

The *Campanula rotundifolia* complex in Bulgaria

Komplex *Campanula rotundifolia* v Bulharsku

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In Bulgaria, the *Campanula rotundifolia* complex is shown to be represented by seven species. *C. euxina* (VELEN.) ANČEV (2n = 34), *C. Jordanovii* ANČEV et KOVANDA (2n = 34), *C. velebitica* BORBÁS (2n = 34, 68), *C. trojanensis* KOVANDA et ANČEV (2n = 34, 68), *C. cochleariifolia* LAM. (2n = 34), *C. Scheuchzeri* VILL. (2n = 68) and *C. rotundifolia* L. Observations on karyology, morphology, pollen size-ploidy level correlation, phenology, variation, ecology and geographical distribution are provided. The occurrence in Bulgaria of *C. polymorpha* WITASEK, *C. serrata* (KIT.) HENDRYCH and *C. witasekiana* VIERH. has not been confirmed.

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INTRODUCTION

In Bulgaria, the subsection *Heterophylla* (WITASEK) FEDOROV of the genus *Campanula* L. (sect. *Campanula*) has so far received little attention. In his Flora Bulgarica, VELENOVSKÝ (1891) listed one single species, *Campanula rotundifolia* L. from the Vitoša, Osogovska Planina, Kotel Balkan and Rila Mts. No infraspecific taxa were recognised, but var. *euxina* VELEN. appeared in the Supplementum I (VELENOVSKÝ 1898). HAYEK (1931) recognised three species in Bulgaria, *C. pseudolanceolata* PANT., *C. Scheuchzeri* VILL. and *C. rotundifolia* L., the latter with four subspecies, subsp. *euxina* (VELEN.) HAYEK, subsp. *bulgarica* (WITASEK) HAYEK, subsp. *rotundifolia* and subsp. *racemosa* (KRAŠAN) HAYEK. STOJANOV et STEFANOV (1925) reported *C. rotundifolia* L. (with seven varieties: var. *euxina* VELEN., var. *tenuifolia* HOFFM., var. *kladniana* SCHUR, var. *bulgarica* WITASEK, var. *balcanica* ADAMOVIČ, var. *napuligera* SCHUR and var. *pinifolia* UECHTR.), *C. Scheuchzeri* VILL. and *C. pusilla* HAENKE which was later (STOJANOV et STEFANOV 1948) changed to *C. rotundifolia* L. (said to be represented almost exclusively by subsp. *balcanica* ADAMOVIČ), *C. pusilla* HAENKE and *C. bulgarica* WITASEK. PODLECH (1965) distinguished, in an authoritative revision, seven species in Bulgaria, including *C. velebitica* BORBÁS, *C. polymorpha* WITASEK, *C. rotundifolia* L., *C. serrata* (KIT.) HENDRYCH subsp. *serrata*, *C. witasekiana* VIERH., *C. Scheuchzeri* VILL. and *C. cochleariifolia* LAM. When preparing the account of heterophyllous Campanulas for Flora Europaea (FEDOROV et KOVANDA 1976), the junior author felt that there was considerable lack of understanding of the *Heterophylla* group in the Balkan Peninsula, especially

Tab. 1. — Chromosome numbers in the Bulgarian members of the *Campanula rotundifolia* complex

Species	Locality	Specimen no.	2n
<i>C. eucina</i> (VELEN.) ANČEV	N.E. Bulgaria, near Madara, 400 m (ANČEV 1983)	A619	34
<i>C. Jordanovii</i> ANČEV et KOVANDA	Vračanska Planina, near the top of Parševica, 1400 m	A8461	34
	Central Rodopi Mts., Trigrad, 1000 m	A5146	34
	Central Rodopi Mts., Čudnite Mostove, 1100 m	A472	34
	Slavjanka, Ambar Dere, 1200 m (ANČEV 1983 sub <i>C. velebitica</i> subsp. <i>bulgarica</i>)	A3185	34
<i>C. velebitica</i> BORBÁS	Central Stara Planina, Trojanski prohod, 1250 m	A8445	34
	Central Stara Planina, Trojanski prohod, 1200 m (ANČEV 1983 sub <i>C. velebitica</i> subsp. <i>bulgarica</i>)	A5283	34,68
	Central Stara Planina, Trojanski prohod, 1300 m	A8498	68
	Pirin, near the Vichren tourist house, 2300 m (ANČEV 1983 sub <i>C. velebitica</i> subsp. <i>bulgarica</i>)	A5228	68
	Pirin, Vichrenski djál, 2200 m	A9101	68
	Belasica, near the top of Kongor, c. 1900 m (ANČEV 1983 sub <i>C. velebitica</i> subsp. <i>bulgarica</i>)	A81114	68
<i>C. trojanensis</i> KOVANDA et ANČEV	Central Stara Planina, near the Dermenkaja tourist house, 1500 m	A8453	34
	Central Stara Planina, near Beklemeto, 1400 m (ANČEV 1983 sub <i>C. rotundifolia</i>)	A5287	68
<i>C. cochleariifolia</i> LAM.	Pirin, Malak Kazan, c. 2100 m (ANČEV 1983)	A5250	34
<i>C. Scheuchzeri</i> VILL.	Central Stara Planina, Kuru-Dere, 1700 m (ANČEV 1983)		68

in Bulgaria. The time available did not permit a more detailed taxonomic study, however, and the resulting treatment, recognising five species in Bulgaria, viz. *C. velebitica* BORBÁS, *C. witasekiana* VIERH., *C. cochleariifolia* LAM., *C. Scheuchzeri* VILL. and *C. rotundifolia* L., was of necessity only tentative. It is the purpose of the present review to update the 1976 account, to collate the evidence now available and to propose a taxonomic reassessment as far as Bulgaria is concerned. Our conclusions are based on field research, study of herbarium material and karyological analysis.

MATERIAL AND METHODS

The karyological studies were made on root-tip mitoses in young seedlings. Seed samples came from natural populations. Following pre-treatment with 0.002 M 8-hydroxyquinoline for 60 minutes, the root-tips were fixed, passed through cold or warm hydrolysis, stained with haematoxyline according to Gomori and squashed.

The pollen grains were taken from mature anthers in flower buds, stained with 4 % acetocarmine, carefully warming the material on a flame. Measurements were made on 150 grains for the pollen diameter ($P \mu\text{m}$). Pores were counted on 300 grains per sample.

Herbarium materials from E, K, PR, PRC, SO, SOM, W and WU were seen.

Voucher specimens are deposited in the Herbarium of the Institute of Botany, Bulgarian Academy of Sciences, Sofia (SOM).

OBSERVATIONS

Key to species

- 1 Ovary papillose
 - 2 Corolla 7–10 mm; capsule 3.5–4.5 mm; basal leaves with a distinct reniform sinus at base
 1. *C. euxina*
 - 2 Corolla (10–) 16–22 mm; capsule 6–8 mm; basal leaves without a distinct reniform sinus at base
 3. *C. velebitica*
- 1 Ovary smooth
 - 3 Flower buds erect
 - 4 Stems terete, hairy below; capsule (2–)3–5 mm
 7. *C. rotundifolia*
 - 4 Stems angular, ciliate or glabrous; capsule 5–7(–8) mm
 2. *C. Jordanovii*
 - 3 Flower buds pendent
 - 5 Stems cespitose or cushion-forming; basal leaves incise-serrate
 5. *C. cochleariifolia*
 - 5 Stems solitary or few; basal leaves crenate to entire
 - 6 Rhizome slender, branched; corolla (16–)18–24(–28) mm; basal leaves $\pm$ crenate; cauline leaves ciliate; capsule (5–)8–10 mm
 6. *C. Scheuchzeri*
 - 6 Rhizome thickened, $\pm$ unbranched; corolla 12–16(–18) mm; basal leaves $\pm$ entire; cauline leaves glabrous; capsule (4–)5–7 mm
 4. *C. trojanensis*

subsect. *Heterophylla* (WITASEK) FEDOROV

Group *Saxicolae*

1. *Campanula euxina* (VELEN.) ANČEV Tab. 1, 3–5, Fig. I

Campanula euxina (VELEN.) ANČEV, Treća Nacionalna Konferencija po Botanika, Sofija, 242, 1983. — Syn.: *C. rotundifolia* var. *euxina* VELEN., Fl. Bulg. Suppl. 1: 185, 1898; STOJ. et STEF. Fl. Bălg. ed. 1, 2: 1084, 1925; *C. rotundifolia* subsp. *euxina* (VELEN.) HAYEK, Prodr. Fl. Penins. Balcan. 2: 538, 1930.

Morphologically, this species is clear-cut and easy to distinguish. From *C. romanica* SAVUL., an endemic of Dobrogea, Romania (MORARU 1964, PODLECH 1965), to which it appears to be most closely related, *C. euxina* differs in its basal leaves having a distinct reniform sinus at the base, cauline leaves entire or with 1–3 minute teeth, corolla 7–10 mm long and capsule 3.5–4.5 mm long. $2n = 34$ (ANČEV 1983).

Tab. 2. — Previous chromosome counts in the Bulgarian members of the *Campanula rotundifolia* complex

Species	2n	References (selected)
<i>C. velebitica</i> BORBÁS	68	PODLECH 1965, ANČEV 1983
<i>C. cochleariifolia</i> LAM.	34	BÖCHER 1960, GUTERMANN in LÖVE et LÖVE 1961, BIELAWSKA 1964, GADELLA 1964, PODLECH 1965, KOVANDA 1970a, GESLOT 1980, 1982, ANČEV 1983
	68	HUBAC 1975 (sec. GESLOT 1982)
<i>C. Scheuchzeri</i> VILL.	68	BÖCHER 1960, GUTERMANN in LÖVE et LÖVE 1961, BIELAWSKA 1964, GADELLA 1964, PODLECH 1965, KOVANDA 1970a, GESLOT 1980, 1982, ANČEV 1983
	102	PODLECH 1965

As is usual with diploid relics in the group *Saxicolae*, *C. euxina* is a calciphilous chasmophyte with a small distribution area in lowland N.E. Bulgaria (Provadijsko Plateau) and on the Black Sea coast (Frangensko Plateau). It occurs in rock crevices and rubble, associated with *Carpinus orientalis* MILLER, *Celtis caucasica* WILLD., *Ostrya carpinifolia* SCOP., *Cotinus coggygria* SCOP., *Alyssum pulvinare* VELEN., *Calamintha nepeta* (L.) SAVI and *Campanula sibirica* L.

VELENOVSKÝ (1898) based his description of *C. rotundifolia* L. β var. *euxina* on a specimen collected by Škorpil near Kestrič on the Black Sea coast in 1896. The village is now within the residential district of Vinica, a part of Varna. No type material could be found in PRC, where Velenovský's herbarium is housed. There are no herbarium specimens in Bulgarian herbaria, either. We have seen *C. euxina* only from its populations occurring on the Provadijsko Plateau in the vicinity of the village of Madara, Šumen district.

Revised herbarium specimens:

North-Eastern Bulgaria: Provadijska Trapeza supra pagum Madara, B. DAVIDOV 1894 sub *C. rotundifolia* L., SOM; in saxosis prepe pagum Madara, I. URUMOV 1899 sub *C. rotundifolia* var. *euxina* VELEN., SOM; Madara, A. JAVASOV 1901 sub *C. rotundifolia* var. *euxina* VELEN., SOM; Madarski skali, ŽELEZOVA 1930 sub *C. rotundifolia* L., SOM; Provadijsko plato, rock crevices, calcareous terrain near Madara, 400 m a.s.l., M. ANČEV 1980, SOM.

2. *Campanula Jordanovii* ANČEV et KOVANDA, sp. nova

Tab. 1, 3–5, Fig. 2, 7, Plate I

Syn.: *Campanula rotundifolia* auct. fl. bulg. p. p., non L.

Diagn.: Rhizomate tenui, ramoso, sine tuberculis; caulibus angulatis, glabris vel in parte inferiore ciliatis; foliis caulinis anguste lanceolatis usque linearibus, integris, glabris vel rarius ciliatis; floribus in racemis paucis dispositis; gemmis erectis; ovario laevi; corolla campanulata usque late campanulata, coerulea usque violaceo-coerulea; capsulis coniformibus, membranaceis, nutantibus, 5–7(–8) mm longis; seminibus 0.7–0.9 mm longis. Chromosomatum numerus: $2n = 34$.

Floret: Julio, Augusto.

Fructificat: Augusto, Septembri.

Holotypus: Bulgaria occidentalis, montes Vračanska Planina; in rupibus calcareis ad cacumen montis Parševica, 1400 m s.m.; die 29. 7. 1984 leg. M. ANČEV. In Herbario Instituti Botanici Academiae Scientiarum Bulgaricae (SOM) Sofia sub no 145670 conservatur.

Etymologia: Ad honorem Academiae Scientiarum Bulgaricae Sodalis Daki Jordanov (1893–1978) nominata.

Perennial. Rhizome slender, creeping, branched, without tubercles. Stems in lax tufts, 15–30 (–40) cm, ascending to erect, angular, glabrous or ciliate on the angles in the lower part, leafy up to the inflorescence. Basal

Tab. 3. — Pollen diameter (P μ m) in Bulgarian members of the *Campanula rotundifolia* complex

Species	2n	Pollen diameter (P)
<i>C. euxina</i> (VELEN.) ANČEV	34	(25.0–) 27.5–35.0 (–37.5) μ m
<i>C. Jordanovii</i> ANČEV et KOVANDA	34	(25.0–) 27.5–37.5 (–40.0) μ m
<i>C. velebitica</i> BORBÁS	68	(30.0–) 32.5–40.0 (–45.0) μ m
<i>C. trojanensis</i> KOVANDA et ANČEV	34	(35.0–) 27.5–32.5 (–32.5) μ m
	68	(32.5–) 35.0–40.0 (–42.5) μ m
<i>C. cochlearifolia</i> LAM.	34	(27.5–) 30.0–35.0 (–37.5) μ m
<i>C. Scheuchzeri</i> VILL.	68	(25.0–) 32.5–40.0 (–42.5) μ m

leaves suborbicular to cordate, entire to slightly crenate, sometimes present at anthesis. Cauline leaves sessile, narrowly lanceolate to linear, (1.0—) 1.5—3.0 mm wide, acute, entire, glabrous, lowermost sometimes shortly ciliate. Inflorescence more or less branched. Flowers few, rarely solitary. Flower buds erect. Ovary smooth. Calyx-teeth setaceous, erecto-patent to patent. Corolla (10—) 12—17 mm long, campanulate to broadly campanulate, blue to violet blue. Pollen-grains (25.0—) 27.5—35.0 (—37.5) μm , with 3 (—4) pores. Capsule conical, pendent, 5—7 (—8) mm long, membranaceous. Seeds 0.7—0.9 mm long.

Time of flowering: VII—VIII; time of ripening of the fruits: VIII—IX.

Karyology. — *C. Jordanovii* is diploid, with $2n = 34$. This number was invariably found in material from all three of the main parts of its known distribution area (Tab. 1).

Morphology. — Morphologically, *C. Jordanovii* resembles *C. velebitica* BORBÁS, but has taller stems leafy up to the inflorescence, basal leaves sometimes present at anthesis, inflorescence more or less branched, pedicels (1.5—) 2—4 (—5.5) mm long, filiform, ovary always smooth, calyx-teeth setaceous, erecto-patent to patent, and capsule 5—7 (—8) mm long.

Ecology. — Like *C. euxina*, *C. Jordanovii* is a calciphilous chasmophyte with a very restricted ecological range. It is confined to rock crevices and rubble in open, sunny habitats. The vertical range of distribution is from 600 to about 1900 m above sea level. The altitudinal minimum is in the Vračanska Planina Mts., in the Balkan foothills region, where an isolated population occurs on the steep slopes of the Vracata gorge. In the Slavjanka Mts., above the village of Paril, *C. Jordanovii* occurs from 1100 to 1900 m, associated with *Onobrychis pindicola* HAUSSKN., *Viola delphinantha* BOISS., *Satureja pilosa* VELEN., *Micromeria dalmatica* BENTHAM, *Asperula purpurea* (L.) EHREND., *Galium aegeum* (STOJ. et KITAN.) ANČEV and *Trachelium Jacquinii* (SIEBER) BOISS. subsp. *rumelianum* (HAMPE) TUTIN. Above the 1400 m contour it may be found growing at the margins of *Pinus Heldreichii* CHRIST forests.

Geographical distribution. — *C. Jordanovii* is a diploid relic. According to present knowledge it is endemic to Bulgaria, occurring in the mountains of the W. and S.W. parts of the country: Vračanska Planina Mts., Slavjanka Mts., Northern Pirin Mts., Western and Central Rodopi Mts. The northernmost locality is the Vracata gorge in the Vračanska Planina Mts., while the southern limit of distribution is reached in the Slavjanka Mts. (Fig. 7). Considering the presence of *C. Jordanovii* in the Slavjanka and Rodopi Mts., the possibility cannot be excluded that the species will be found in similar habitats in adjacent parts of N. Greece.

Revised herbarium specimens:

Balkan foothill region: Vračanska Planina, D. MICHAÏLOV et St. GEORGIEV 1898 sub *C. rotundifolia* L., SO.

Stara Planina: Western Stara Planina, Zimevica, A. JANEV 1965 sub *C. rotundifolia* L., SO.

Slavjanka, 1600 m, A. DRENOVSKY 1934 sub *C. rotundifolia* L., SOM.

Rodopi Mts.: Central Rodopi Mts., Trigrad, D. JORDANOV 1940 sub *C. rotundifolia* L., SO; Trigrad, 1400 m a.s.l., M. ANČEV 1975, SOM; Čudnite mostove, 110 m, M. ANČEV 1972, SOM.

3. *Campanula velebitica* BORBÁS

Tab. 1—5, Fig. 3, Plates II—III

Campanula velebitica BORBÁS. Math. Term. Értes. 1: 81, 1883; HAYEK, Prodr. Fl. Penins. Balcan. 2: 538, 1930. — Syn.: *Campanula bulgarica* WITASEK, Magy. Bot. Lap. 5: 244, 1906;

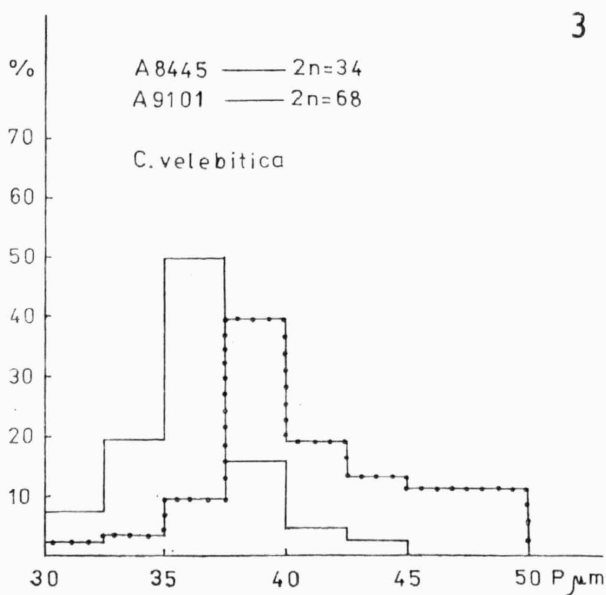
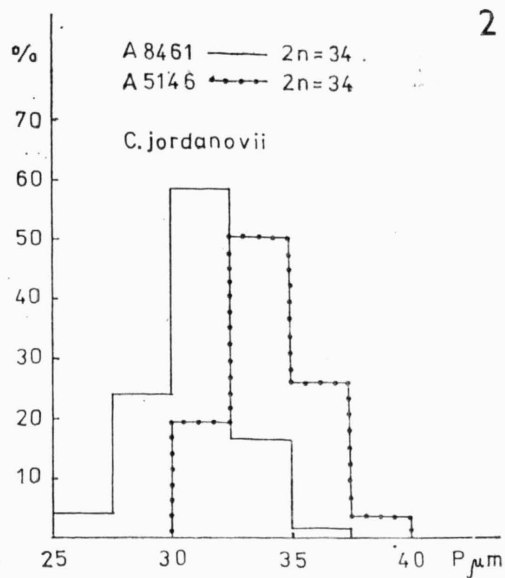
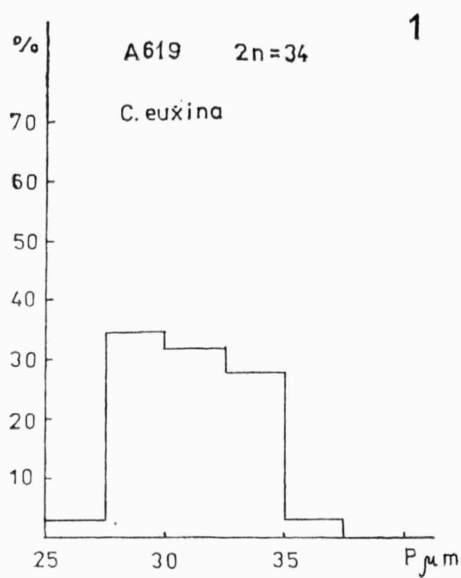


Fig. 1—3. — Variation in pollen grain diameter in *Campanula euxina* (VELEN.) ANČEV (1), *C. Jordanovii* ANČEV et KOVANDA (2) and *C. velebitica* BORBÁS (3).

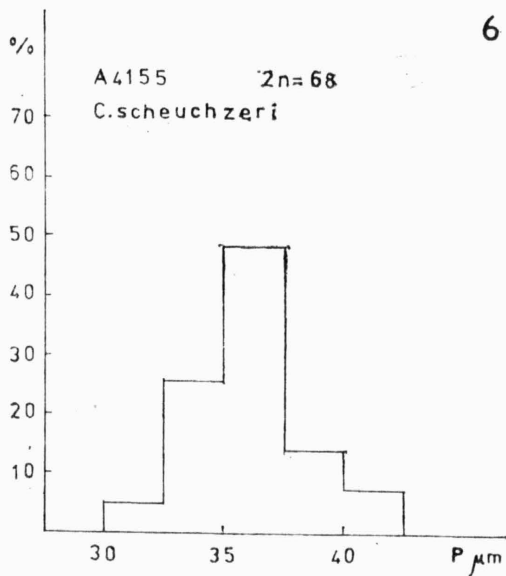
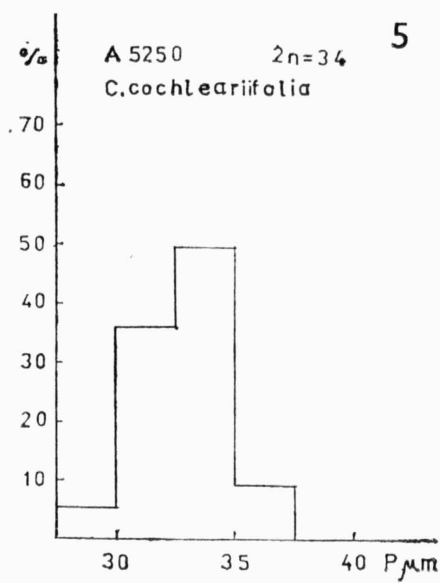
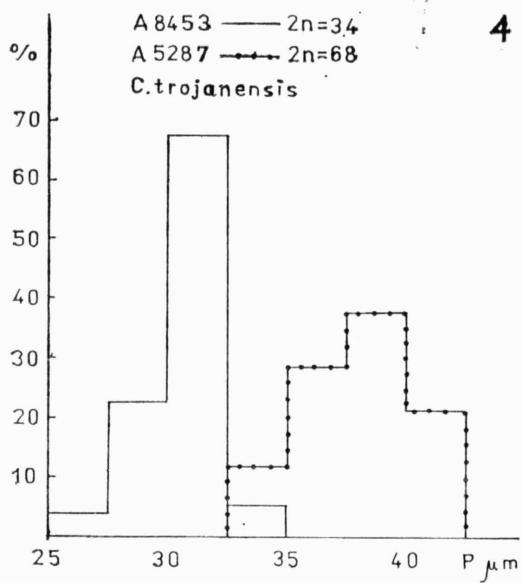


Fig. 4—6. — Variation in pollen grain diameter in *Campanula trojanensis* KOVANDA et ANČEV (4), *C. cochleariifolia* LAM. (5) and *C. Scheuchzeri* VILL. (6).

STOJ. et STEF., Fl. Bălg. ed. 2: 980, 1933; *C. rotundifolia* L. var. *bulgarica* (WITASEK) STOJ. et STEF., op. c. ed. 1, 2: 1084, 1925; *C. rotundifolia* L. subsp. *bulgarica* (WITASEK) HAYEK, l. c.; *C. rotundifolia* L. var. *bulgarica* NEIC., Jahrb. Univ. Sofia, 2: 140, 1906; *C. rotundifolia* L. subsp. *euxina* f. *Neicevii* HAYEK, l. c.; *C. rotundifolia* subsp. *Neicevii* (HAYEK) STOJ. et ACHT., Mitt. Königl. Naturwis. Inst. Sofia, 12: 186, 1939; *C. pinifolia* auct. bulg., non UECHTR. ex PANČIČ.

C. velebitica has previously been shown to be tetraploid, with $2n = 68$ (PODLECH 1965, ANČEV 1983). Our karyological survey revealed the presence in Bulgaria also of the diploid cytotype, $2n = 34$, which apparently represents the archetype of the species. The tetraploid cytotype seems to be more frequent (six counts from six populations in three different floristic regions).

Tab. 4. — Percentage of pollen grains with various numbers of apertures in the Bulgarian members of the *Campanula rotundifolia* complex

Species	2n	Specimen no.	Number of apertures				
			2	3	4	5—8	12—15
<i>C. euxina</i> (VELEN.) ANČEV	34	A619		99.33	0.66		
<i>C. Jordanovii</i> ANČEV et KOVANDA	34	A8461		100.00			
<i>C. velebitica</i> BORBÁS	34	A8445		75.47	24.53		
	68	A9101		13.66	73.66	12.33	0.33
	68	A5228		69.33	29.33	1.33	
<i>C. trojanensis</i> KOVANDA et ANČEV	34	A8453		70.74	29.26		
	68	A5287		15.33	55.66	25.33	
	34	A5250		99.33	0.66		
<i>C. cochlearifolia</i> LAM.							
<i>C. Scheuchzeri</i> VILL.	68	A4155		66.00	33.66	0.33	

The diploid chromosome number was found in one population only, viz. along the Trojanski Prohod Pass on the southern slopes of the Stara Planina Mts. between 1200 and 1300 m above sea level. Studies are now in progress to elucidate the morphology, ecology, biology and geographical distribution of the two cytotypes. It seems certain that the presence of two ploidy levels is responsible for the wide ecological amplitude of the species.

The species is chiefly a plant of rocks, scree and rubble in dry, open situations from the submontane (c. 700 m above sea level) to the snow zone (c. 2500 m above sea level). Occasionally it also colonizes xerothermous mountain meadows and grasslands. It is more frequent on siliceous substrata but is found on limestones as well. In the granitic part of the Pirin Mts. it grows in plant associations with *Daphne cneorum* L., *Silene lichenfeldiana* BAUMG., *Aquilegia aurea* JANKA, *Arabis alpina* L., *Saxifraga bryoides* L., *Galium anisophyllum* VILL. and *Jasione laevis* LAM. subsp. *orbiculata* (GRISEB. ex VELEN.) TUTIN.

C. velebitica is endemic to the mountains of the N. part of the Balkan Peninsula (PODLECH 1965, FEDOROV et KOVANDA 1976). Its distribution area consists of two parts, one in Yugoslavia and Albania, the other in Bulgaria (for a distribution map, see PODLECH, op. cit.). The disjunction may be only illusory, however, and due to insufficient knowledge of the geographical distribution.

In Bulgaria, *C. velebitica* is fairly widespread and is the most frequent representative of the subsection *Heterophylla*. It is known to occur in the

W. and C. Stara Planina Mts., Znepole region (Mt. Čepan and Ruj), Vitoša Mts., Slavjanka Mts., Pirin Mts., Rila Mts., C. and W. Rodopi Mts., Sredna Gora (above Koprivštica) and Thracian Plain (Sacar Planina).

Records of *C. polymorpha* WITASEK from Mt. Vitoša and Mt. Maragidik¹⁾ (PODLECH 1965) belong to this species.

C. albanica WITASEK, a diploid with flowers solitary or rarely 2—3 together and corolla only 14—18 (—22) mm long, occurs in Yugoslavia, Albania and Greece where it comes near to the southern boundary of Bulgaria. It might perhaps be found in the Slavjanka Mts.

Revised herbarium specimens:

Western Stara Planina, Okolčica, leg. A. PETROVA, det. M. ANČEV, 1976, SOM.

Central Stara Planina: Trojanski prohod, 1300 m a.s.l., M. ANČEV 1984 SOM; Trojanski Balkan, S. of the tourist house Dermenkaja, 1600 m a.s.l., M. KOVANDA et M. ANČEV 1986 PR, SOM; Kaloferska planina, Čufadarica, D. JORDANOV 1923 sub *C. rotundifolia* L., SO; Gabrovski Balkan, I. NEJČEV 1898 sub *C. rotundifolia* L., SOM; Kuru-dere, I. NEJČEV 1903 sub *C. rotundifolia* L., SOM; Karlovski Balkan, I. URUMOV 1927 sub *C. rotundifolia* L., SOM; Karlovski Balkan, B. ACHTAROV 1941 sub *C. rotundifolia* L., SOM; Murgas, B. ACHTAROV et V. VELČEV 1952 sub *C. rotundifolia* L., SOM; Buzludža, I. NEJČEV 1898 sub *C. rotundifolia* L., SO; ad cae. Baba, B. ACHTAROV 1950 sub *C. rotundifolia* L., SOM.

Znepole region: Trän, I. URUMOV 1906 sub *C. pinifolia* UECHTR., SOM; Čepan, B. ACHTAROV 1941 sub *C. pinifolia* UECHTR., SOM.

Vitoša region: Vitoša Mt., Kopitoto — Momina skala, B. KITANOV 1964 sub *C. rotundifolia* L., SO; Vitoša Mt., reserve area Bistriško branište, M. ANČEV 1986, SOM.

Belasica, near vr. Kongor, M. ANČEV 1981, SOM; Belasica, visokoplaninski pojas, leg. I. BONDEV et S. GANČEV 1975, det. M. ANČEV, SOM.

Slavjanka, A. DRENOVSKY 1930 sub *C. balcanica* var. *pseudopinifolia*, SOM; Ambar-dere, E. BOŽILOVA, S. TONKOV et D. STOJANOV 1983 sub *C. rotundifolia* L., SOM.

Pirin: El-Tepe²⁾, B. ACHTAROV 1938 sub *C. rotundifolia* L., SOM; in saxosis inarmoreis et graminosis El-Tepe, I. d. Malki valog, N. STOJANOV 1938 sub *C. rotundifolia* subsp. *controversa* STOJ. et ACHT., SO; Bjalata reka, D. JORDANOV et B. KITANOV sub *C. rotundifolia* L., SO; Sklo-novete na vr. Kuklite, E. BOŽILOVA 1968 sub *C. rotundifolia* L., SO; circus Kamenitica, N. ANDREJEV 1975 sub *C. rotundifolia* L., SOM; Sinaniški djal, S. KOŽUCHAROV et C. DENČEV 1982 sub *C. rotundifolia* L., SOM; along the river Glazne, M. ANČEV 1979 SOM; Banderica — Vichren, M. ANČEV et M. KOVANDA 1986, PR, SOM; circus Malak Kazan, M. ANČEV et M. KOVANDA 1986, PR, SOM.

Rila: Šiškovica pr. Kulata ad Demir Kapija, St. GEORGIEV 1889 sub *C. rotundifolia* L., SO; in graminosis alpinis, A. DRENOVSKY et I. URUMOV 1907 sub *C. rotundifolia* L., SOM; Suchoto ezero, B. DAVIDOV 1911, SOM; Sokolec, B. DAVIDOV 1910 sub *C. rotundifolia* L., SOM; Mala Čärkva, above the river Levi Iskar, granite, M. ANČEV 1986, SOM.

Sredna Gora: inter cae. Pop et Popadija, N. STOJANOV et B. ACHTAROV 1951 sub *C. rotundifolia* subsp. *balcanica* ADAMOVIČ, SO; supra urbem Koprivštica, N. STOJANOV et B. ACHTAROV 1952 sub *C. rotundifolia* L.

Central Rodopi Mts.: Bezovo, B. ACHTAROV 1937 sub *C. rotundifolia* subsp. *pinifolia* (UECHTR.) ADAMOVIČ.

Group *Lanceolatae*

4. *Campanula trojanensis* KOVANDA et ANČEV, sp. nova

[Tab. 1, 3—5, Fig. 4, 7

Syn.: *Campanula rotundifolia* auct. fl. bulg. p. p., non L.; *C. tenuifolia* sensu STOJ. et STEF., Fl. Bälğ. ed. 1, 2: 1084, 1925, non HOFFM.; *C. napuligera* sensu STOJ. et STEF., op. c. 1085, non SCHUR; *C. pseudolanceolata* sensu HAYEK, Fl. Penins. Balcan. 2: 536, 1930, non PANT.; *C. serrata* (KIT.) HENDRYCH subsp. *serrata* auct., PODLECH, Feddes Repert. 71: 131, 1965 pro exsicc. bulg.

Diagn.: Rhizomate incrassato, paulo ramoso, sine tuberculis; caulibus angulatis, glabris in parte inferiore dense foliosis; foliis caulinis anguste lanceolatis usque setaceis, integris vel

¹⁾ Present name: Mt. Rusalka

²⁾ Present name: Mt. Vichren

rarius remote serratis, glabris; floribus in racemis confertis dispositis; gemmis pendentibus; ovario laevi; corolla campanulata, coerulea usque violaceo-coerulea; capsulis turbinatis usque conformibus, membranaceis, nutantibus, (4—) 5—7 mm longis; seminibus (0.8—) 0.9—1.0 (—1.1) mm longis. Chromosomatum numerus: $2n = 34, 68$.

Floret: a mense Julio usque ad Septembrem.

Fructificat: Septembri, Octobri.

Holotypus: Bulgaria centralis, montium Stara Planina pars media: in graminosis et fruticetis *Juniperi sibiricae* prope refugium Dermenkaja, 1500 m s.m.; die 12. 8. 1986 leg. M. KOVANDA et M. ANČEV. In Herbario Instituti Botanici Academiae Scientiarum Bulgaricae (SOM) Sofiae sub no 145669 conservatur.

Etymologia: Epitheton specificum e nomine civitatis Trojan Bulgariae derivatum.

Perennial. Rhizome thickened (2—6 mm in diameter), 10—15 (—20) cm long, poorly branched, without tubercles; roots thin. Stems solitary or 2—3, (8—) 12—30 (—40) cm, erect, angular, glabrous, densely leafy below. Basal leaves cordate or rounded, more or less entire, mostly absent at anthesis. Lower and middle cauline leaves sessile, narrowly lanceolate to linear, 1.0—2.9 (—3.2) mm wide, entire or rarely remotely serrate, glabrous; upper leaves sessile, linear to setaceous, 0.4—1.0 mm wide, entire, glabrous. Inflorescence more or less congested, many-flowered. Flower buds pendent or rarely suberect. Ovary smooth. Calyx-teeth narrowly triangular, 0.5—0.7 mm wide at the base, erecto patent to patent. Corolla 12—18 mm long, campanulate, blue to violet-blue. Pollen grains in diploids (25.0—) 27.5—32.5 (—37.5) μm in diameter, with 3 (—4) pores, in tetraploids (32.5—) 35.0—40.0 (—42.5) μm in diameter, with (3—) 4—5 (—6) pores. Capsule turbinate to conical, pendent, (4—) 5—7 mm long, membranaceous. Seeds (0.8—) 0.9—1.0 (—1.1) mm long.

Time of flowering: VII—IX. Time of ripening of the fruits: IX—X.

Karyology. — In *C. trojanensis* two cytotypes occur, diploid ($2n = 34$) and tetraploid ($2n = 68$). Both were found in similar habitats, in the *Juniperus sibirica*-*Vaccinium myrtillus* association in the Stara Planina Mts., about 9 km apart. Further study is required to elucidate their distributional patterns. Tetraploid individuals differ from the diploids in having usually larger and longer corolla and larger pollen grains (Tab. 3, Fig. 4). These differences have also been observed in other species of *Campanula* containing diploid and tetraploid cytotypes (KOVANDA 1970a, b, 1977). In addition, the number of apertures (pores) in the pollen grains proved helpful in distinguishing the two cytotypes: 3 (—4) in diploids and (3—) 4—5 (—6) in tetraploids (Tab. 4). The tetraploid race has previously been reported as *C. rotundifolia* L. (ANČEV 1983).

Morphology. — This species is readily distinguished from related taxa. From *C. serrata* (KIT.) HENDRYCH it differs in having shorter stems, much narrower cauline leaves, which are almost always entire (except for the 1—3 lowermost), and glabrous in the edges, and shorter corolla. From *C. witasekiana* VIERH. it differs in the absence of tubercles, glabrous leaves congested in the lower part of the stem and larger corolla.

C. trojanensis shows little variation, a property it shares with other diploid oreophytes. A certain amount of variability is shown in the shape of the leaves (both cauline and basal), position of calyx-teeth and size and shape of corolla but this variation is purely individual and cannot serve as the basis for the delimitation of any infraspecific taxa. Unlike the majority of heterophyllous Campanulas, in which glabrous and hairy (or pubescent) plants

Tab. 5. — Times of flowering and ripening of fruits in the Bulgarian members of the *Camula rotundifolia* complex. (Data summarised from herbarium specimens and personal observations.)

Species	Time of flowering	Time of ripening of the fruits
<i>C. euzina</i> (VELEN.) ANČEV	15 May—30 June	15 July—30 August
<i>C. Jordanovii</i> ANČEV et KOVANDA	15 July—30 August	15 August—30 September
<i>C. velebitica</i> BORBÁS	15 July—30 August	15 August—30 September (—15 October)
<i>C. trojanensis</i> KOVANDA et ANČEV	15 July—20 (—30) August	1 September—15 October
<i>C. cochleariifolia</i> LAM.	10 July—30 August	15 August—30 September
<i>C. Scheuchzeri</i> VILL.	15 July—30 August	1 September—15 October

occur side by side, in *C. trojanensis* the latter seem to be missing. An interesting modification is seen in plants growing in prostrate shrubs of *Juniperus sibirica* BURGSD. in which the part of the stem protected by the twigs is completely leafless and the leaves are congested in the middle of the stem.

Ecology. — *C. trojanensis* occurs in mountain meadows and grasslands on acid soils. The geological substratum is most often granite. It is usually found in the *Juniperus sibirica* BURGSD. *Vaccinium myrtillus* L., *Juniperus sibirica* BURGSD.-*Vaccinium vitis-idaea* L. and *Bruckenthalia spiculifolia* (SALISB.) REICHENB.-*Jasione montana* L. associations, as well as together with *Thymus* sp. div., *Acinos alpinus* (L.) MOENCH and *Dianthus petraeus* WALDST. et KIT. Vertically, *C. trojanensis* extends from 1300 m (slopes of the Trojanski Prochod Pass, Stara Planina Mts.) to 2000 m (near the top of Mt. Ruen, Osogovska Planina Mts.) above sea level.

Geographical distribution. — *C. trojanensis* occurs in the W. and C. Stara Planina Mts. as well as in the Osogovska Planina Mts. It is also known from one locality in the Rila Mts. (Mala Čärkva) (Fig. 7). It seems likely that the species occurs also in the mountains of the S.E. part of Yugoslavia. It may be classified as a relic oreophyte of the N.E. part of the Balkan Peninsula.

Reports of *C. serrata* (KIT.) HENDRYCH (WITASEK 1902, PODLECH 1965) and *C. witasekiana* VIERH. (PODLECH 1965, FEDOROV et KOVANDA 1976) from the Kalofer Balkan refer to *C. trojanensis*.

Revised herbarium specimens:

Stara Planina: Western Stara Planina, Kom — Todorini kuli, I. STAMBOLIEV 1898 sub *C. rotundifolia* L., SOM; Central Stara Planina, Trojanski Balkan, I. URUMOV 1900 sub *C. napuligera* SCHUR, SOM; Gabrovski Balkan, Kuru-dere; I. NEJČEV 1903 sub *C. Scheuchzeri* VILL., SOM; Gabrovski Balkan, JURKOVSKI 1932 sub *C. rotundifolia* var. *balcanica* (HRUBY) ADAMOVIČ, SOM; Beklemeto, S. VASILEVA et N. VICHODZEVSKY 1970 sub *C. rotundifolia* subsp. *balcanica* ADAMOVIČ, SO; vr. Botev — vr. Djuz-Čal, J. KOEVA 1974 sub *C. rotundifolia* L., SOM; Kuru-dere, M. ANČEV 1974, SOM; Trojanska Planina, in the surroundings of tourist house Dermenkaja, M. ANČEV 1984, SOM; M. KOVANDA et M. ANČEV 1986, PR, SOM; Orlovo gnezdo, M. KOVANDA et M. ANČEV 1986, PR, SOM.

West frontier mountains: Osogovska planina, vr. Šapka, M. ANČEV 1981, SOM; I. URUMOV 1902 sub *C. rotundifolia* L., SOM.

Rila, Mala Čärkva, B. DAVIDOV 1911, SOM.

5. *Campanula cochleariifolia* LAM.

Tab. 1—5, Fig. 5

Campanula cochleariifolia LAM., Encycl. Méth. Bot. 1: 578, 1785; HAYEK, Prodr. Fl. Penins. Balcan. 2: 536, 1930. — Syn.: *Campanula pusilla* HAENKE in JACQ. Collect. Bot. 2: 79, 1788; STOJ. et STEF., Fl. Bălg. ed. 1, 2: 1085, 1925; *C. pusilla* HAENKE var. *perinica* VELEN., S.-B. Königl. Böhm. Ges. Wiss., 1910/8: 9, 1911; *C. cochleariifolia* L. f. *pirinica* (VELEN.) HAYEK, l.c.; STOJ., STEF. et KITAN., Fl. Bălg. ed. 4, 2: 1049, 1967; *C. cochleariifolia* LAM. subsp. *perinica* (VELEN.) STOJ. et ACHT., Mitt. Königl. Naturwiss. Inst. Sofia, 12: 186, 1939; *C. cochleariifolia* LAM. subsp. *perinica* (VELEN.) STOJ. et ACHT. f. *umbrosa* STOJ. et ACHT., l. c.

C. cochleariifolia is an ancient alpine diploid with $2n = 34$. Counts have been published for plants from the Pyrenees (GESLOT 1982), Alps (e.g. BÖCHER 1960, GUTERMANN in LÖVE et LÖVE 1961, GADELLA 1964) and Western

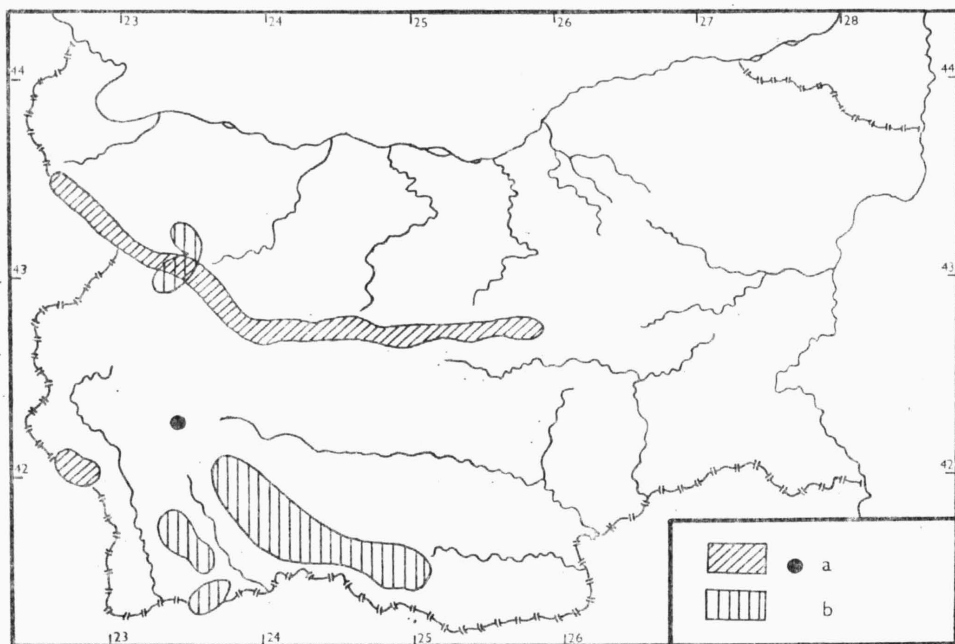


Fig. 7. — Distribution in Bulgaria of *C. trojanensis* KOVANDA et ANČEV (a) and *C. Jordanovii* ANČEV et KOVANDA (b)

Carpathians (BIELAWSKA 1964, GADELLA 1964, KOVANDA 1970a). The diploid chromosome number was also noted on material from Bulgaria (Tab. 1). A tetraploid number, $2n = 68$, was reported by SUGIURA (1940, 1942) and GADELLA (1964) for cultivated material of unknown origin. HUBAC (sec. GESLOT 1982) gives the tetraploid number for material from Haute Savoie, France.

The species is calcicole throughout its extensive distribution area (mountains of W., C., S. and S.E. Europe). Whereas in the Alps it occasionally invades siliceous substrata, elsewhere it is strictly confined to limestones and dolomites. This is the case also in Bulgaria. Here it grows in associations with *Festuca dalmatica* (HACKEL) K. RICHTER, *Paronychia kapela* (HACQ.) KERNER,

Saxifraga oppositifolia L., *Scutellaria alpina* L., *Globularia cordifolia* L., *Leontopodium alpinum* CASS. and *Aster alpinus* L.

In Bulgaria, *C. cochleariifolia* occurs only in the limestone part of the Pirin Mts. where it extends from 1900 to c. 2900 m above sea level.

Revised herbarium specimens:

Pirin: EL-TEPE, B. DAVIDOV 1915, SOM; SINANICA, B. ACHTAROV 1937, SOM; BAJUVI dupki, B. ACHTAROV 1939, SOM; BAJUVI dupki, N. STOJANOV 1939 sub *C. pusilla* var. *perinica* VELEN., SO; in rupibus umbrosis marmoreis valle Banderica, N. STOJANOV 1938 sub *C. pusilla* f. *umbrosa* STOJ. et ACHT., SO; in lapidosis graniticis sub locus Sinanica, N. VICHODZEVSKY sub *C. pusilla* f. *pirinica* HAYEK, SO; BANSKI SUCHODOL, E. BOŽILOVA 1968 sub *C. pusilla* f. *pirinica* HAYEK, SO.

Group *Scheuchzerianae*

6. *Campanula Scheuchzeri* VILL.

Tab. 1—5, Fig. 6

Campanula Scheuchzeri VILL., Prosp. Pl. Dauph. 22, 1779; STOJ. et STEF., Fl. Bălg. ed. 1, 2: 1085, 1925; HAYEK, Prodr. Fl. Penins. Balcan. 2: 536, 1930. — Syn.: *C. rotundifolia* L. var. *balcanica* ADAMOVIČ, Allg. Bot. Z. 5: 73, 1899; STOJ. et STEF., l. c.; *C. rotundifolia* L. subsp. *balcanica* (ADAMOVIČ) STOJ. et STEF., op. c. ed. 2: 930, 1933; *C. Scheuchzeri* VILL. var. *kladniana* sensu STOJ. et STEF., op. c. ed. 1, 2: 1084, 1925, non SCHUR.

C. Scheuchzeri is a polyploid oreophyte widely distributed in the mountains of C. and S. Europe (Pyrenees, Jura, Schwarzwald, Alps, Apennines, Balkan Peninsula southwards to Albania and Macedonia). The chromosome counts available (e.g. BÖCHER 1960, GUTERMANN in LÖVE et LÖVE 1961, GADELLA 1964, PODLECH 1965, KOVANDA 1970a, GESLOT 1982) indicate that the species is predominantly tetraploid ($2n = 68$), hexaploids ($2n = 102$) having been reported only from the Abruzzi Mts. in Italy (PODLECH 1965). The tetraploid count published by ANČEV (1983) is apparently the first made on material from the Balkan part of the distribution area.

We know *C. Scheuchzeri* only from one locality, Kuru-dere in the Central Stara Planina Mts. where it occurs in associations with *Juniperus sibirica* BURGSD., *Agrostis capillaris* L., *Arctostaphylos uva-ursi* (L.) SPRENGEL, *Vaccinium vitis-idaea* L., *Bruckenthalia spiculifolia* (SALISB.) REICHENB., *Acinos alpinus* (L.) MOENCH and *Homogyne alpina* (L.) CASS. PODLECH (1965) reports *C. Scheuchzeri* from two more localities in the Stara Planina Mts. The vertical range of distribution is from c. 1400 to c. 2200 m above sea level.

Revised herbarium specimens:

Central Stara Planina: Kaloferski Balkan, A. DRENOVSKY et I. URUMOV 1909 sub *C. rotundifolia* L., SOM; Kuru-dere, M. ANČEV 1974, SOM.

Group *Vulgares*

7. *Campanula rotundifolia* L.

Campanula rotundifolia L., Sp. Pl. 163, 1753.

C. rotundifolia, even in its narrow circumscription (e.g. PODLECH 1965, FEDOROV et KOVANDA 1976), is a huge polyploid structure with a complex variation pattern. It is widespread and extremely variable throughout much of the temperate zone of Europe but clearly declines towards the south where it is replaced by its mountain derivatives and members of the *Saxicolae* group. The distribution of the three cytotypes (diploid, tetraploid and hexaploid) is somewhat puzzling (KOVANDA 1970a,b).

The vast majority of Bulgarian specimens are outside the species limits of *C. rotundifolia* L. and have been referred to other well-defined taxa (see above). Perhaps the only exception is a small collection from near Borovec in the Rila Mts. Unfortunately, the material is too scanty, with no flowers, making its classification as belonging to *C. rotundifolia* somewhat doubtful. Despite a detailed search of the locality in 1987, we failed to confirm the occurrence of *C. rotundifolia* (or any other representative of the complex) there. Neither it is certain whether the plant was autochthonous in this site. Borovec was a hunting area of the Tsar Boris III. and a number of plants have been planted there by the German gardener E. Schwach in 1931–1941. Some of them still survive, including *Rhododendron myrtifolium* SCHOTT et KOTSCHY, *Telekia speciosa* (SCHREBER) BAUMG., *Campanula latifolia* L., *Adenophora liliifolia* (L.) LEDEB. and others. Another possibility is that *C. rotundifolia* was inadvertently introduced there with grass seed, as is the case e.g. with *C. rhomboidalis* L. in its extra-Alpine localities (e.g. KOVANDA et HUSOVÁ 1976).

Revised herbarium specimen:

Rila, near the forestry station Ovnarsko, P. IVANOVA 1976, SOM.

SOUHRN

Komplex *Campanula rotundifolia* je v Bulharsku zastoupen sedmi druhy, *C. euxina* (VELEN.) ANČEV (2n = 34), *C. Jordanovii* ANČEV et KOVANDA (2n = 34), *C. velebitica* BORBÁS (2n = 34, 68), *C. trojanensis* KOVANDA et ANČEV (2n = 34, 68), *C. cochleariifolia* LAM. (2n = 34), *C. Scheuchzeri* VILL. (2n = 68) a *C. rotundifolia* L. Z nich jsou *C. euxina*, *C. Jordanovii* a snad i *C. trojanensis* bulharskými endemity. *C. Scheuchzeri* je v Bulharsku známa z jediné lokality, *C. rotundifolia* rovněž, není však jasné, zda je původní a zda jde skutečně o tento druh. Údaje o výskytu *C. polymorpha* WITAS., *C. serrata* (KIT.) HENDRYCH a *C. witasekiana* VIERH. se ukázaly být mylné. U každého druhu jsou připojeny poznámky k morfologii, karyologii, fenologii, variabilitě, ekologii a geografickému rozšíření. Rovněž byla studována korelace mezi stupněm ploidie a velikostí pylových zrněk.

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See also Plates I—III in the Appendix.

M. M. Duckert-Henriod et C. Favarger:

Contribution à la cytotaxonomie et à la cytogéographie des *Poa* (*Poaceae* = *Gramineae*) de la Suisse

(Index des nombres chromosomiques des Spermatophytes de la Suisse: II *Poaceae*, Genre *Poa*)

Mémoires de la Société Helvétique des Sciences Naturelles, vol. 100. — Birkhäuser Verlag, Basel et Boston 1987, 130 str., 28 tab. a 97 + 5 obr. v textu, cena váz. 98,— SFr. (Kniha je v knihovně ČSBS.)

Karyotaxonomie již dlouho nepatří k novinkám v botanickém výzkumu, přesto však ji musíme řadit stále k moderním a hlavně v nejlepším slova smyslu plodným taxonomickým disciplinám. Pravdou je, že extenzivní karyotaxonomický výzkum se postupně odsouvá do oblastí s menší botanickou tradicí, neméně i v současnosti se setkáváme s karyologickými pracemi ze střední či západní Evropy, které stojí za to si přečíst. Obvykle se jedná o studie zevrubněji zkoumající taxonomickou či biosystematickou problematiku naznačenou předešlejší karyologickou prospekci. K takovým pracím náleží i recenzované dílo vytvořené pod vedením seniora evropské karyotaxonomie prof. C. Favagera.

Autoři zpracovali úctyhodné množství materiálu 19 druhů rodu *Poa* z celého území Švýcarska (kupř. chromozómové počty byly zjišťovány u více než 800 rostlin ze 700 populací). Výsledky zkoumání meiózy a mitózy, korelace s morfologickými vlastnostmi a geografickými či ekologickými charakteristikami a obsažné diskuse, vše doplněné přehlednými tabulkami a ilustracemi, jsou uveřejněny formou, jakou nemohu nazvat jinak než výpravnou monografií.

Při taxonomické, mikroevoluční či fytogeografické interpretaci získaných dat jsou autoři poměrně zdrženliví, což však lze sotva pokládat za nedostatek. Z výsledků alespoň stručně o druzích