Federico Selvi

New findings of *Anthemis cretica* (*Asteraceae*) on serpentine outcrops of Tuscany (C Italy)

Abstract

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Two records of the polymorphic taxon *Anthemis cretica* L. (*Asteraceae*) on serpentine outcrops in central Tuscany are reported. The species is new to this region, and the two isolated populations mark the northwestern distribution limit of the taxon. Based on morphology of mainly capitula and achenes, the populations can be referred to *A. cretica* subsp. *columnae* (Ten.) Franzén, and karyological analyses showed that these are tetraploid with $x = 9$. Populations are located in garrigue-like communities of the association *Armerio-Alyssetum bertolonii*, together with several obligate serpentine endemics. At these sites *A. cretica* is found at only ca. 300 and 500 m a.s.l., well below its normal altitudinal range which is usually above 1200 m. Such findings reveal the capacity of this species to penetrate into mediterranean habitats and to tolerate the several anomalies of the ultramaphic substrates, as confirmed by its presence in similar habitats of Greece and, probably, Albania.

Key words: Anthemis cretica, serpentine plants, flora of Tuscany.

Introduction

Anthemis cretica L. (= *A. montana* L. nom. illeg., see Grierson 1974: 212), is a suffrutescent hemicryptophyte with several erect to ascending, usually unbranched stems and 1- to 2- pinnatisect, tomentose to densely white-sericeous leaves with mucronulate segments. The capitula are heterogamous, radiate or more rarely discoid, with white ligules. The involucre is hemispherical with obtuse bracts of variable color, and the receptacle bears acuminate scales (paleate). The achenes are weakly striate, without pappus but with a tiny corona around the tip. The polymorphism of this species, stressed by several authors (i.e. Fernandes 1976; Pignatti 1982; Franzén 1986; Greuter 2008), has led to the formal description of numerous taxa that in most cases are local variants with little taxonomic value (Franzén 1986; Oberprieler 1998). On the other side, a workable infraspecific taxonomy for the European populations of this species is still needed.

From the ecological viewpoint, *A. cretica* is a beautiful mountain plant usually growing above 1200 m a.s.l. in xeric, open habitats with a continental climate. According to Pignatti (1982), it belongs to the Orophytic S European-W Asiatic chorotype with a range stretching from southern Europe to western Asia. It is discontinuously distributed in the Pyrenees, the southwest Alps, the Balkans, the Aegean area, eastern Anatolia and the Kabylian range in Algeria (Grierson 1975; Fernandes 1976; Franzén 1986; Oberprieler 1998; Greuter 2008). The centre of highest diversity of forms and polymorphism lies in Anatolia, where 12 subspecies have been described by Grierson (1975), while in the Mediterranean area 23 subspecies were reported by Greuter (2008). In Italy it shows a strongly discontinuous range encompassing the Maritime Alps and the central and southern Apennines from the Sibillini mountains in Marche and Umbria to Aspromonte in Calabria (Pignatti 1982; Conti & al. 2005). As reported by Fiori (1927) and Pignatti (1982), old records exist from also the northwest Apennines (Appennino pavese), but these are not supported by herbarium material or recent field observations.

During field excursions on serpentine outcrops of Tuscany (central Italy), two localities of this species were discovered in areas which are floristically still poorly known. The first finding was preliminarly reported by Chiarucci & al. (1998) as *Anthemis* cfr. *montana*, but doubts persisted about the identity of the plant. As a consequence, *A. cretica* is still "officially" unknown for this region, as resulting from the more recent checklist of the Italian vascular flora (Conti & al. 2005). Following the recent discovery of a second locality, it was possible to obtain more data on the taxonomic position, distribution, ecology and chromosome complement of the two isolated populations. These data bring to the light some ecological aspects previoulsy unknown for *A. cretica*, such as the capacity to grow on rocky, serpentine soils well below the normal altitudinal range.

New records of *A. cretica*

The species was collected in the following two localities (Fig. 1): Toscana, Castellina M.ma (PI), zona del Nocolino c. 2 km a SE del paese, affioramenti di serpentino sul versante nord-ovest del Poggio La Sambuca, vallecola esposta a ovest, 510-530 m, 43°23.859'N - 10°35.204' E, 16.05.08, *F. Selvi* (Herb Selvi n° 2990, FI); Toscana, Casciano di Murlo (SI), affioramenti di serpentine in Val di Merse fra Poggio La Croce e Poggio al Piano, esp. nord-ovest, 43°07.931' N - 11°18.594' E, 295 m, *A. Chiarucci & F. Selvi* (Herb. Selvi n° 3002, FI, SI).

Herbarium records are conserved in SI, FI and Herb. Selvi. The two localities lie c. 70 km from each other (Fig. 1), a distance which is likely to prevent genetic exchanges between the populations. The first locality is located on the hills along the tyrrhenian coastline in the southern part of the Pisa province, near the relief named Nocolino (616 m). The second one lies much more inland, on the hills on the left side of the river Merse valley a few kilometers before its junction to the river Ombrone (Siena province). From the bioclimatic point of view, both localities fall in a transition zone between the mesomediterranean and the supramediterranean belts, characterised by the evergreen woodland and macchia of the *Quercion ilicis* Br. Bl. (1931) 1936 and the broadleaf forest dominated by decidu-

Fig. 1. Italian distribution of *A. cretica* subsp. *columnae* (grey area) and location of the two new findings in Tuscany (stars).

ous oaks of the *Quercetalia pubescenti-petraeae* Klika 1933, respectively. The vegetation of the two sites, however, is heavily affected by the presence of extensive outcrops of serpentine rocks which cause a strong discontinuity in the cover and abrupt changes in the species composition of the communities. The results of three floristic surveys in the two sites (two at Nocolino, PI, and one at Murlo, SI) using the phytosociological method are reported in Table 1. The low plant cover of the plots, the lack of tree species, and the presence of numerous serpentine-adapted species, either obligate endemics or locally preferential, shows that these communities belong to the association *Armerio denticulatae-Alyssetum bertolonii* Arrigoni, Ricceri et Mazzanti 1983. The obligate endemic *Armeria denticulata* (Bertol.) DC. was not found in the plot surfaces but it is sporadically present in both areas.

In these communities *A. cretica* is present with small populations of a few dozens of individuals distributed on a few hundreds of square meters. In both sites they colonize the lower parts of relatively steep slopes rolling down to small valleys facing to the west. Both

populations suddenly desappear in the higher parts of the slopes and on the ridges with very poor vegetation, avoiding therefore sites which are strongly exposed to wind, soil erosion, sunlight and drought. From a demographic point of view, these include seedlings and juvenile plants besides adult plants that flower in May and produce mature capitula with normally developed achenes from the end of June. Accordingly, no anomalies in terms of reproductive efficiency seem to affect these populations.

Morphological and taxonomic characterization of the populations

Given the phenotypic polymorphism of the species, five subspecific taxa are currently recognized in Italy: (Conti & al. 2005): *A. cretica* subsp. *alpina* (L.) R. Fern. (Abruzzi, dubious for Umbria), subsp. *calabrica* (Arcang.) R. Fern. (Calabria), subsp. *columnae* (Ten.) Franzén (Marche, Umbria, Abruzzi, Campania, Basilicata), subsp. *petraea* (Ten.) Oberpr. & Greuter (Abruzzi), and subsp. *saxatilis* (DC.) R. Fern. (Piedmont, Maritime Alps). In *Flora Alpina* (Aeschimann & al. 2004), the latter taxon is not recognized but included in the typical *A. cretica* subsp. *cretica*. It is therefore interesting to assess to which of these taxa the isolated Tuscan populations are closer.

In the more recent literature (Franzén 1986, Oberprieler 1998), the infraspecific taxonomy of *A. cretica* is based on the density of the indumentum of the leaves (from nearly green to white-sericeous), the length of the achenes and the diameter of the involucre and capitula. The latter can be discoid (without ligulate, female florets) or radiate (with ligulate florets), while the involucral bracts can have a dark-brown to almost hyaline margin. The size of the plant and the position of the stems (erect or ascending) are also considered of taxonomic value.

With respect to these characters, the Tuscan populations consist of individuals up to 35 cm tall, with erect and unbranched stems (Fig. 2). At the beginning of the spring at least, the indumentum is fairly dense so that leaves are white-sericeous and have an aromatic smell. The capitula are ca. 3.5 cm in diam., and the involucre is also relatively large (ca. 12 mm, Fig. 3); at maturity they have a slightly umbonate shape. The involucral bracts are arranged in 3-5 rows, are abaxially appressed tomentose and have a brown, longitudinal strip; they are rounded at the tip and have a membranous, pale brown margin (Fig. 3B). The ray florets have well developed ligules up to 12 mm long (Fig. 3A), while the disc florets are yellow, short (3-4 mm long) and have a basal part which becomes inflated and spongy at maturity. The achenes of the disc florets are ca. 2 mm long and 0.9 mm wide, narrowly obconical and slightly curved, and are provided with an apical corona c. 0.2 mm long.

Using the identification keys in *Flora Europaea* (Fernandes 1976) and *Flora d'Italia* (Pignatti 1982) these characters lead to *A. cretica* subsp. *cretica*, a taxon that, however, is currently known for only Greece (continental part and Peloponnese), northern and eastern Aegean islands and southwest Anatolia (Franzén 1986). The more closely related taxon also occurring in Italy is *A. cretica* subsp. *columnae* (Ten.) Franzén, originally described as *A. montana* L var. *columnae* Ten. (Tenore 1831), and differing by the erect vs. ascending stems and the larger (9-13 vs. 7-11 mm), always radiate involucre. In the protologue, Tenore (1831) also indicates the size of the capitula: "floribus sesquipollicaris diametri", which is exactly the size of our specimens (ca. 3.5 cm). According to Franzén (1986), this

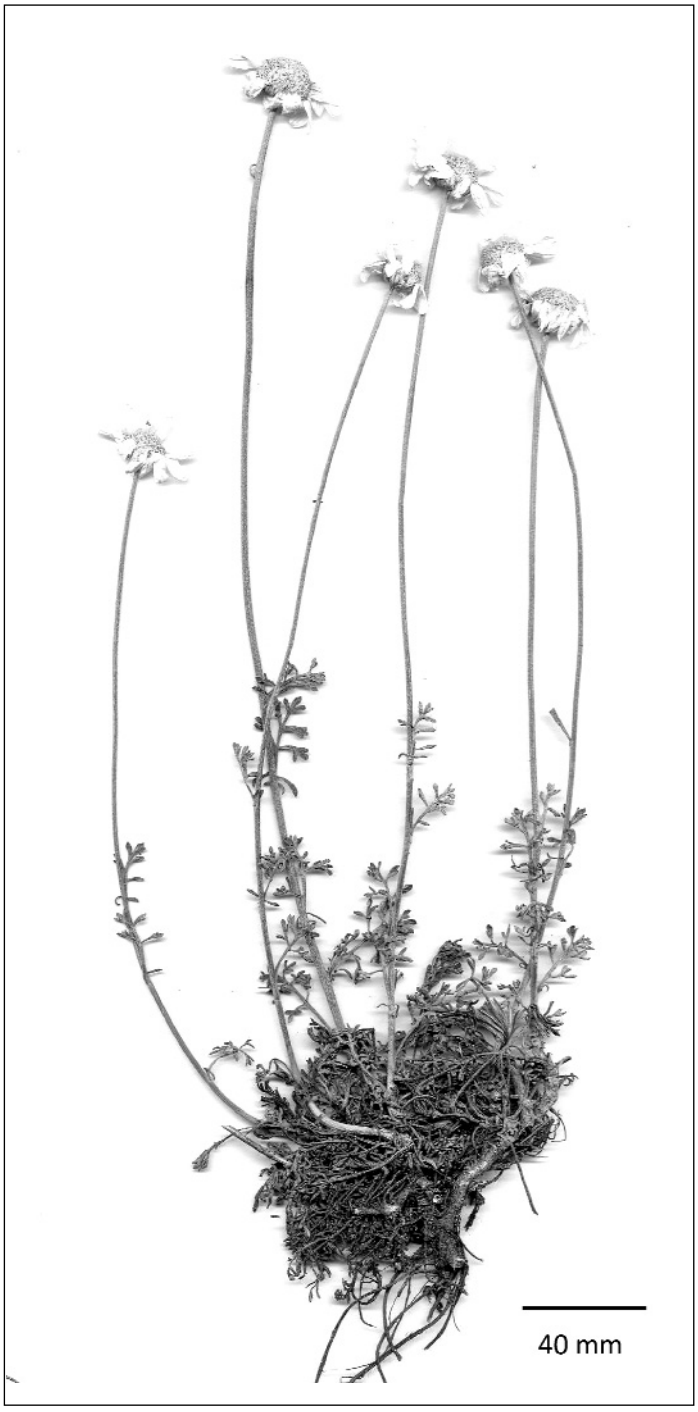

Fig. 2. Habit of *A. cretica* subsp. *columnae* from Casciano (SI).

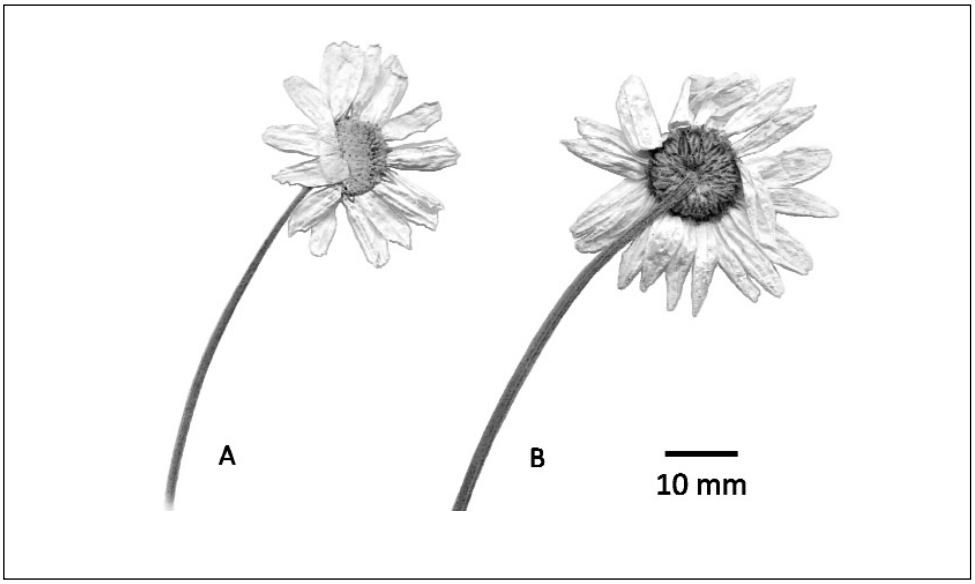

Fig. 3. Detail of capitula of *A. cretica* subsp. *columnae* from Castellina M.ma (PI), showing radiate and disc florets (A, adaxial view) and involucral bracts (B, abaxial view).

taxon is much more widely distributed than subsp. *cretica* as it occurs from southern France to Bulgaria and Greece, with isolated localities in the north of the Balkan penisula. Oberprieler (1998) quotes it for also the mountains of the "petite Kabylie" in Algeria. Over this range, it grows on mountain, rocky slopes and cliffs between 1200-2000(2500) m, on various substrates. Though described from Italy, this entity was mostly included in *A. cretica* subsp. *cretica* by Italian botanists (i.e. Fiori 1927, Pignatti 1982), while Arcangeli (1882: 354) treated it as a separate subspecies. Since this author used the illegitimate name *A. montana*, however, the combination *A. montana* L. subsp. *columnae* (Ten.) Arcang. can not be adopted. The *locus classicus* of this taxon is Montevergine near to Avellino in Campania ("ad rupes Montevergine propre Coenobium", specimens in FI!), and its distribution in Italy stretches discontinuously from the Sibillini mountains at the north to Mt. Sirino (Basilicata) at the south (Conti & al. 2005, 2006; Fig. 1) while populations from Aspromonte in Calabria are still doubtful. The Tuscan populations are therefore sharply isolated and mark the northwest limit of the Italian range. In spite of this, they match the "typical" ones from Montevergine. Those from the highest parts of the central Apennines (Sibillini, Velino, Sirente, Morrone, Gran Sasso), show instead a denser white-sericeous indumentum and slightly wider leaf segments, possibly in relation to the higher altitude.

Chromosome observations

Since no data seem to exist on chromosome number of *A. cretica* in Italy, we performed a karyological analysis using two cultivated plants collected in the population from the

Pisa province (Castellina M.ma). Root tips were collected in September 2008, treated with 8-hydroxiquinoline (3 hs) and fixed in Carnoy. After hydrolysis in HCl at 60 °C they were stained with lactopropionic orcein overnight, dissected on a clean glass slide and observed with a Zeiss light microscope.

All plates showed a complement with $2n = 36$ (Fig. 4), in line with existing reports for Greek provenances of *A. cretica* subsp. *columnae* (Strid & Franzén 1983 sub *A. carpatica*; Papanicolau 1984 sub *A. cretica*). The taxon is therefore tetraploid with base number $x = 9$.

Conclusions

The presence of isolated populations of *A. cretica* subsp. *columnae* on the hills of central Tuscany allows a better definition of the northwestern distribution limit of this taxon in Italy. A more interesting aspect, however, is that the new findings bring to the light an ecological trait which was previously unknown for the species, e.g. the capacity to persist on serpentine outcrops located well below the normal altitudinal range. Being able to tolerate the several anomalies of this soil, *A. cretica* takes part to the pioneer and specialized phytocoenoses of the association *Armerio-Alyssetum bertolonii* Arrigoni, Ricceri et Mazzanti 1983 (Table 1) and this allows to extend the synecological amplitude of the taxon. In other parts of its range, *A. cretica* s.l. is known to grow on either limestone (central Apennines) or sandstone, schist or other siliceous rocks, as in the Maritime Alps where it is linked to the communities of the *Koelerio-Corynephoretea* Klika ap. Klika et Nowak 1941 (Aeschimann & al. 2004).

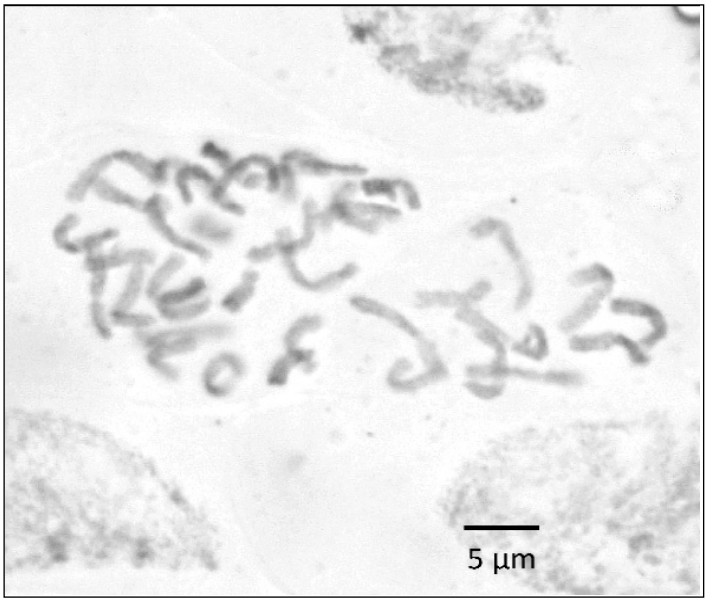

Fig. 4. Micrograph of metaphase plate showing the complement $2n = 36$.

Table 1. Floristic composition of the communities including *Anthemis cretica*, with cover estimations according to the scale of Braun Blanquet's phytosociological method. The character -species of the association *Armerio denticulate-Alyssetum bertolonii Arrigoni*, Ricceri et Mazzanti 1983 are indicated.

	Nocolino 40 mq, cop.%: 50	Nocolino 50 mq, cop.%: 60	Casciano 70 mq cop. % 65
obligate serpentine endemics of the association			
Armerio denticulate-Alyssetum bertolonii			
Centaurea aplolepa Moretti L. subsp. carueliana (Micheletti) Dostál	1	1	.
Alyssum bertolonii Desv.	+	1	+
Festuca robustifolia Mgf.–Dbg.	1	+	.
Stachys recta L. ssp. serpentini (Fiori) Arrig.	.	.	r
Thymus striatus Vahl var. ophioliticus Lacaita	r	+	1
preferential serpentinophytes			
Notholaena maranthae (L.) Desv.	.	.	r
Onosma echioides (L.) L.	.	.	1
Plantago holosteum Scop.	1	.	+
Euphorbia spinosa L.	1	.	.
Trinia glauca (L.) Dumort.	.	.	r
others *(in alphabetical order)*			
Aira caryophyllea L.	+	.	.
Aira elegantissima Schur	.	+	r
Allium sphaerocephalon L.	.	.	+
Anthemis cretica L. ssp. columnae (Ten.) Franzén	1	+	+
Anthericum liliago L.	+	1	.
Asperula cynanchica L.	.	.	r
Bromus erectus Huds.	.	1	.
Cerastium semidecandrum L.	.	+	+
Cistus salvifolius L.	+	.	1
Convolvulus cantabrica L.	.	.	r
Dianthus sylvestris Wulf. ssp. longicaulis (Ten.) Greuter & Burdet	r	.	.
Echium vulgare L.	.	.	+
Erica arborea L.	.	.	+
Festuca inops De Not.	.	+	+
Galium corrudifolium Vill.		+	+
Genista januensis L.	r	.	+
Helichrysum italicum G. Don	.	.	2
Herniaria glabra L.	.	.	+
Iberis umbellata L.	r	.	1
Jasione montana L.	.	.	r
Juniperus oxycedrus L.	.	.	+
Koeleria splendens C. Presl subsp. ophiolitica Brullo et al.	.	r	.
Linum tryginum L.	.	.	+
Myrtus communis L.	.	.	+
Potentilla hirta L.	1	+	.
Psilurus incurvus (Gouan) Schinz et Thell.	.	.	+
Sanguisoba minor Scop.	.	+	.
Scrophularia canina L.	.	.	+
Sedum rupestre L.	.	.	1
Silene armeria L.	+	r	.
Teucrium montanum L.	.	.	1
Vincetoxicum hirundinaria Medik. subsp. hirundinaria.	.	.	r

Although the Tuscan populations are the only ones known for serpentine soils in Italy, there is evidence that *A. cretica* subsp. *columnae* can grow on the ophiolitic outcrops of the Balkan peninsula. We, in fact, had the opportunity to collect it in June 2008 on the serpentine rocks of Mt. Vourinos in the Greek Macedonia (specimens in FI), where it was associated to other species of the order *Halacsyetalia sendtneri* Ritter-Studnička 1970. This locality is also indicated in the distribution map of the taxon in Greece (Franzén 1986), suggesting that other collections exist from serpentine habitats. A second indication is that Antonio Baldacci (1902: 536) quotes this taxon (sub *A. montana* var. *columnae* Ten.) from the district of Oros in northern Albania, which is characterized by extensive outcrops of serpentine with a rich, endemic flora (Cecchi & al. 2007). In his report Baldacci (1902) wrote "questi esemplari corrispondono bene colla pianta del m. Vergine dell'Italia meridionale". A third suggestion is that Fiori (1927) quoted *A. cretica* (sub *A. montana* var. *saxatilis*) for also the northern Appennines in the province of Pavia, a region where important serpentine outcrops are found. No recent confirmation, however, seem to exist for this area.

Finally, the finding of *A. cretica* in Tuscany underscores the important role as refugia that the ophiolitic "islands" of NW Italy have for taxa usually growing at higher altitudes in areas with a dry, continental climate. This is possible thanks to the physiological capacity of these plants to tolerate the anomalies of serpentine soils and to take advantage from the low competition by other species on such an hostile substrate. They probably underwent a lowering of their altitudinal range during the cold phases of the Holocene and/or Pleistocene, when they reached the low serpentine hills with a milder climate and discontinuous plant cover due to selective pressure of the soil. Other similar cases are, for example, those of *Linum austriacum* subsp. *tommasinii*, *Scorzonera austriaca*, *Campanula medium*, and others, that persist at low altitudes with relic populations on the serpentine islands of NW Italy (Selvi 2007).The lack of a clear and genetically-controlled morphological differentiation in these edaphic races suggests that their colonization of the ophiolitic outcrops is relatively recent.

Further studies are planned at the two sites in order to monitor the demographic trend of the populations of *A. cretica* and to investigate in more detail some genecological aspects.

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Address of the author:
Federico Selvi,
Dipartimento di Biologia Vegetale dell'Università, Via La Pira 4 I-50121 Firenze. E-mail: selvi@unifi.it