (Narbona & al., 2005).

At the same time the seeds lose their attractiveness, reducing the likelihood of secondary dispersal by ants (Stamp & Lucas, 1990; Narbona & al., 2005). It has been postulated that secondary dispersal by ants is more effective than explosive mechanisms in dispersing the seeds from the parent plant (Stamp & Lucas, 1990) and species that use explosive dispersal maximize either explosive distances or secondary myrmecochorous dispersal (Beattie & Lyons, 1975; Stamp & Lucas, 1990). However, ornithochory and anemochory have been also reported to be involved in the secondary dispersion of *Euphorbia* species lacking caruncules (Baiges & al., 1991), like the Mediterranean psammophyte *E. paralias* where dispersal distances up to 100 m have been recorded (Baiges & al., 1991).

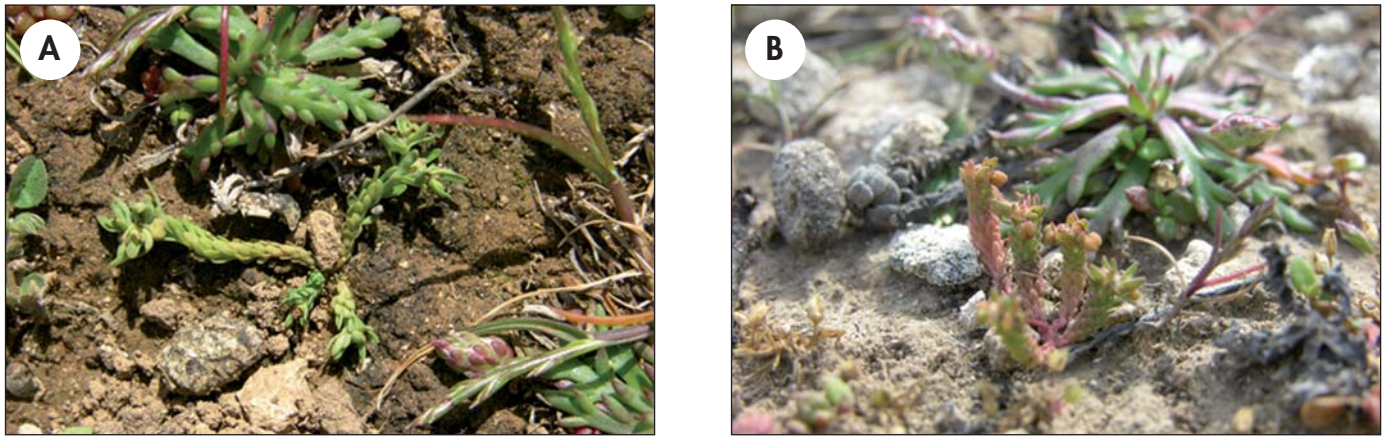

Fig. 3. – Field specimens of *Euphorbia nurae* P. Fraga & Rosselló at the type locality. **A.** At anthesis, showing a prostrate habit; **B.** At the fruiting stage showing the upright stems. [*Fraga s.n.*, Herbarium Fraga-Arguimbau]

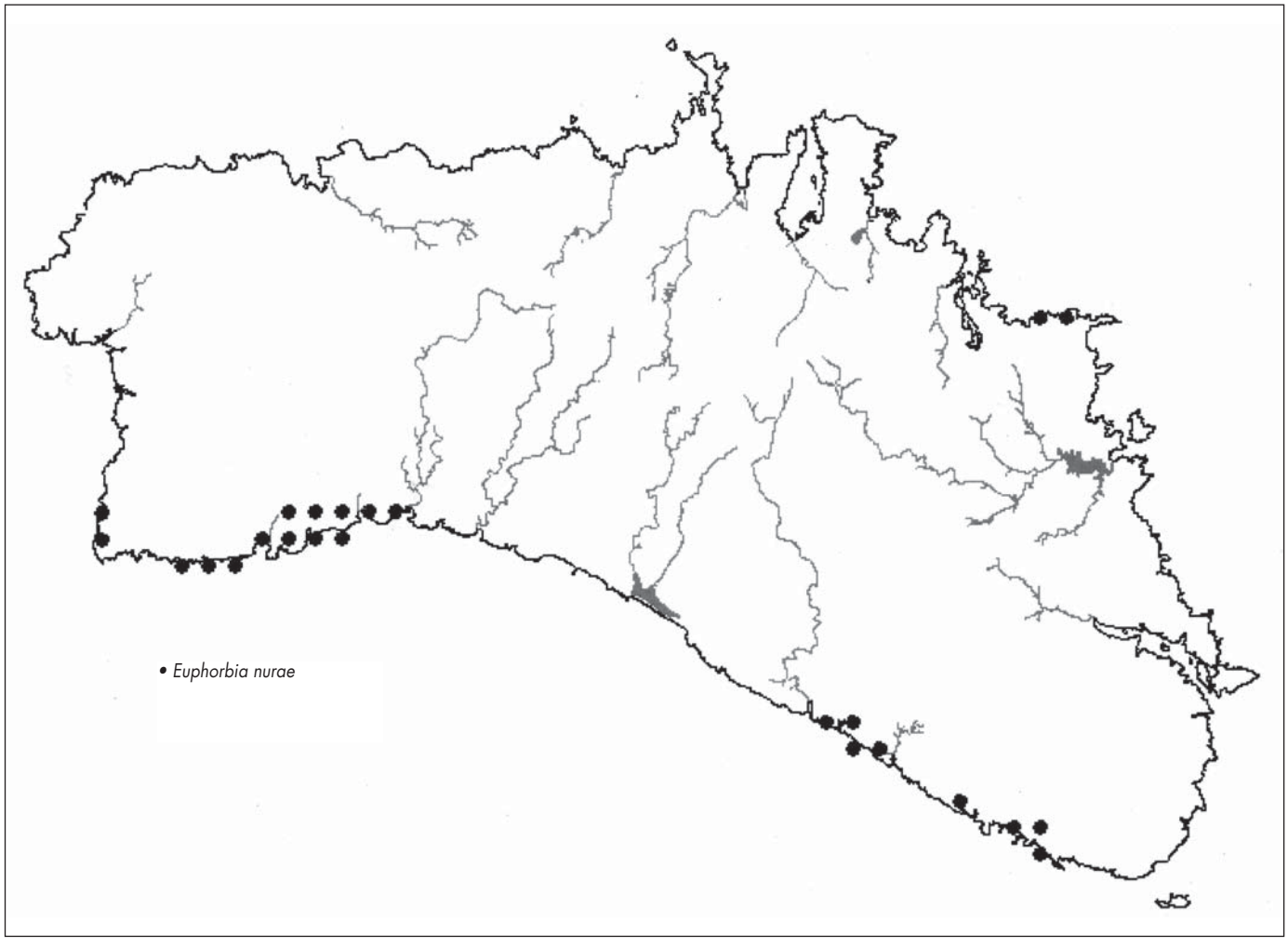

Fig. 4. – Distribution map of *Euphorbia nurae* P. Fraga & Rosselló based on field records and herbarium specimens (UTM grid of 1 x 1 km).

Table 1. – Main diagnostic morphological features between *Euphorbia nurae* P. Fraga & Rosselló and closely related taxa.

	E. nurae	***E. exigua* L. subsp. *exigua***	***E. exigua* subsp. *merinoi* M. Laínz**
Stems	prostrate	erect, rarely prostrate	erect, rarely prostrate
Height (cm)	0.5-2.5	2-40	2-40
Leaf disposition	densely imbricate	sparse to dense	sparse to dense
Leaf dimensions (mm)	0.4-0.8 × 0.8-2(3)	2-35 × 1-5	2-35 × 1-5
Leaf shape	linear-lanceolate to linear-spatulate	linear to linear-cuneiform	linear to linear-cuneiform
Leaf thickness	slightly carnulose	herbaceous	herbaceous
Dichasial rays number	1 to 3	2 to 7	2 to 7
Dichasial rays maximum length (mm)	10	30	30
Dichasial rays number of bifurcations	0	1 to 8	1 to 8
Length of nectary appendages (mm)	ca. 0.2	ca. 0.5	ca. 0.5
Stigma length (mm)	ca. 0.2	0.4-0.6	0.4-0.6
Capsule dimensions (mm)	1.1-1.4 × 1.2-1.5	1-2 × 1-2	1-2 × 1-2
Seed size (mm)	0.3-0.6 × 0.6-0.8	0.7-1.7 × 0.5-0.9	0.7-1.7 × 0.5-0.9
Seed ornamentation	papillate	tuberculate	transversally sulcate
Seed shape	ovoid to subglobose	subovoid	subovoid
Seed caruncle	absent	conic-subglobose	conic-subglobose

Thus, the lack of a conspicuous elaiosome in *E. nurae* could be linked to a loss of secondary seed dispersal capacity favoring the colonization of suitable neighborhood environments. However, the presence of *E. nurae* in disjunct populations in Minorca (Fig. 4) might suggest that eventual episodes of long range dispersal might occur. Overall, plants of *E. nurae* are smaller than those related species, showing at anthesis prostrate rather than erect stems (Fig. 3A) and only at the fruiting stage the stems of *E. nurae* are upright (Fig. 3B). This could be related to reproductive strategies aimed to be more efficient concerning seed dispersal (Swaine & al., 1979; Stamp & Lucas, 1990; Garrison & al., 2000) to counteract caruncle loss.

Significant reduction of dispersal ability may develop relatively quickly in small, isolated natural populations (Cody & Overton, 1996) and has been documented for species living on both oceanic (Carlquist, 1974) and continental islands (Cody & Overton, 1996; Fresnillo & Ehlers, 2008). Changes in morphological features that are well suited for the colonization of Mediterranean environments with severe summer drought have been reported in Minorcan species of *Bellium* L. growing in the same habitats as *Euphorbia nurae* (Fraga & al., 2007). It would be interesting to know which species is sister to *E. nurae* in order to check the hypothesis that changes in reproductive features could have promoted intraspecific divergence, population isolation and, ultimately, speciation.

Acknowledgements

We thank our colleague Andrés Bermejo for sharing information about the distribution of the new species and for suggesting the specific name and Dr Duncan Ackery for linguistic advice, and Josep Quintana for the drawings.

References

Baiges, J. C. & C. Blanché (1991). Morphologie des graines des espèces ibéro-baléariques du genre Euphorbia L. (Euphorbiaceae). II. Subgen. Esula. *Bull. Soc. Bot. France, Lettres Bot.* 138: 321-327.

Baiges, J. C., X. Espadaler & C. Blanché (1991). Seed dispersal in W Mediterranean Euphorbia species. *Bot. Chron.* 10: 697-705.

Battandier, J. A. & L. Trabut (1888). *Fl. Algérie*. Alger.

Beattie, A. J. & N. Lyons (1975). Seed dispersal in Viola (Violaceae): adaptations and strategies. *Amer. J. Bot.* 62: 714-722.

Benedí, J., J. Molero, J. Simon & J. Vicens (1997). Euphorbia L. *In:* Castroviejo, S. & al. (ed.), *Fl. Iber.* 8: 210-285.

Bolòs, O. de & J. Vigo (1990). *Fl. Països Catalans* 2. Ed. Barcino.

Bonafè, F. (1979). *Fl. Mallorca* 3. Ed. Moll.Carlquist, S. (1974). *Island biology*. Columbia University Press.

Cody, M. L. & J. McC. Overton (1996). Short-term evolution of reduced dispersal in island plant populations. *J. Ecol.* 84: 53-61.

Coste, H. J. (1903). *Fl. Descr. Ill. France* 2. Paris.

Fiori, A. (1925). *Nuovo Fl. Analitica Italia* 2. Firenze.

Fraga, P., C. Mascaró, D. Carreras, O. Garcia, X. Pallicer, M. Pons, M. Seoane & M. Truyol (2004). *Catàleg de la flora vascular de Menorca.* Institut Menorquí d'Estudis.

***E. dracunculoides* subsp. *glebulosa* Coss. & Durieu**	***E. dracunculoides* subsp. *inconspicua* (Ball) Maire**	***E. sulcata***
erect, rarely procumbent	erect, rarely procumbent	erect
5-25	5-25	2-16
sparse	sparse	sparse to dense
5-55 × 1.5-4	5-55 × 1.5-4	2-14 × 1-5
linear-oblong to oblong-cuneiform	narrowly linear to oblongue-cuneiform	linear to linear-cuneiform
herbaceous	herbaceous	herbaceous
3 to 5	2 to 3	2 to 7
40	40	28
1 to 4	1 to 4	1 to 5
1	1	ca. 0.5
0.7-1.7	0.7-1.7	0.4-0.6
2.5-3 × 2.5-3.2	2.5-3 × 2.5-3.2	1.8-2.2 × 1.8-2.2
1.5-2.5 × 1-1.5	1.4-2 × 1-1.3	1.2-1.6 × 0.6-0.9
acutely tuberculate	tuberculate	sulcate
ovoid o subovoid	ovoid o subovoid	subovoid
conic-subacute	conic-subglobose to hemispheric	conic-reniform

Fraga P., M. Castro, M. & J. A. Rosselló (2007). A new annual species of Bellium (Asteraceae) from the Balearic Islands. *Bot. J. Linn. Soc*. 154: 65-77.

Fresnillo, B. & B. K. Ehlers (2008). Variation in dispersability among mainland and island populations of three wind dispersed plant species. *Pl. Syst. Evol.* 270: 243-255.

Garrison, W. J., G. L. Miller & R. Raspet (2000). Ballistic seed projection in two herbaceous species. *Amer. J. Bot.* 87: 1257-1264.

IUCN (2001). *IUCN red list categories and criteria, Version 3.1*. IUCN Species Survival Commission.

Jeanmonod, D. & J. Gamisans (2007). *Fl. Corsica*. Edisud.

Meikle, R. D. (1985). *Fl. Cyprus* 2. Bentham-Moxon Trust.

Molero, J., A. M. Rovira & J. Vicens (1996). Euphorbia L. sect. Cymatospermum (Prokh.) Prokh. (Euphorbiaceae) en la Península Ibérica. Morfología de las semillas. Precisiones taxonómicas y corológicas sobre algunos taxones críticos. *Anales Jard. Bot. Madrid* 54: 207-229.

Moris, J. H. (1859). *Fl. Sardoa.* Torino.

Narbona, E., A. Montserrat & P. L. Ortiz (2005). Explosive seed dispersal in two perennial Mediterranean Euphorbia species (Euphorbiaceae). *Amer. J. Bot.* 92: 510-516.

Pignatti, S. (1982). *Fl. Italia* 2. Edagricole.

Quezel, P. & S. Santa (1963). *Nouv. Fl. Algérie* 2. CNRS.

Smith, A. R. & T. G. Tutin (1968). *Euphorbia* L. *In:* Tutin, T. G. & al. (ed.), *Fl. Eur.* 2: 213-226.

Stamp, N. E. & J. R. Lucas (1990). Spatial patterns and dispersal distances of explosively dispersing plants in Florida sandhill vegetation. *J. Ecol.* 78: 589-600.

Swaine, M. D., T. Dakubu & T. Beer (1979). On the theory of explosively dispersed seeds: a correction. *New Phytol*. 82: 777-781.

Vindt, J. (1953). Monographie des euphorbiacées du Maroc. Part. I. Révision et Systématique. *Trav. Inst. Sci. Chérifien, Sér. Bot.* 6.

Webster, G. L. (1994). Sinopsis of the genera and suprageneric taxa of Euphorbiaceae. *Ann. Missouri Bot. Gard.* 81: 33-144.

Willkomm, M. & J. Lange (1880). *Prodr. Fl. Hispan.* 3. E. Schweizerbart.

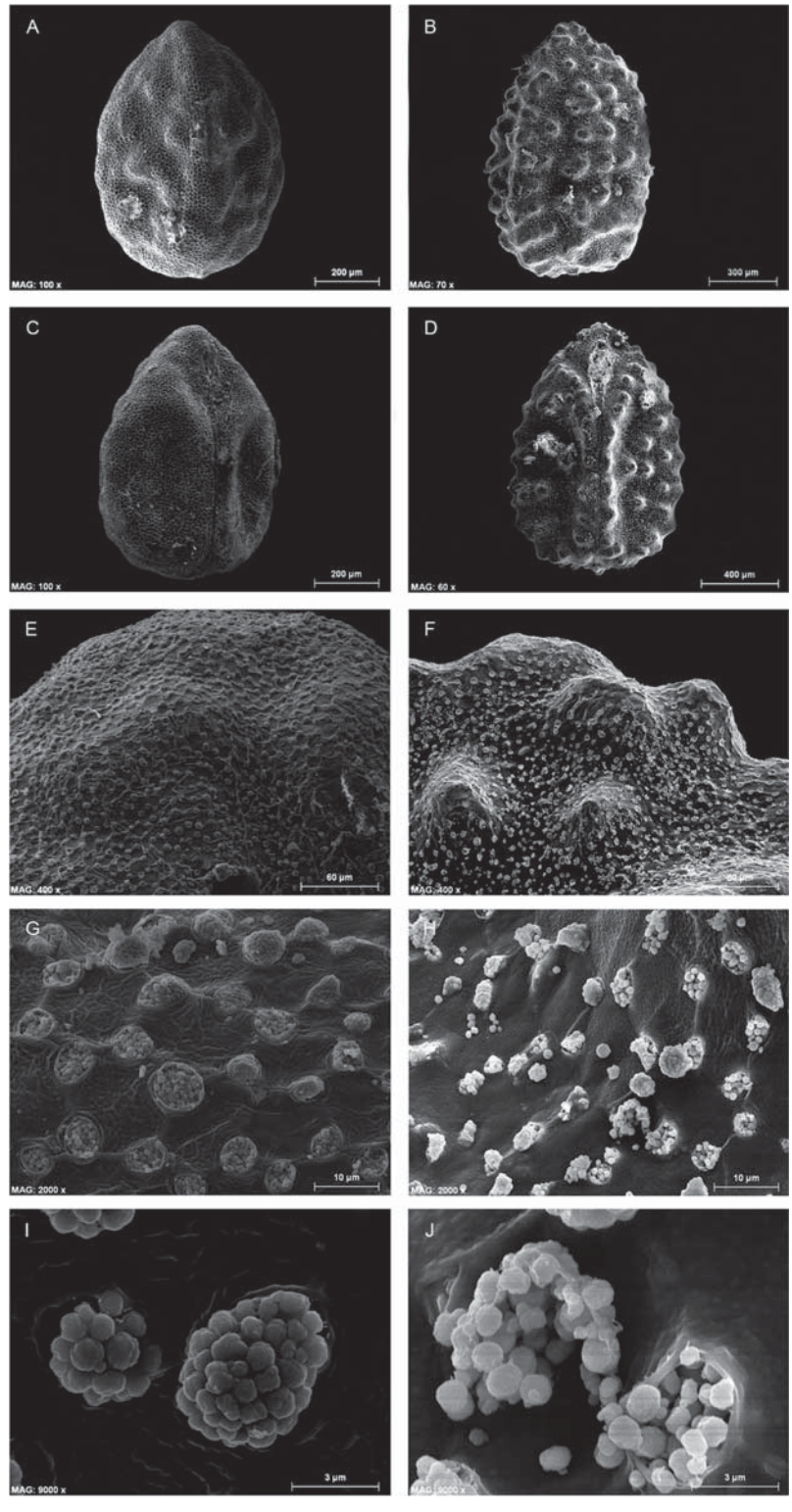

Fig. 5. – Morphology of seeds **(A-D)** and episperm **(E-J)** of *Euphorbia nurae* P. Fraga & Rosselló.
[*P. Fraga s.n.*, VAB 7996]

Appendix 1 – Additional herbarium material examined.

Euphorbia dracunculoides subsp. ***glebulosa*** Coss. & Durieu

Morocco. Gafsa: Canyon of Oued Seldja, near Metlaoui, 25.V.1992, *C. Benedí, C. Blanché, J. Molero & J. Vicens s.n.* (MA [579274]).

Euphorbia dracunculoides subsp. ***inconspicua*** (Ball) Maire

Morocco. Oujda: between Oujda and Jerada, 8 km NW of Guenfouda, 21.V.1991*, J. Molero & J. Vicens s.n.* (MA [579275]); **Safi:** Road from Marrakech to Essaouira, cross-road to Korimat and Mouarid, 26.V.1991, *J. Molero & J. Vicens s.n.* (MA [579276]); **Désert Occidental:** Tatta, Règion du Djebel Bani, 8.IV.1934, *R. Maire & E. Wilczek s.n.* (MA [75611]); **Moyen Atlas:** El Hammam, 10.V.1975, *E. Jahandiez s.n.* (MA [75612]).

Spain. Almeria: Pilar de Jaravías, 24.III.1986, *M.A. Carrasco & M. Velayos s.n.* (MA [593988]); **Granada:** Cerca del Túnel de Izbor, 9.IV.1974, *J. Fernández Casas s.n.* (MA [395718]).

Euphorbia exigua L. subsp. ***exigua***

Austria. Niederösterreich N. von Wien, Hagenbrun, 24.VII.1999, *Ernst Vitek s.n.* (MA [642213]).

Belgium. Tilff, Sur la Mont, 3.X.1980, *V. Demoulin s.n.* (MA [346747]).

Czech Republic. Moravia: 10.VIII.1927, *R. Dvo ak s.n.* (BC [88099]).

Denmark. Vallensbaek, SW of Copenhagen, 26.VIII.1989, *A. Hansen s.n.* (MA [497588]).

France. Pegomas, 4.V.1963, *G. Gavelle s.n.* (MA [178887]); Ablon, Seine-et-Oise, 18.VIII.1912, *H. Debaise s.n.* (BC [57499]).

Germany. Oberbayern, lehmiger Acker in München-Riem, 15.VII.1963, *W. Lippert s.n.* (MA [192574]); Munitz, VIII.1933, *Zaus s.n.* (MA [75567]).

Israel. Judaean Mts., Jerusalem, Givat Ram, 18.V.1956, *H. Parmet s.n.* (MA [172097]).

Italy. Mont. Catalfano, commune de Bagheria, province de Palerme, Sicilie, 38º 06'N 13º 31'E, 22.IV.1999, *A. Certa & A. Carratello s.n.* (MA [693144]); Venetia, 1897, *Rigo s.n.* (MA [75570]).

Morocco. Env. de Martimprey du Kiss, 22.IV.1933, *A. Faure s.n.* (MA [75604]); Tarquist, 21.V.1927, *P. Font Quer s.n.* (MA [75565]); Sidi-Musa, Beni-Sicar, 14.III.1935, *Hno. Mauricio s.n.* (MA [161496]); Tetuan, V.1975, *M. G. s.n.* (MA [75574]); Yebel Malmusi, 8.V.1927 *Font Quer s.n.* (MA [75577]); Oran, 10.IV.1908, *A. Faure s.n.* (BC [57501]).

Netherlands. Rhijnauwen, vic. of Utrecht (prov. Utrecht), 1.IX.1959, *W. Punt s.n.* (MA [173615]).

Portugal. Madeira, Cabo Girão, 29.V.1954, *M. Beliz s.n.* (MA [250853]); Caillabé, Coimbra, 25.IV.1949, *Y. Cebãlos s.n.* (MA [250832]).

Spain. Álava: San Román de Kampezo, Bernedo, Vitoria, 14.IX.1983, *J. A. Alejandre s.n.* (MA [408763]); Lapuebla de Labarca, Vitoria, 12.V.1983 *Goyo Morante & J. A. Alejandre s.n.* (MA [408734]); Zambrana, Vitoria, 8.X.1983, *J. A. Alejandre s.n.* (MA [408762]); Laserna, Laguardia, Vitoria, 21.V.1983, *J. A. Alejandre s.n.* (MA [408733]). **Alicante:** Villafranquesa, 23.III.196, *A. Rigual s.n.* (MA [370816]); Barranco de las Ovejas, 09.V.1959, *A. Rigual s.n.* (MA [370814]); Barranco de Chirles, 10.VII.1933, *M. Martínez s.n.* (MA [75526]); Muchamel, 9.V.1962, *A. Rigual s.n.* (MA [370797]); Moraira la Torre, 13.IV.1996, *J. X. Soler & B. Banyulus s.n.* (MA [587493]); Murla. S. del Peñon, 1.IV.1983 *J. X. Soler & al. s.n.* (MA [572184]); Jesús Pobre, 29.V.1994, *J. X. Soler s.n.* (MA [546387]); Montgó, Denia, 30.V.1988, *Pilar Donat s.n.* (MA [502801]); Chirles, 9.VII.1933, *M. Martínez s.n.* (MA [75562]). **Barcelona:** Castelldefels, 20.V.1917, *E. Gros s.n.* (MA [75534]); Collsacabra, VII.1885, *F. Trémols s.n.* (MA [75533]); Gualba, Montseny, 15.V.1915, *Font Quer s.n.* (BC [57490]); Font d'en Fargas, Horta, IV.1933, *Dra. Gallardo s.n.* (BC [125051]); Sant Llorenç del Munt, 1.VI.1941, *A. de Bolòs s.n.* (BC [99624]); Santa Coloma de Gramenet, 28.V.1939, *A. de Bolòs s.n.* (BC [99268]). **Cádiz:** Algeciras, 21.V.1962, *B. Casaseca s.n.* (MA [178881]); Chiclana, 28.V.1957, *A. de Bolòs s.n.* (BC [116711]). **Cantabria:** Unquera, Santander, 21.V.1960, *F. Bellot & B. Casaseca s.n.* (MA [178880]). **Castellón:** Benicarló, 8.IV.1993, *V. J. Arán & M. J. Tohá s.n.* (MA [523434]); Embalse de Ulldecona, 7.VI.1999, *C. Navarro & al. s.n.* (MA [626643]); Fredes, hacia la peña Blanca, 8.VI.1999, *J. Güemes & al. s.n.* (MA [628568]). **Ciudad Real:** Sierra de Alhambra, 30.IV.1933, *J. González Albo s.n.* (BC [84115]). **Gerona:** Torroella de Montgrí, 25.IV.1948, *Font Quer s.n.* (BC [106205]); Palafrugell, 16.IV.1922, *Font Quer s.n.* (BC [99342]); Cadaqués, 12.V.1917, *Gros s.n.* (BC [99276]). **Granada:** Guadix, 16.V.1929, *Gros s.n.* (BC [99329]). **Huelva:** Huelva, 24.IV.1931, *Gros s.n.* (BC [99343]). **Islas Baleares:** Cabrera, 19.IV.1948, *P. Ferrer s.n.* (MA [75528]); Isla Dragonera, 17.VI.1980, *E. Valdés-Bermejo s.n.* (MA [405901]); Matorrales debajo de Sa Vicaria, Cabrera, 29.V.1947, *P. Ferrer s.n.* (MA [75530]); Riera de Palma, 9.VI.1946, *P. Ferrer s.n.* (MA [75531]); Ibiza, IV.1899, *C. Pau s.n.* (MA [75542]); Camino de San Juan a Cala Portinatx, 15.VI.1949, *P. Ferrer s.n.* (MA [75527]); Port des Torrents, Ibiza, 1.V.1980, *Rivas Martínez, M. Costa & A. M. Regueiro s.n.* (MA [422598]); Puigpunyent, Mallorca, 2.VI.1982, *R. Morales & al. s.n.* (MA [618132]); Fornalutx, Mallorca, 6.VI.1998, *M. Velayos & al. s.n.* (MA [618910]); Son Àngel, Menorca, 27.III.1999, *P. Fraga s.n.*

(MA [624572]); Portopí, Mallorca, 1.IV.1956, *O. Bolòs & R. Molinier s.n.* (BC [136083]); Porto Pi, Mallorca, 26.III.1948, *Palau Ferrer s.n.* (BC [112256]); Porto Pi, Mallorca, 24.III.1948 *Palau Ferrer s.n.* (BC [106779]); Cala Llonga, Eivissa, IV.1918, *Gros s.n.* (BC [99335]); Sant Antoni, Eivissa, 25.III.1918, *Gros & Font Quer s.n.* (BC [99301]); Torrent d'en Costa, Sant Rafel, Eivissa, 31.V.1918, *Gros s.n.* (BC [99333]); Pont d'Inca, 6.V.1917, *Bianor s.n.* (BC [574 80]); Alcaufar, Sant Lluís, Menorca, III.1912, *Font Quer s.n.* (BC [57477]); Santa Ponsa, Menorca, 10.V.1913, *Font Quer s.n.* (BC [57478]); Cala en Turqueta, Ciutadella de Menorca, Menorca, 19.V.1959, *A. de Bolòs & O. de Bolòs s.n.* (BC [121 535]); Espardell, Eivissa, 19.V.1920, *Gros s.n.* (BC [99328]); Santa Eulàlia, Eivissa, 27.III.1918, *Gros & Font Quer s.n.* (BC [142376]). **La Rioja:** Canales de la Sierra, 22.VII.1975, *B. Casaseca y Fernández Díez s.n.* (MA [204 505]); San Millán de Yécora, 28.V.1988, *J. Arizaleta, F. Muñoz Garmendia, J. Pedrol y R. Rodríguez s.n.* (MA [438801]). **Málaga:** Estepona, 16.V.1919, *Gros s.n.* (BC [57504]). **Melilla:** Melilla, IV.1912, *A. Caballero s.n.* (MA [75578]). **Murcia:** Sierra de la Puerta, Cehegín, 1.V.1982, *Caridad Selme s.n.* (MA [541799]); Algameca Chica, Cartagena, 20.VII.1902, *Ibáñez, Jiménez & Pau s.n.* (MA [75 564]); Cabo Cope, Aguilas, 24.III.1978, *Fernández Díez s.n.* (MA [250400]); Javali N., 11.IV.1986, *R. Garcia s.n.* (MA [456780]); Castillo de la Azohía, 29.III.1998, *A. Carrillo, E. Coy, J. Güemes, A. Hernández, F. Muñoz-Garm. & C. Navarro s.n.* (MA [612425]); pr. Portman, 1.III.2004, *C. Aedo s.n.*, (MA [713875]). **Navarra:** Mendavia, 30TWM 6898, 28.V.1985, *J. A. Alejandre s.n.* (MA [337872]). **Santander:** Monegro (Reinosa), VII.1924, *L. Atendo s.n.* (MA [145087]); San Vicente de la Barquera, VII-1920, *J. de la Espada* (MA [75539]). **Sevilla:** Moron, 25.IV.1933, *C. Vicioso s.n.* (MA [75525]). **Tarragona:** Litoral prope l'Hospitalet del Infante, 01.VII.1969, *L. Carreras & E. Valdés Bermejo s.n.* (MA [397257]); Muntanyes de Poblet, Montblanc, 30.IV.1950, *F. Masclans s.n.* (BC [127549]); La Bisbal de Falset, 31.V. 1974, *J. Molero & A. Boldú s.n.* (BC [631681]). **Valencia:** La arboleda, Llíria, 24.VIII.1993, *Fco. Morán s.n.* (MA [565 502]); El Paller, 29.IV.1982, *M. Palasà s.n.* (MA [331740]); Serra Perengisa, Torrent, 25.IV.1984, *Rivas-Martínez s.n.* (MA [337632]); Bétera, 27.III.1984, *J.A. Alcober s.n.* (MA [383189]); Los Corrales, 21.V.1984, *R. Figuerola & G. Mateo s.n.* (MA [426932]); Coll d'Eslida, Serra d'Espadà, 24.V.1947, *Font Quer s.n.* (BC [106115]). **Vizcaya:** Bilbao, 1.V.1947, *E. Guinea s.n.* (MA [461173]). Bilbao. zona camino de Iturri-Gorri, V.1947, *E. Guinea s.n.* (MA [1650 60]). **Zaragoza:** Calatayud, 21.VII.1897, *Iñiguez s.n.* (MA [145086]).

Tunisia. Gabés (Menzel), II.1907, *C. J. Pitard s.n.* (MA [75605]).

Euphorbia exigua subsp. ***merinoi*** M. Laínz

Italy. Sardinia: Nouro, Genargentu, 4.VI.2003, *C. Navarro & al. s.n.* (MA [708348]).

Spain. Cáceres: El Pozuelo, Guadalupe, 20.V.1949, *A. Caballero s.n.* (MA [75544]); Cercanías del río Guadalupe, 25.V.1949, *A. Caballero s.n.* (MA [75545]); Las Hurdes, 21.V.1947, *A. Caballero s.n.* (MA [75547]); Guadalupe, 16.VI.1948, *A. Caballero s.n.* (MA [75546]). **Cuenca:** Término de Cuenca, barranco de la Madera, 7.VII.2001, *V. J. Arán & al. s.n.* (MA [691928]). **Orense:** Rubió, supra Pardellán, 2.V.1987, *F. J. Silva-Pando & al. s.n.* (MA [406650]); Barco de Valdeorras, Xaguarras, 14.V.1989, *Amigo & al. s.n.* (MA [478113]).

Euphorbia sulcata Loisel.

France. Arnas (Rhône), 16.IX.1874, *M. Gandoger* (MA [145085]); Aix (B. du R.) au Prégnon, IV.1887, *Bruyas s.n.* (MA [75670]).

Italy: Abruzzo, L'Aquila, Sª Eufemia, 7.VII.2002, *J. Aldasoro s.n.* (MA [698660]).

Spain. Burgos: Tejada: pie del Pico Valdosa, 3.VII.1979, *Fdez. Casas, Lara, Pons-Sorolla & Susanna s.n.* (MA [251162]). **Cuenca:** Laguna del Hito, Montalvo, 19.VI.1975, *S. Cirujano s.n.* (MA [408772]); **Lleida:** La Noguera, entre Balaguer y Castelló de Farfanya, 3.V.1986, *C. & J. Pedrol s.n.* (MA [304602]); Entre Balaguer y la Sentiu de Sió, 6.V.1985, *J. Pedrol s.n.* (MA [313986]); **Logroño:** Dehesa de Ausejo, 29.V.1985, *J. Pedrol & al. s.n.* (MA [438411]); **Madrid:** Cerca de Aranjuez, 6.IV.1946, *Rivas Goday s.n.* (MA [276056]); Cerro Negro, 1.VI.2002, *J. Isern s.n.* (MA [720252]); **Murcia:** Moratalla, proximidades de El Sabinar, 25.IV.1997, *I. Álvarez s.n.* (MA [591040]); **Salamanca:** La Orbada, 25.V.1985, *E. Rico s.n.* (MA [390778]); **Segovia:** Arroyo de la Hoz, Cedillo de la Torre, 30.IV.1984, *M. J. Illueca s.n.* (MA [507332]); **Valladolid:** Tiedra, 8.VI.1981, *Fernández Diez* (MA [250608]); Cabezón de Pisuerga, 31.V.1980, *A. R. Burgaz s.n.* (MA [308989]); Fuenteoco, 15.V.1983, *J. L. Fernández Alonso s.n.* (MA [406320]).