



## *Euphorbia flavicoma* subsp. *bermejense* (Euphorbiaceae): a new obligate serpentinophyte from the southern Iberian Peninsula

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### Abstract

A new subspecies of the genus *Euphorbia* is described and illustrated. The new taxon occurs on rocky peridotite soils as an endemism forming part of the serpentine open scrublands in the province of Malaga (southern Iberian Peninsula, Spain). The only population belonging to this new taxon was formerly identified as *E. flavicoma* subsp. *giselae*, which also lives in the south of France. The new subspecies can now be separated from the French population and from *E. flavicoma* subsp. *flavicoma* by several characters: biological type, pubescence, margin and lamina shape and ecology.

**Key words:** Euphorbiaceae, peridotite, conservation, Spain, France

### Introduction

The genus *Euphorbia* Linnaeus (1753: 450) (Euphorbiaceae) includes at least 2100 species distributed through temperate and tropical areas of all continents (Riina & Berry 2016). Nuclear and chloroplast DNA sequence data from several species in the clade strongly support the monophyly of *Euphorbia* s.l. (e.g., Horn *et al.* 2012, Riina *et al.* 2013, Dorsey *et al.* 2013), with all former segregate genera included (Steinmann & Porter 2002). However, the data show a marked incongruence with most of the traditionally recognized subgeneric groupings within *Euphorbia*, clearly indicating that previous morphologically based delimitations of subgenera or sections within the genus should not be taken at face value. Four major clades were identified in the first phylogenetic investigation of *Euphorbia* by Steinmann & Porter (2002). These clades were later formalized by Bruyns *et al.* (2006) as four subgenera: *E.* subg. *Rhizanthium* (Boissier 1862: 3) Wheeler (1943: 488), *E.* subg. *Esula* Persoon (1806: 14), *E.* subg. *Euphorbia*, and *E.* subg. *Chamaesyce* Rafinesque (1817: 119).

In Europe, *Euphorbia* is represented by more than 100 species with highest diversity in the Mediterranean area; the majority of taxa belong to subgenus *Esula*, including about 500 taxa (Frajman & Schönschwetter 2011). Subgenus *Esula* comprises approximately 400 species primarily distributed in temperate regions of the Northern Hemisphere. Most of the species have cyathia with nectariferous involucre glands, as well as a caruncle on their seeds (Barres *et al.* 2011). *Euphorbia flavicoma* Candolle (1813: 110) is placed in the group of *Euphorbia* subg. *Esula* (Riina *et al.* 2013) and the distribution is restricted to the central and southern parts of Europe (Govaerts *et al.* 2016). In the Iberian Peninsula, the group of taxa included in *Euphorbia flavicoma* is composed of three subspecies (Benedí *et al.* 1997): subsp. *flavicoma*, subsp. *occidentalis* Lainz (1976: 7) and subsp. *giselae* Simon Pallisé (1997: 199). This group was previously studied by Simon Pallisé (1993) in his PhD thesis, where he recorded the presence of *E. flavicoma* subsp. *flavicoma* in the Mediterranean region from Bosnia to the South of the Iberian Peninsula and *E. flavicoma* subsp. *giselae* in the ultramafic outcrops of Sierra Bermeja (Malaga, Spain), the distribution here overlapping with the typical subspecies. Similarly, Simon Pallisé (1993) found that *E. flavicoma* subsp. *giselae* also occurs in a population in the southeast of France, in Alpes-de-Haute-Provence, Saint Benoît.

When describing the subspecies *giselae* and its two disjunct populations, Simon Pallisé (1993, 1997) mentioned several morphological discrepancies between the Spanish and French populations in relation to the pubescence of the plant and the leaf shape. He argued that the length and the density of the indument were significantly lower in the

Sierra Bermeja population, and the leaves were more elliptic and larger with acute leaf apex in the French population compared with the Sierra Bermeja population. Simon Pallisé argued that with more studies, the Spanish population in the Sierra Bermeja could be assigned with a new taxonomic rank. Apart from these morphological differences, the habitat of the subsp. *giselae* in France was described by Simon Pallisé (1993) as clayey and calcareous-rocky, while in the Sierra Bermeja rocks are ultramafic peridotite.

In the Flora Iberica, Benedí *et al.* (1997) separated the subsp. *flavicomae* from the subsp. *giselae* using leaf characters: reflexed leaves with the lower side pubescent for *Euphorbia flavicomae* subsp. *giselae*, and glabrous (except on the margin) leaves for *E. flavicomae* subsp. *flavicomae*. In the Flora Vascular de Andalucía Oriental, Salinas (2011) used the pubescence and the morphology of the leaves to segregate them: sericeous pubescence and pubescent leaves on both sides for *E. flavicomae* subsp. *giselae* and folded pubescence and glabrous leaves in *Euphorbia flavicomae* subsp. *flavicomae*.

Following Simon Pallisé's suggestion (1997), Pérez-Latorre *et al.* (2013) proposed separating the Sierra Bermeja population of *Euphorbia flavicomae* subsp. *giselae* from the French population, adding more differences according to the size and the margin of the leaves and making it clear that the two populations are geographically disjunct.

For all these reasons, we consider that the Sierra Bermeja population of *E. flavicomae* subsp. *giselae* should be differentiated from the French population, as representing a new subspecies which exclusively inhabits the Sierra Bermeja and which has its own characters and habitat.

## Material & Methods

### Study site

The ultramafic outcrop of Sierra Bermeja was sampled from 2012 to 2014 to study the populations of *E. flavicomae* *s.l.*, focusing efforts on locating *E. flavicomae* subsp. *giselae* which had not been seen since the 1970s. Sampling was designed according to the chorological data of the voucher specimens consulted at the "Global Biodiversity Information Facility in Spain" (GBIF), especially the voucher specimens of the University of Málaga herbarium (MGC), and based on Simon Pallisé's data (1993) and field work in the indicated areas.

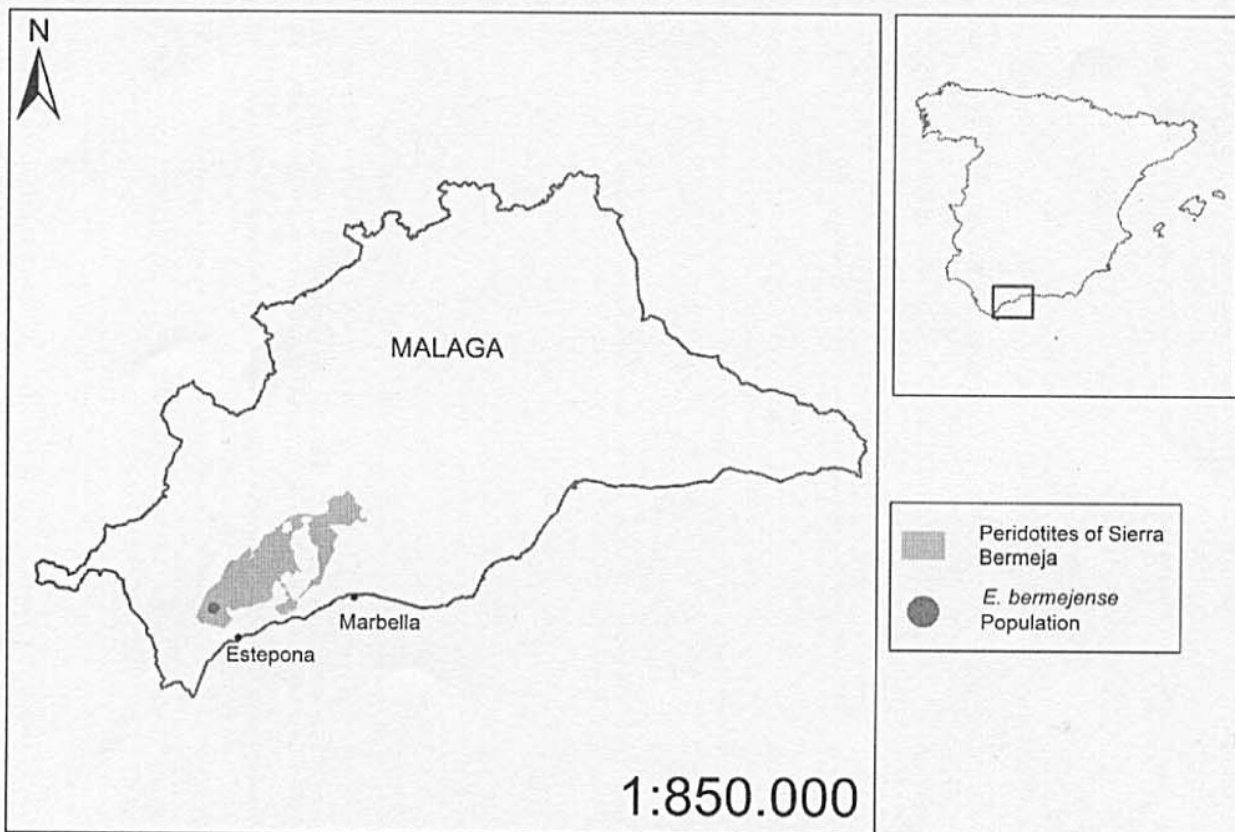


FIGURE 1. Study site. Sierra Bermeja ultramafic outcrop, Málaga, Andalusia, Spain.



## Methods

After studying the distribution area of *E. flavicoma* subsp. *giselae* in Sierra Bermeja, we only found one population which has been studied at the population level (Martella *et al.* 2012), identifying and counting the number of individuals of *E. flavicoma* subsp. *giselae* and *E. flavicoma* subsp. *flavicoma* which share a reduced population area (Fig. 1). During the field work, we used KITE field magnifying glasses (10X) and followed the morphological characters described by Simon Pallisé (1997) to separate the two subspecies: pubescence or no pubescence on the leaf lamina. Moreover a third group of individuals was differentiated with intermediate characteristics (not very pubescent on the leaf lamina). We shall refer to this group from this point as “intermediate” form.

To study the French population of *E. flavicoma* subsp. *giselae*, the Madrid herbarium (MA) kindly provided several specimens, which were studied following Simon Pallisé (1993). Moreover, we studied material of *E. flavicoma* subsp. *flavicoma* collected in different localities and *E. flavicoma* subsp. *giselae* from Sierra Bermeja specimens of the herbarium MGC (Malaga).

Using a Multizoom Nikon microscope, AZ-100 model, with a digital freeze camera Nikon Digital Sight DS-5Mc, leaves, flowers, and fruits of voucher specimens of *E. flavicoma* subsp. *flavicoma* of Sierra Bermeja and of *Euphorbia flavicoma* subsp. *giselae* from the Sierra Bermeja and Alps were photographed.

The ecomorphology and phenomorphology of the *E. flavicoma* subsp. *flavicoma* and *Euphorbia flavicoma* subsp. *giselae* populations from Sierra Bermeja were studied following Orshan's methodology (Orshan 1986, 1989) improved by Pérez-Latorre & Cabezudo (2002); the results of this study are used in the description and phenological calendar of the new subspecies.

## Results

### Taxonomy

#### *Euphorbia flavicoma* subsp. *bermejense* Hidalgo Triana, Pérez Lat. & Cabezudo, *subsp. nov.* (Fig. 2)

Differs from subsp. *flavicoma* in habit (climbing), pubescence of leaf lamina, bracts and inflorescence (all glabrous), and in the colour of the margin of the lamina leaf (sometimes reddish), and from subsp. *giselae* in life form (chamaephyte) and habit (suffruticose), pubescence of stems (with long reflexed hairs), leaf lamina (with reflexed and long hairs), bracts (with long hairs in the lower side) and inflorescence (with hair tufts), in the colour of the margin of the lamina leaf (green) and in the shape of leaf lamina (elliptic).

**Type:**—SPAIN. Málaga: Estepona, Sierra Bermeja, Sierra de Los Reales, 30SUF0439, 22 April 1976, M. Ladero & S. Rivas Goday *s.n.* (holotype MA 250416!, isotype MA 250416-1!).

Densely pubescent cryptophyte / chamaephyte suffruticose perennial, 20–30 cm high. Tap root present, root depth 10–25 cm. Stems 10 cm long, procumbent, erect or climbing. The older stems have corky bark and the younger ones short folded hair. Branches of the previous year sometimes persistent but without leaves, because the leaves last around 6–14 months. Malacophyllous leaves, green and glaucous, scarcely serrated and with a red margin, lanceolate, alternate, with short and appressed hairs on both sides, one-nerved and shortly petiolate. Leaves of long branches are between 0.25–2.25 cm<sup>2</sup> in size, 1–2 cm long, and 2–3 mm wide. Leaves of short branches are less than 1 cm<sup>2</sup>, 1–2 cm long and 1–2 mm wide. Pleiochasium with 3(–5) terminal rays up to 20 mm long, glabrous or with very lax tufts of hair, shorter than the bracts, 1–2(–3) divided, yellow at the anthesis and reddish after; pleiochasial bracts pubescent in the lower side, wider and longer than the upper leaves. Cyathium 2.3–3 mm long, sessile with peduncle of 0.8–1 mm; nectaries without appendices, elliptic or reniform, yellow or reddish. Ovary 0.8 × 0.8 mm. Capsules trilobate, 3.2–4.1 × 3.4–4.1 mm, ovoid, not very sulcate, rounded shaped, covered with warts also in the grooves, warts of 0.3 mm. Seeds smooth 3 × 2 mm, brown; caruncle 0.4–0.8 × 0.5–1.1 mm, reniform.

**Etymology:**—The specific epithet *bermejense* refers to the only mountain range and biogeographical sector where the taxon lives.

**Distribution and habitat:**—Rocky screes and slopes; exclusively in serpentine soils; elevation 500–600 m, southerly orientation. *Euphorbia flavicoma* subsp. *bermejense* is an endemic subspecies in the south of peninsular Spain, restricted to the province of Malaga. There is only one known locality: Sierra Bermeja, Estepona. 30SUF0439.

**Phenology:**—Vegetative growth from September to May, flowering May–June, fruiting May–June, seed dispersal June, leaves of long branches (dolichoblast leaves) shedding June–September (Fig. 3).



FIGURE 2. *Euphorbia flavicoma* subsp. *bermejense* in the field. A, Habitat; B, Habit; C, Detail of inflorescence; D, Detail of fruits. Photographs by the authors.

**Additional specimens studied (paratypes):**—SPAIN. Málaga: Estepona a Puerto de Peñas Blancas, 22 April 1976, *E. Fuertes s.n.* (MA 405927-1!); Estepona, Sierra Bermeja, 22 April 1976, *B. Díez & A. Asensi s.n.* (MGC 3254!); Estepona, Sierra Bermeja, 8 April 1978, *B. Díez & A. Asensi s.n.* (MGC 4950!); Estepona, Sierra Bermeja, 500 m, 13 January 2016, *A. V. Pérez Latorre s.n.* (MGC 81774!), *A. V. Pérez Latorre s.n.* (MGC 81776!); Estepona, Sierra de los Reales, 22 April 1976, *M. Ladero & S. Rivas Goday s.n.* (GDAC 15895-1-2!).

**Taxonomic discussion:**—The new taxon *E. flavicoma* subsp. *bermejense* is differentiated from the other two similar taxa by several morphological and ecological characters (Table 1, Fig. 4). 1. The biological life form following Raunkiaer (1934) is different in *E. flavicoma* subsp. *giselae*. 2. Pubescence of leaves, inflorescences and stems: this character contributes to establish differences in type and density of hairs: *E. flavicoma* subsp. *flavicoma* only has hair on the stems, while *E. flavicoma* subsp. *giselae* is notably pubescent on all parts except for the bracts, with reflexed and long hairs, and *E. flavicoma* subsp. *bermejense* is distinctly pubescent mainly on the leaves but the hairs are appressed and short. 3. Colour of leaf margin: always reddish in *E. flavicoma* subsp. *bermejense* in contrast to the other subspecies, which are green (*E. flavicoma* subsp. *giselae*) or sometimes reddish in *E. flavicoma* subsp. *flavicoma*. 4. Leaf lamina shape: distinguishes the subspecies *giselae*, which is elliptic here, while the other taxa have lanceolate leaf laminae. 5. Ecology: only *E. flavicoma* subsp. *bermejense* is restricted to rocky serpentine soils.

**Ecology**—The results from the population study undertaken in the area where individuals of *E. flavicoma* subsp. *bermejense* were previously found indicated that in a total of 165 individuals inhabiting 5000 m<sup>2</sup>, 81 (49.09 %) showed the characteristics of *E. flavicoma* subsp. *flavicoma*, 22 (13.33 %) were individuals with the characteristics of *E. flavicoma* subsp. *bermejense* and 62 (37.6 %) had intermediate characteristics between the two taxa (intermediate form). Some individuals have the same characters as the new subspecies but are glabrous. This phenomenon might suggest that they are suffering one of the syndromes of serpentinomorphism: glabrescence (Pichi-Sermolli 1948, Whittaker 1954). This question should be addressed because the phenomenon may be affecting the new subspecies, which shows nanism (cushion scrub), reddening (leaf margin) and it is a macro-rooted plant (Hidalgo Triana 2016).