



## A new species of *Aquilegia* (Ranunculaceae) from Sardinia (Italy)

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### Abstract

The new species *Aquilegia cremnophila* (Ranunculaceae) from the Italian island of Sardinia is here described and illustrated. It occurs in shady rocky crevices, near the upper parts of Mt. Corراسi (Supramontes Region), where it is a member of chasmophilous communities. This species is morphologically, phenologically, ecologically and genetically well differentiated from the other Sardinian taxa, showing some relationships mainly with *A. nugorensis*, an endemic species of Central-Eastern Sardinia. Its conservation status is examined. A key of all taxa present in Sardinia is also provided.

**Key words:** columbine, endemic flora, Mediterranean Basin islands, taxonomy

### Introduction

*Aquilegia* L. is a genus of Ranunculaceae distributed across circumboreally (temperate Asia, Europe and North America), where it is represented by ca. 66 taxa (Garrido *et al.* 2012, and references therein). This genus groups herbaceous geophytes characterized by a well-developed rhizome with an erect, usually pubescent stem growing from a basal rosette with bi- or triternate compound leaves. Hermaphrodite flowers are radially symmetrical and exhibit five sepals and five petals, each petal consisting of a flat limb and a backwardly directed, nectar-secreting spur. Basal rosettes sprout in spring and develop one or more stems with inflorescences, eventually fructifying in summer (Cullen & Heywood 1964, Whittemore 1997, Nold 2003).

During field investigations in Sardinia, very peculiar population of *Aquilegia*, occurring at calcareous rocky crevices of Mt. Corراسi (Oliena, Central-Eastern Sardinia) were found. They were previously doubtfully attributed to *A. nugorensis* by Fenu *et al.* (2010). According to Arrigoni & Nardi (1977, 1978) and Arrigoni (2006), three endemic species of this genus are quoted for Sardinia: *A. barbaricina* Arrigoni & Nardi (1977: 265), *A. nugorensis* Arrigoni & Nardi (1978: 220), and *A. nuragica* Arrigoni & Nardi (1978: 215), which usually grow in wet places. Although the population of Mt. Corراسi exhibits some features in common with *A. nugorensis*, it differs in numerous relevant morphological characters, such as the colour, shape and size of the perianth, as well as in phenology and ecology.

In order to clarify the correlation between the Sardinian *Aquilegia* taxa, genetic and eco-physiological analyses were carried out (Garrido *et al.* 2012, Mattana *et al.* 2012). In particular, Garrido *et al.* (2012) highlighted that the population of Mt. Corراسi appeared genetically differentiated from all the other known species. Mattana *et al.* (2012) also identified a different behaviour in the seed germination in the Mt. Corراسi

population, with respect to the other examined populations. Based on this evidence, the populations of Mt. Corrasi are here treated as a species new to science.

## Taxonomic Treatment

### *Aquilegia cremnophila* Bacch., Brullo, Congiu, Fenu, J. Garrido & Mattana, *sp. nov.* (Fig. 1–2)

*Aquilegia nugorensis affinis sed caulibus minoribus, periantio azureo-violaceo, lamina petalis majore, calcare arcuato-uncinato differt.*

Type:—ITALY. Sardinia: Palumbrosa (Monte Corrasi, Oliena - Nuoro), calcari mesozoici, pareti rocciose ombreggiate, 40° 14' N – 09° 25' E, 1330 m, 5 June 2011, G. Bacchetta, G. Fenu & E. Mattana, *s.n.* (holotype CAT!, isotypes CAG!, CAT!, FI!).

Perennial herb with rhizome branched at ground level in 2–3 caudicles. Stems 2–3, erect, rigid, (18–)24–30 cm tall, pubescent with patent hairs 0.3–0.5 mm long, 1–2(–3) branched above. Basal leaves in rosette, more or less numerous; petiole (6.0–)9.5–11.5(–13.0) cm long, covered with patent pubescent and woolly hairs 0.3–0.5 mm long, 2-ternate (rarely 1-ternate), with primary petioles 1.5–6.0 cm long and secondary ones 0.2–1.5 cm long; leaflets tripartite, 1.5–3.0 × 1.5–3.5 cm, green-greyish and glabrescent beneath, green and pubescent above, with appressed hairs 0.1–0.2 mm long, irregularly cuneate-obovate, more or less incise-lobate, with lobes obtuse to subacute, mucronate. Cauline leaves 1–2 like basal ones; petiole (1.0–)3.5–5.5(–7.5) cm long, the uppermost bracteate, ternate or simple, shortly petiolate or sessile. Pedicels densely covered by glandular hairs. Flowers 4–10, suberect or reclinate in bud, suberect or erect at anthesis, (40.5–)48.5–54.5(–59.0) mm in diameter. Sepals blue-violet (rarely lilac), patent, (18–)20–26(–29) × (7.5–)9.5–11.5(–12.5) mm, multinerved, ovate-lanceolate, glandular-puberulous outside, glabrous inside; apex acute, yellow-greenish; keel greenish. Petals concolourous, sometime lilac inside, suberect, (21.0–)25.5–31.5(–33.5) mm long (spur included), multinerved; blade glabrous, truncate-rounded or rounded at apex, (10.0–)12.0–16.5(–19.0) × (8.5–)10.5–13.0(–13.5) mm. Spur funnel-shaped, curved to curved-uncinate at apex, 14.0–17.5(–19.0) mm long, rigid, glabrous or subglabrous with scattered patent hairs; nectary yellow-greenish. Stamens numerous, unequal, with filament hyaline, (8.5–)9.0–12.0(–13.5) mm long. Staminodes 10, hyaline, linear-lanceolate, (5.8–)6.1–8.4(–11.8) × (0.8–)1.0–1.2(–1.4) mm, keeled, strongly wrinkled, acute and revolute at apex. Anthers lemon-yellow, 1.6–2.6 × 1.1–1.5 mm. Pistils 12–15 mm long; ovary densely hairy-glandular; style (6.5–)7.3–9.9(–10.9) mm long, erect-curved, hairy below, persisting in fruit; stigma grooved dorsally, curved and bilobed at apex. Carpels (4–)5–6(–8), densely glandular hairy. Fructiferous peduncles erect or suberect. Immature follicles green, erect, (18–)23–28(–30) × 4–5 mm, divaricate-patent above and curved at apex, glandular-pubescent, markedly reticulate-veined. Mature follicles pale-brown, (17.0–)21.5–25.5(–30.0) × 3.0–4.5 mm. Seeds trigonous or ovoid-trigonous, ribbed, black and shining, 2.22–2.62 × 1.23–1.49 mm.

*Habitat:*—*Aquilegia cremnophila* is a chasmophyte growing on Mesozoic dolomitic limestones, at an elevation of 1300–1420 m. It likes the rocky walls, colonizing the shady crevices. The species is a member of a rupestrian plant community rich in Sardinian and Cyrno-Sardinian endemics, such as *Armeria morisii* Boiss., *Campanula forsythii* (Arcangeli) Podlech, *Euphorbia amygdaloides* subsp. *semiperfoliata* (Viv.) Radcl.-Sm., *Hieracium supramontanum* Arrigoni.

*Distribution:*—This species is circumscribed to the upper part of Mt. Corrasi, municipality of Oliena (Nuoro - Sardinia), where it is represented by only four nuclei (Garrido *et al.* 2012).

*Etymology:*—From the Greek words “*cremnos*” = cliff, and “*philos*” = fond of, in reference to its habitat.

*Phenology:*—Flowering late May to June, fruiting July to August (Mattana *et al.* 2012).

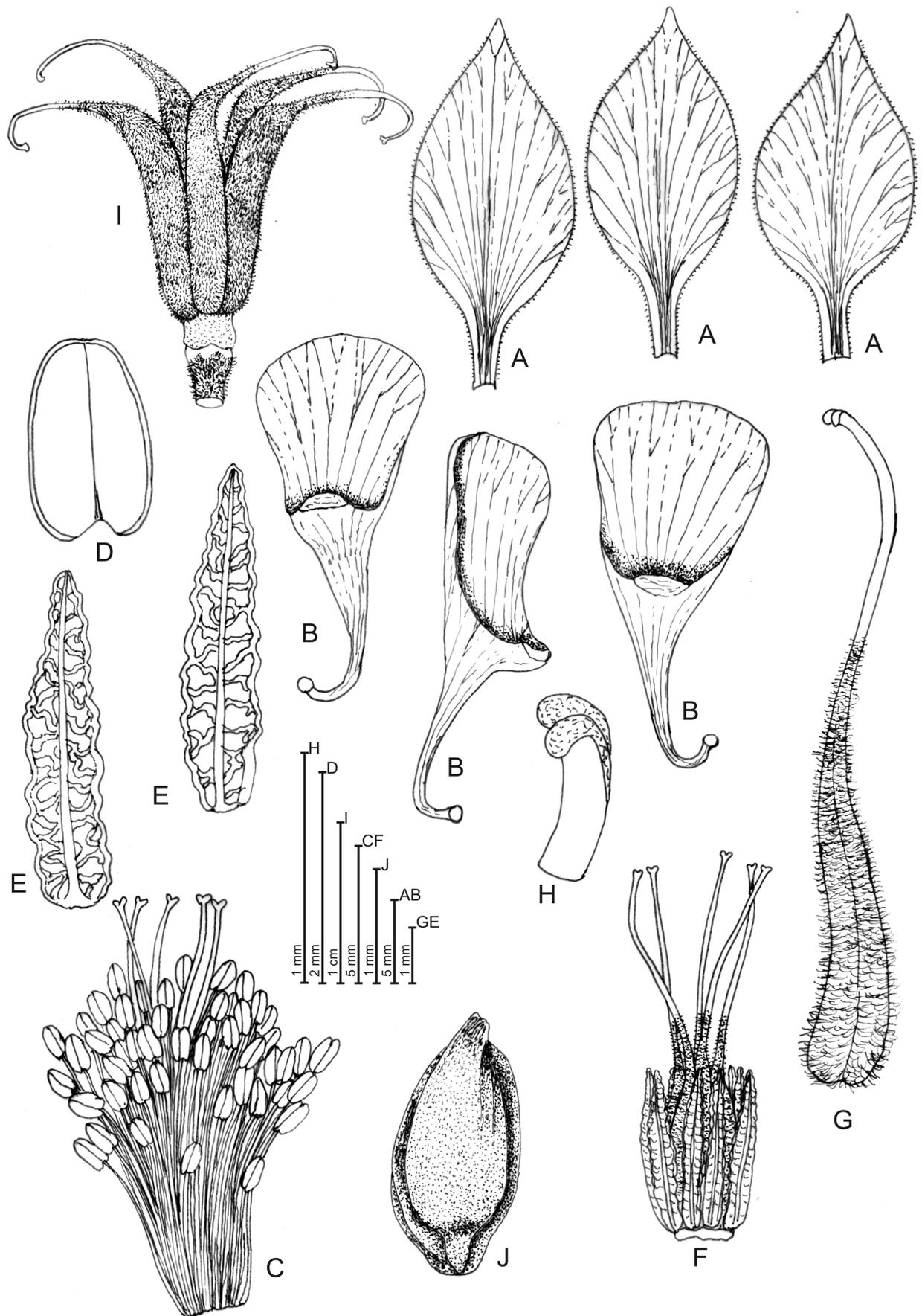
*Conservation:*—Although the four nuclei are threatened by goat and mouflon grazing, a population decline was not observed. However, considering the small size population and the possibility that the level of threat could quickly increase (i.e. human activity or stochastic events), *Aquilegia cremnophila* we applied the

IUCN criteria (2001) and propose an IUCN red list category as vulnerable: VU = D2, as the total number of mature plants ranged from 250 to 1000, distributed in less than 10 km<sup>2</sup>.

As part of the projects funded by the Regione Autonoma della Sardegna, the Centro Conservazione Biodiversità (Università degli Studi di Cagliari) initiated a conservation programme of *in situ* studies and long-term *ex situ* conservation at the Sardinian Germplasm Bank (BG-SAR) for all *Aquilegia* species endemic of Sardinia, including *A. cremnophila*.



**FIGURE 1.** Diagnostic features of *Aquilegia cremnophila*. **A.** Leaf. **B.** Leaf lobe. **C.** Flower, frontal view. **D.** Flower, lateral view. Illustration by Salvatore Brullo based on Bacchetta, Fenu & Mattana s.n. (CAT).



**FIGURE 2.** A. Sepals. B. Petals. C. Stamens and pistils. D. Anther; E. Staminodes. F. Staminodes and pistils. G. Pistil. H. Stigma. I. Follicles. J. Seed. Illustration by Salvatore Brullo based on *Bacchetta, Fenu & Mattana s.n.* (CAT).

*Observations:*—*Aquilegia cremnophila* represents an endemism circumscribed to the Mt. Corrasi (Central-Eastern Sardinia). It shows close relationships mainly with *A. nugorensis* and also with *A. nuragica*, species occurring in the same Sardinian territories. In particular *A. cremnophila* differs from *A. nugorensis* in having smaller size, perianth blue-violet, petal blade larger (12–16 × 10–13 mm), spur curved and uncinated at apex (Fig. 3). Besides, they are well differentiated from a phenological and ecological point of view, since *A. cremnophila* is an calcicolous orophyte having a later fruiting (Mattana *et al.* 2012), exclusive of shady rupestrian habitat, behaving as a true chasmophyte. As concerns *A. nugorensis*, it is a nemoral hygrophyte growing along the streams in the canopy of riparian woods and is indifferent to the geological substratum (Arrigoni & Nardi 1978). This new species differs also from *A. nuragica* for the stems and petioles pubescent, perianth colour and spur longer (14–20 mm), as well as for the ecology. In fact, *A. nuragica* grows on vertical rocks just next of petrifying springs with tufa formation.



**FIGURE 3:** Frontal and lateral view of the *Aquilegia cremnophila* (a–b) and *A. nugorensis* (c–d) flower. Pictures were taken on the *holotypus* for *A. cremnophila* and on the *locus classicus* for *A. nugorensis* (Seui, OG, Central-Eastern Sardinia).

The morphological and ecological differentiation of *Aquilegia cremnophila* is also supported by the molecular and the eco-physiological investigations carried out by Garrido *et al.* (2012) and Mattana *et al.* (2012), respectively. In particular, Garrido *et al.* (2012), studying the spatial genetic structure of the *Aquilegia* taxa occurring in Sardinia, found that the analyses of AFLP multilocus individual profiles were not fully compatible with the current taxonomic affiliations of Sardinian taxa. The population of Mt. Corrasi, now attributed to *A. cremnophila*, represents a spatial genetic group well differentiated from all the other species, including *A. nugorensis*. Data regarding the germination behaviour of Sardinian *Aquilegia*, put in evidence that the riparian species (*A. barbaricina* and *A. nugorensis*) germinate only after warm and cold stratification pre-treatments, while the rupestrian species (*A. cremnophila*) germinates also without any pre-treatments at warm temperatures (Mattana *et al.* 2012), as detected for many others Mediterranean orophytic plants (Giménez-Benavides *et al.* 2005).

*Paratypes*:—ITALY. Sardinia: Ahottadoglios (Monte Corrasi, Oliena - Nuoro), 1345 m, 5 June 2011, G. Bacchetta, A. Congiu, G. Fenu & E. Mattana, s.n. (CAG); Arco Corrasi (Monte Corrasi, Oliena - Nuoro), 1370 m, 5 June 2011, G. Bacchetta, A. Congiu, G. Fenu & E. Mattana, s.n. (CAG); Punta Corrasi (Monte Corrasi, Oliena - Nuoro), 1420 m, 5 June 2011, G. Bacchetta, A. Congiu, G. Fenu & E. Mattana, s.n. (CAG).

### Key to the species of *Aquilegia* from Sardinia

1. Pedicel curved at anthesis, perianth white to white-pinkish, sepals lanceolate 5–8 mm wide..... *A. barbaricina*
- Pedicel erect at anthesis, perianth cerulean to blue-violet, sepals ovate to ovate-lanceolate 9–14 mm wide ..... 2
2. Stems and petioles glabrous to glandular-puberulous, spur 11–13 mm long ..... *A. nuragica*
- Stems and petioles pubescent, spur 14–20 mm long ..... 3
3. Perianth cerulean, petal blade 8–12 × 5–9 mm, spur straight and curved at apex ..... *A. nugorensis*
- Perianth blue-violet, petal blade 12–16 × 10–13 mm, spur curved and uncinated at apex.....*A. cremnophila*

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