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Karyological and nomenclatural notes on the *Cerastium banaticum* group (*Caryophyllaceae*)

Abstract

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Diploid chromosome numbers ($2n = 36$), reported for Romanian populations of *C. banaticum* subsp. *banaticum*, are the first evidence for diploids within this polyploid complex with $2x$ -, $4x$ -, $7x$ -, and $8x$ -cytotypes. The designated lectotype for the name *C. grandiflorum* var. *banaticum* (= *C. banaticum*) has its origin in approximately the same area in Romania. The *Cerastium banaticum* group, centred in the mountains of Italy and the Balkans, is characterised as a disjunct and evidently old assembly of taxa exhibiting morphological affinities to the *C. tomentosum* and *C. arvense* groups.

Introduction

The perennial species *Cerastium banaticum* (Rochel) Heuff. was placed into the so-called *C. scaranii* group by Buschmann (1938), which also included related taxa such as *C. scaranii* Ten. s. lat. (incl. *C. apuanum* Parl.; *C. hirsutum* Ten. non Crantz, nom. illeg. [= *C. lacitae* Barberis & al.]), and *C. soleirolii* Ser. ex Duby. She considered this group to be close to the *C. tomentosum* group.

Later Schellmann (1938) included *C. julicum* Schellmann into the *C. scaranii* group and insisted on the morphological differences between *C. julicum* and *C. arvense* (e.g., pedicels always straight in *C. julicum*, but bent in *C. arvense*, and outer and inner capsule wall thicker in the former than in latter).

Finally, Jalas (1966) included three Macaronesian species, i.e. *C. sventenii* Jalas, *C. vagans* Lowe and *C. azoricum* Hochst. ex Seub.

Recent studies have shown that *C. scaranii* s. lat., as defined by Buschmann, is a heterogeneous assembly. Bechi & al. (1992) demonstrated clear morphological differences between *C. apuanum* Parl. and *C. scaranii* s. str.

Furthermore, Barberis & al. (1994) recognized *C. lacitae* Barberis & al. (= *C. hirsutum* Ten.) as a third distinct species, and insisted on relegating *C. scaranii* Ten. s. str. to the *C. arvense* group.

Material and methods

The karyological observations of the present study are based on live material of *Cerastium banaticum* collected from four localities in Romania (see Table 1) of which voucher specimens are deposited at WU. Furthermore, herbarium specimens from the collections B, BM, BP, CL, GZU, GJO, K, MA, W, and WU were considered. We have also seen xerocopies of several herbarium specimens from BR, E, H and LE.

Mitotic chromosomes were counted from root tip squashes of 4-5 individuals from each of four populations of *Cerastium banaticum* subsp. *banaticum*. Roots were obtained from transplanted plants, grown in the experimental garden. The root tips were fixed in glacial acetic acid : ethanol (1 : 3) after a pretreatment of 2-4 hours in 0.002 M hydroxyquinoline. For staining, the Giemsa standard method was used, as recommended by Guerra (1983). In this way, also the somatic karyotype of *C. banaticum* subsp. *banaticum* was obtained. For the karyogram, microphotographs were taken with a camera adapted to a Polyvar photomicroscope (Fig. 2), and the chromosomes were arranged first according to their increasing arm ratio, and then according to their decreasing length within each group.

Table 1. Chromosome counts of *Cerastium banaticum* subsp. *banaticum*

Acc. no.	2n	Locality, date, collector
93052943	36	Romania: distr. Caraş-Severin, village of Prolaz, in the Cerna Valley, between Băile Herculane and Topleţ, limestone, 120 m a.s.l., <i>Asplenio-Silenetum petraeae</i> N. Boşcaiu 1971, 29 May 1993, M. Boşcaiu
95051779	36	Romania: distr. Caraş-Severin, Mt Domogled, Valea Feregari, limestone, 300 m a.s.l., <i>Festucetum xanthinae</i> N. Boşcaiu 1971, 17 May 1995, F. Krendl & N. Boşcaiu
92080719	36	Romania: distr. Mehedinţi, Cioaca Goală, near Tisoviţa, in the Danube Valley, serpentine, 90-110 m a.s.l., <i>Asplenio septentrionali-Melicetum ciliatae</i> Soó 1940, 7 Aug 1992, M. Boşcaiu
92080820	36	Romania: distr. Gorj, Cheile Olteţului, near Mănăstirea Polovragi, limestone, 750 m, <i>Asperulo capitatae-Seslerietum rigidae</i> (Zoly. 1939) Coldea 1991, 8 Aug 1992, M. Boşcaiu

Results and discussion

Circumscription of the Cerastium banaticum group

Bearing in mind the above mentioned studies of Bechi & al. (1992) and Barberis & al. (1994), it seems feasible to include *C. banaticum*, *C. julicum*, *C. apuanum*, *C. soleirolii*, and *C. lacaitae* in a redefined assembly. As *C. scaranii* s. str. is now regarded as a member of the *C. arvense* group (because of bent pedicels, deflexed hairs on pedicels, and seed morphology), this assembly should bear a new informal designation. Because of the wide distribution area of *C. banaticum* we propose to name it after this species, i.e. the *C. banaticum* group.

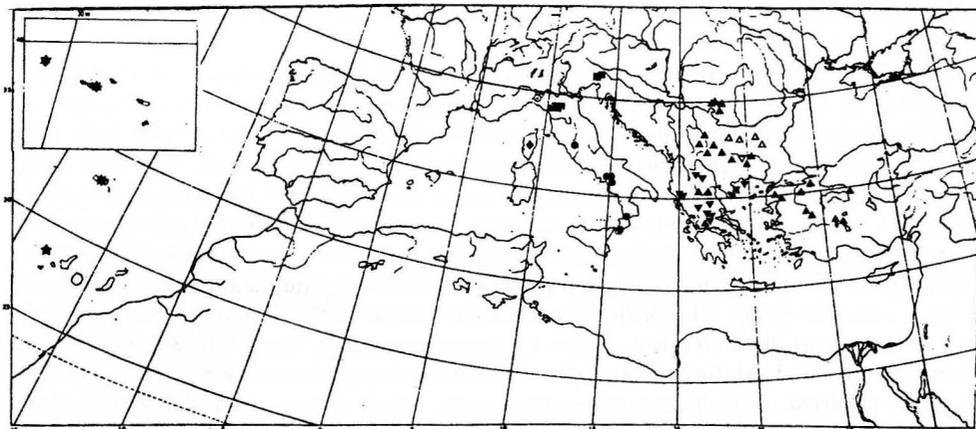


Fig. 1. Distribution map of the taxa of the *Cerastium banaticum* group: *C. banaticum* subsp. *banaticum* (▲), *C. banaticum* subsp. *speciosum* (▼), *C. julicum* (■), *C. apuanum* (■■), *C. lacaitae* (●), *C. utriense* (○), *C. soleirolii* (◆), and the related Macaronesian taxa, *C. sventenii* (★), *C. vagans* (*), and *C. azoricum* (:*). Each full symbol represents at least one herbarium specimen or population examined, empty symbols stand for literature references to *C. banaticum* subsp. *banaticum* and subsp. *speciosum*.



Fig. 2. Karyotype of the diploid cytotype of *C. banaticum* subsp. *banaticum*. Bar = 5 μm.

The inclusion of the above-mentioned three species inhabiting the Azores, Madeira, and Canary Islands (*C. sventenii*, *C. vagans* and *C. azoricum*), proposed by Jalas (1966), into this *C. banaticum* group leads to a remarkable and peculiar distribution pattern with an extensive gap in the western Mediterranean, and particularly in the Iberian Peninsula (Fig. 1) (cf. Rico 1990). The question, whether the *C. banaticum* group in such wide sense represents a natural monophyletic group remains to be solved by further studies.

Furthermore, the inclusion of *C. utriense*, described by Barberis (1988) from the Ligurian-Piedmontese Apennines, needs verification.

The *C. banaticum* group, in the sense discussed above, exhibits morphological similarities to the *C. tomentosum* and the *C. arvense* groups. The *C. banaticum* and *C. tomentosum* groups differ in their indumentum, the former has relatively short hairs with thickened walls, never entangled, whilst those of the second group are very fine, long, contorted and entangled. The distinction between the groups of *C. banaticum* and *C. arvense* is more difficult, nevertheless, there are several differential characters (cf. Barberis & al. 1994, 1995), such as the orientation of the hairs on the pedicel and on the upper part of the stem, being horizontal in the *C. banaticum* group and turned downwards in the *C. arvense* group. The pedicels are always straight in the *C. banaticum* group, but bent in the group of *C. arvense*. In the *C. banaticum* group, the seeds are chondro- or physospermous and exhibit a characteristic ornamentation of the exotesta (seed coat cells are much ramified, with thickened anticlinal walls, which appear much darker than their contents), whereas the seeds of the *C. arvense* group are much more similar to those of the *C. alpinum* group (Boşcaiu 1996), i.e. they are always chondrospermous, with seed coat cells less ramified, and not so thickened.

Karyological diversity within Cerastium banaticum

There is considerable variation in morphology and karyology, particularly in *Cerastium banaticum* s. str. Most authors (e.g., Jalas & al. 1993, Strid 1986) recognize two subspecies within this taxon, i.e. *C. banaticum* subsp. *banaticum* and subsp. *speciosum* (Boiss.) Jalas (= *C. banaticum* subsp. *alpinum* (Boiss.) Buschm.).

The present study revealed for the first time diploid chromosome numbers ($2n = 36$) in populations of *C. banaticum*, namely in subsp. *banaticum* from four localities in Romania (see Table 1 and Fig. 3). It is important for the correct interpretation of the name *C. banaticum* that one of the studied localities of diploids, namely the valley of Prolaz nearby Băile Herculane, is mentioned by Rochel in its protologue (see below). The karyotype of the diploid cytotype of *C. banaticum* subsp. *banaticum* (Fig. 2) is slightly asymmetrical with a range from meta- to submetacentric and subtelocentric chromosomes, and a gradual change in chromosome length, with pairs 1, 2 and 14 the longest and pairs 12 and 13 the shortest. Satellites were identified in one pair of metacentric chromosomes (pair 10). The karyotype formula is $13m + 3sm + 2st$, the mean chromosome length is $2.06 \pm 0.06 \mu\text{m}$, and the mean arm ratio is 1.45 ± 0.17 .

Otherwise, tetraploid chromosome numbers ($2n = 72$; $n = 36$) have been previously reported for *C. banaticum* by Söllner (1950: 336, 1954: 286) on cultivated material, and by Favarger (1969: 65, 71-72) on plants from Bella Voda (= Kaló Neró, = Béla Vóda, North Central Greece) and Zygos (North Pindhos, Greece) ($2n = \text{ca. } 72$, as *C. banaticum* s. str.). Contrary to Favarger, Strid (1986: 114-115) considered only the former count as belonging to subsp. *banaticum* and the latter probably to subsp. *speciosum*. This is in accordance with the distribution of both subspecies, presented by Strid (1986: 115), where in Zygos ["Zigos"] (N. Pindhos) only subsp. *speciosum* occurs. Thus, the present delimitation of the two subspecies seems to be between northern and southern 4x-populations. Furthermore, for *C. banaticum* subsp. *speciosum* an approximately heptaploid number ($2n = \text{ca. } 126$) was reported from Mt Vardousia, Greece, by Franzén & Gustavsson (1983: 102, as *C. banaticum* subsp. *alpinum* (Boiss.) Buschm.) and an octoploid ($2n = \text{ca. } 144$) from Mt Olympus, Greece, by Favarger (1969: 65, 72, as *C.*

speciosum Spruner ex Boiss.). Thus, *C. banaticum* includes a polyploid series from 2x-, to 4x-, 7x-, and 8x-cytotypes. The distribution of all these chromosome counts is shown on Fig. 3.

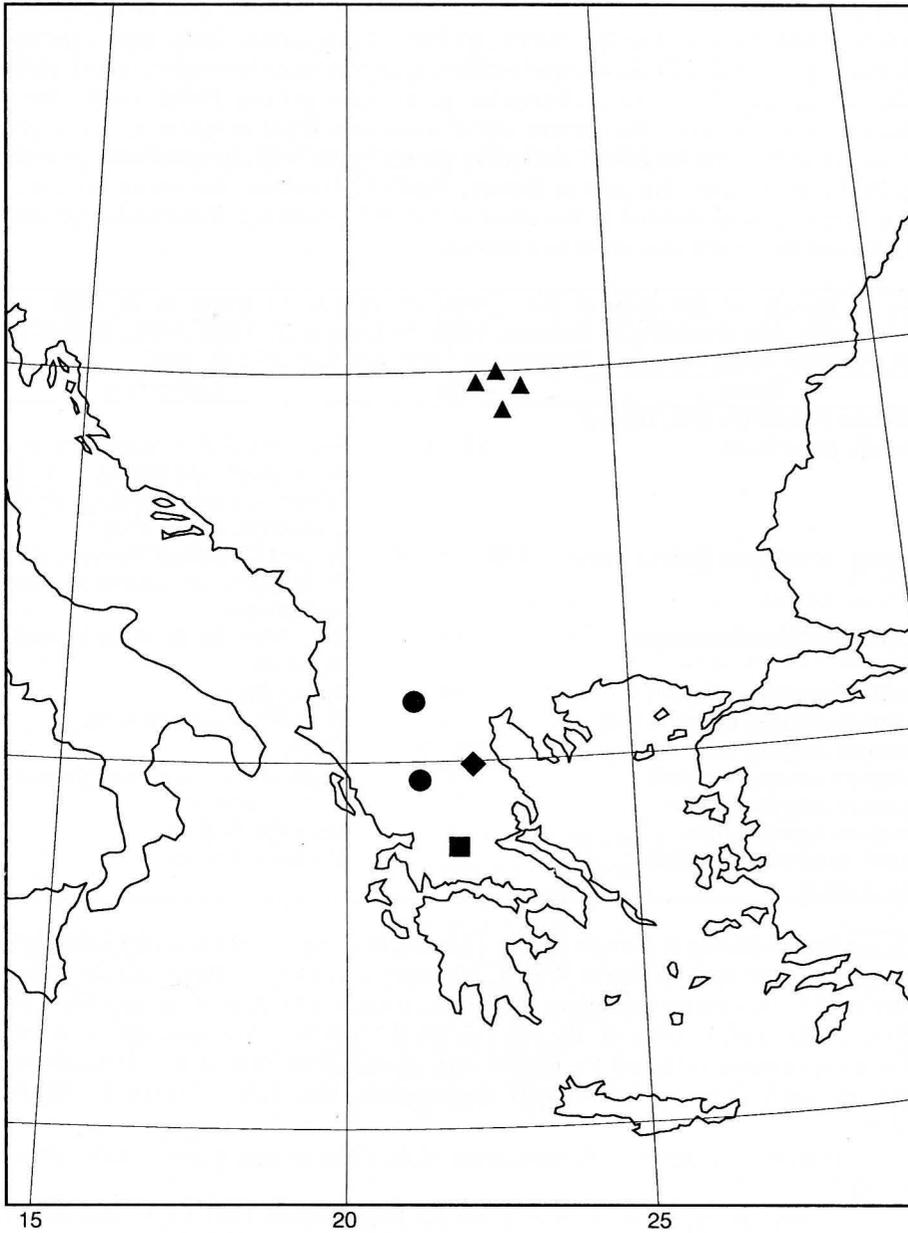


Fig. 3. Distribution map of the chromosome counts of *Cerastium banaticum*. $2n = 36$ (▲), $2n = 72$ (●), $2n = c. 126$ (■), $2n = c. 144$ (◆).

Typification of Cerastium banaticum

Only subsp. *speciosum* has been properly typified (Strid 1986); the type subspecies remains to be done. In the protologue Rochel (1828) mentioned the following data on the occurrence of *Cerastium grandiflorum* var. *banaticum*: "Habitat rara et caespitosa in regionis Il-dae fissuris rupium humo repletis, et in saxis ipsis pone speluncas Kolumbacs'ienses vulgo Kolumbacs-Hoehlen, copiosior in eadem regione simili statione ad Danubium inter Swinicza et Bersaska, et in valle petrosa Prolaz prope thermas Mehadienses vel Herculis". Buschmann (1938: 140) considered as type of *C. banaticum* a specimen from W, with the label: "Cerastium grandiflorum W.K. b. banaticum. In rupibus alvei Proláz ad Thermas Herculis in Banatu, Heuffel". However, this specimen does not belong to the original material in the sense of Art. 9.7 (footnote) of the Code (Greuter & al. 1994) and thus could only serve as a neotype.

Table 2. Survey of the taxa of the *Cerastium banaticum* group in its wide sense (chromosome data according to Barberis 1988, Barberis & al. 1994, 1995, Söllner 1950, 1954, Favarger 1969, Franzén & Gustavsson 1983, and Garbari & al. 1980).

Taxon	2n	Distribution
<i>Cerastium banaticum</i> (Kit.) Rochel		
subsp. <i>banaticum</i>	36, 72	From the S.E. Carpathians to the N. Balkan (according to Strid (1986) extending through Anatolia to Georgia and N. Iran)
subsp. <i>speciosum</i> (Boiss.) Jalas	?72, 126, 144	W. and C. Balkan Peninsula, from C. Bulgaria, Macedonia to Albania and Greece
<i>Cerastium julicum</i> Schellmann	36	S.E. Alps of S. Austria and N. Slovenia
<i>Cerastium apuanum</i> Parl.	36	Apuan Alps
<i>Cerastium lacaitae</i> Barberis & al.	72	C. and S. Apennines, Sicily
<i>Cerastium soleirolii</i> Ser. ex Duby	36, 72	Corsica
<i>Cerastium utriense</i> Barberis	36	Ligurian-Piedmontese Apennines
<i>Cerastium sventenii</i> Jalas	?	Canary Islands
<i>Cerastium vagans</i> Lowe	?	Madeira, Azores
<i>Cerastium azoricum</i> Hochst. ex Seubert	?	Madeira, Azores

According to Stafleu & Cowan (1983: 123) Rochel's herbarium was deposited in DR, where it was destroyed in World War II. However according to them and according to Vegter (1983: 772) extant herbarium specimens, collected by Rochel are deposited in the herbaria B, BP, BR, E, GJO, H, JE, LE, LZ, M, W, and WU. We were able to trace the following specimens collected by Rochel and identified by him as *C. grandiflorum* b. *banaticum* (with three exceptions with characteristic blue labels, written by Rochel's hand):

- (1) "*Cerastium grandiflorum* β. *banaticum* Nob. Culta e sem. banat., 1815" [Rochel] (CL);
- (2) "*Cerastium grandiflorum* b. *banaticum* 2,3 Reg. Bannat. 1821 IX m. Rochel" (LE) [without original Rochel's label!];

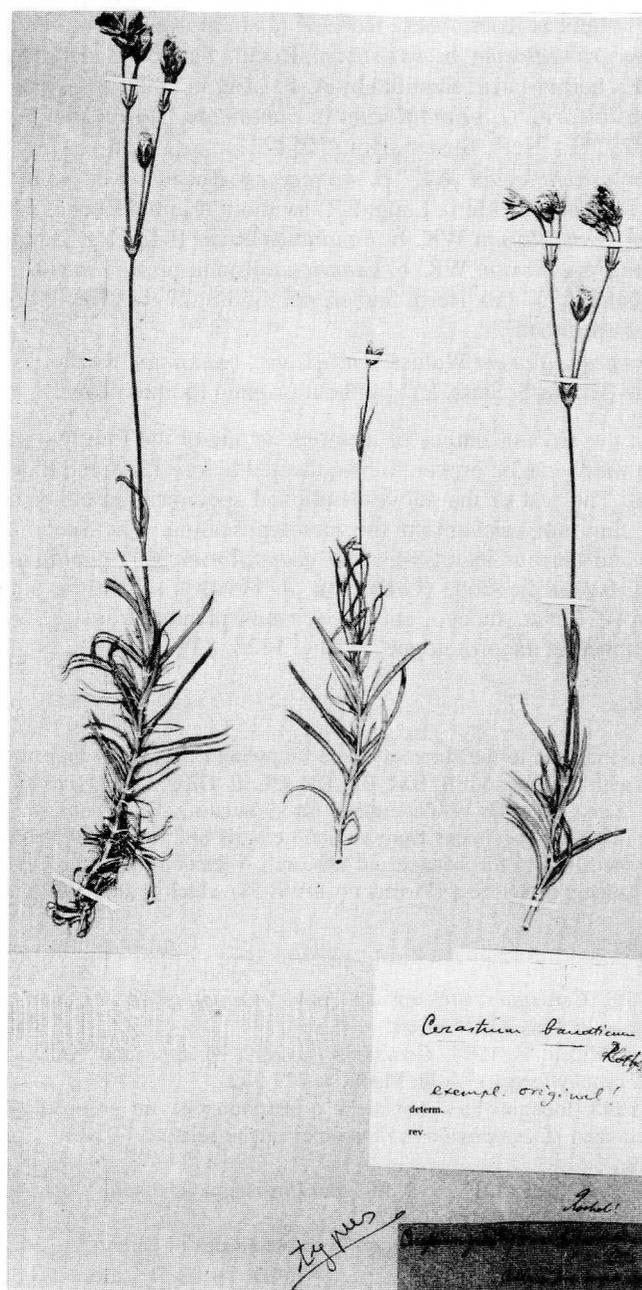


Fig. 4. Lectotype of *Cerastium grandiflorum* var. *banaticum* Rochel (\equiv *C. banaticum* (Rochel) Heuff.), "*Cerastium grandiflorum* b. *banaticum* Nob. Culta e sem. banat., 1815" [Rochel] (CL).

- (3) "*Cerastium grandiflorum* WK. b. *banaticum* Rchl. Rchl. Plant. Ban. rar. Tab. II. f. 6. II. Rg. Ad speluncas Kolumbacs., Rochel" (ex herb. Keck, acquired in 1830, WU);
- (4) "*Cerastium grandiflorum* b. *banaticum* Rochl. det. pl. banat. E rupib. Banatus" [Rochel] (Ex herb. Martii, acquired by A. F. Láng in 1829, BR);
- (5) "*Cerastium lineare?* *C. grandiflorum* b. *banaticum*, Nob. Culta e semme banatici. Rochel, 1829" (Ex Herb. Steven, H, n. 1052221);
- (6) "*Cerastium grandiflorum* WK. β . *banaticum* Rochel. Ad speluncas Kolumbacs. Hungar. I. Rochel" (Ex Herb. Láng, BR) [without original Rochel's label!];
- (7) "*Cerastium grandiflorum* WK. b. *banaticum* Rchl. II-III. Rg. Ban. merid. Rochel"; "*Cerastium grandiflorum* WK. b. *banaticum* Rochl. pl. Ban. rar. t. 2. f. 6. II-III. Rg. Rochl. it. ban. 1835" (Ex Herb. Sadler, no. 22700, 22701, BP) [two Rochel's labels on the same specimen];
- (8) "*Cerastium grandiflorum* Waldst. Kit.! β) var. *banaticum* Rochel!, in Banatu leg. cl. Rochel ipse (Ex Herb. Stetz, E)" [without original Rochel's label!].

It is clear that the obvious choice of lectotype is one of the first two specimens as they are the only two which can be proven to be collected before 1828 and thus were part of the original material. The rest of the above-mentioned specimens is either undated or dated after 1828 and thus not relevant to the lectotypification. The specimen (1) (Fig. 4), formally designated here as lectotype of *C. grandiflorum* var. *banaticum* Rochel in the sense of the Art. 9.2 of the Code (Greuter & al. 1994) is said to be planted from seeds from the region of Banat. Indeed, such specimens planted from seeds and studied by Rochel are mentioned in the protologue (Rochel 1828: 33).

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