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The genus *Campanula* L. (Campanulaceae) in Croatia, circum-Adriatic and west Balkan region

SANJA KOVAČIĆ*

University of Zagreb, Faculty of Science, Department of Botany and Botanical Garden, Marulićev trg 9a, HR-10000 Zagreb, Croatia

The status of the genus *Campanula* L. (Campanulaceae) in southeast-European, circum--Adriatic and west Balkan countries (Italy, Slovenia, Croatia, Bosnia and Herzegovina, Serbia and Montenegro, FYR Macedonia, and Albania) is discussed, according to the local checklists, recent nomenclature and research. The flora of the region comprises at least 84 *Campanula* species and subspecies, out of which 75% are endemic, with a considerable number of incipient taxa. Accent is placed on the Croatian flora, which contains 30 species and 5 subspecies (42% of the regional taxa), while some older references are found to be inaccurate or recently unconfirmed. The predominant chromosome number is diploid, 2n = 34, while the most prevailing life form is hemichryptophytic (97% of the taxa). More than 30% of the Croatian campanulas are endemic, particularly of the *Isophylla*, *Heterophylla* (*Rotundifolia*), *Pyramidalis* and *Waldsteiniana* lineages, the unsolved relations among which are considered to be the most interesting in the region. The genus *Campanula*, in its current circumscription, needs fundamental revision.

Key words: *Campanula*, Croatia, Adriatic coast, Balkan

Introduction

Members of the family Campanulaceae Juss. *s.l.* are widespread on most continents, with up to 90 genera and 2200 species (JUDD et al. 2002). Although the family is found to be monophyletic (COSNER et al. 1994, EDDIE et al. 2003), there is no single living genus that could be regarded as the ancestor of the others. Three subfamilies – Campanuloideae, Cyphoideae and Lobelioideae (SCHÖNLAND 1894) – may as well be recognized at the family level (LAMMERS 1992). There is still dispute even as to the number of recognized genera within the family, while the criteria for delimiting taxa are problematic due to the complexity of characters within and among genera (EDDIE 1984, 1998).

Ancestors of the recent »campanuloids«, i.e. *Campanula* taxa and their relatives, probably started to develop in the early Tertiary (55 to 60 million years ago), in the warm climate of Gondwanaland. In Europe, the evolution of this group was additionally facilitated in the Quaternary, by the Alpine Orogenesis and the Ice Ages. Today, Campanulaceae in

* Corresponding address: sanja@botanic.hr

Eurasia are most frequently represented by the related genera *Asyneuma* Griseb. et Schenk., *Campanula*, *Phyteuma* L. and *Symphyandra* DC., which are exceptionally rich and uniquely developed in the higher mountains of Western and Central Europe, in the Mediterranean area, the Middle East and the Caucasus. Apparently, the most primitive campanuloids today are gathered around the Mediterranean Sea, e.g. *Trachelium* L. (including the eastern groups *Tracheliopsis* and *Diosphaera*), *Legousia* Durande, *Edraianthus* DC. and *Jasione* L., followed by archaic »true« campanulas of the subsection *Annuae* (Boiss.) Fed. and subgenus *Roucela* (Dumort.) Damboldt (CONTANDRIOPOULOUS 1984, EDDIE 1998). It seems that the whole campanuloid lineage spread over the northern hemisphere from this major evolutionary centre in the Mediterranean region (EDDIE et al. 2003).

The numerous *Campanula* taxa – 350 to 450 species of bellflowers, bluebells, harebells and starbells, with many taxa lower than species – mostly inhabit steppe and mountainous habitats in temperate and subtropical zones of the northern hemisphere. Many of them are orographically, edaphically and microclimatically highly specialized and characterized by extensive polymorphism. The first approaches to the *Campanula* taxonomy were often geographically limited and based exclusively on (very variable) morphological characteristics, which led to the circumscription of a large number of species, subspecies, varieties, subvarieties, forms, and even subforms (WITASEK 1906, HRUBY 1930, 1934). Many authors over the centuries also tried to develop a suitable sub-classification of this large genus, in order to help in systematization (DE CANDOLLE 1830, BOISSIER 1875, FIORI 1927, FEDOROV 1957, GADELLA 1964, PODLECH 1965, DAMBOLDT 1978, KOVANDA 1970b, 1977, GESLOT 1984, KOLAKOVSKY 1992). These positive efforts resulted though in many assemblages of frequently heterogeneous taxa, causing more and more confusion. Such serious problems in delimiting taxa have recently initiated partial investigations in *Campanula*, using classical taxonomic methods in combination with molecular and statistical analyses, which have resolved some of the taxonomic problems of evolutionary-related and geographically--closer groups (CARLSTRÖM 1986, KOVANDA and ANČEV 1989, RUNEMARK and PHITOS 1996, EDDIE and INGROUILLE 1999, OGANESIAN 2001, SAEZ and ALDASORO 2003). In spite of all this, no generally accepted criteria for the subgeneric delimitation of *Campanula* exist: phylogeny and relationships among the »campanuloids« in general are still poorly known.

It is traditionally considered that at least two major *Campanula* lineages (»sections«) have separate evolutionary patterns (BOISSIER 1875, FEDOROV 1957, CHARADZE 1949, FEDOROV and KOVANDA 1976), a conclusion based mainly on calyx morphology (presence/absence of appendages between the lobes) and on the mode of capsule dehiscence (apical or lateral, valvate or porate). The section *Rapunculus* Dumort. is most probably older, while it is widely distributed (also in North America), although outnumbered by the taxa within the Section *Campanula s.str.* However, the most recent investigations indicate that not even those two lineages are entirely natural.

The latest molecular phylogenetic research (EDDIE et al. 2003) reveals some very interesting details: according to the analysis of ITS-sequences of nuclear ribosomal DNA, the genera *Azorina*, *Campanulastrum*, *Edraianthus* and *Phyteuma* actually nest within *Campanula*. The various taxa of that assemblage further group with related genera in three main clades: the Campanula *s.str.*-clade, which includes *Azorina*, *Edraianthus*, *Symphyandra*, *Trachelium* and some others; the *Rapunculus*-clade, with the addition of *Adenophora*,

Asyneuma, *Legousia*, *Phyteuma* and others; and a small clade called the »transitional--taxa«, composed of *Jasione* and several other genera. Although the family is monophyletic, the genus *Campanula* is therefore polyphyletic.

It appears that in its current circumscription *Campanula* is a classic »waste bin« taxon that includes a number of dubious taxa left over after morphologically well-characterized groups of campanuloids were removed to separate genera. Many taxa during the years have been placed in *Campanula* for convenience, while even some of the satellite sister-genera could well be restored to *Campanula*. Taking all of this into consideration, it is clear that this heterogeneous genus (collective genus acc. to GADELLA 1964), as it now stands, is in need of fundamental revision.

The genus *Campanula* in the west Balkans and circum-Adriatic region

According to the still valid literature (compilation of the Flora Europaea and the MedCheck-list, EURO+MED, in preparation, as well as the Atlas Florae Europeae with Campanulaceae included), approximately 200 to 250 *Campanula* species and subspecies are listed for Europe (FEDOROV and KOVANDA 1976) and the Mediterranean region (GESLOT 1984), respectively. The actual number of taxa may be greater considering the fact that so few have been adequately investigated.

In south-eastern Europe research on the genus *Campanula* began with the floristic investigations in 18th century – and yet even 300 years later the quest for new taxa is not over (e.g. LUCCHESE 1993, RANĐELOVIĆ and ZLATKOVIĆ 1998, LAKUŠIĆ and CONTI 2004). Nevertheless, older botanists (e.g. BORBAS 1883, POSCHARSKY 1896, BECK-MANAGETTA 1901, ADAMOVIĆ 1909, 1911, 1929, HEGI 1908–1931, JAVORKA 1924–1925, FIORI 1927, HAYEK 1925–1933) noticed a tremendous diversity of campanulas in the west Balkans and both Adriatic coasts, occupying different habitats, from the shoreline to the highest mountains. The circum-Adriatic regions of the Balkans and Apennines (Fig. 1) form the northern section of the eastern Mediterranean biogeographical region (QUEZEL 1985). These two large European peninsulas are generally highly related in floristic and vegetation composition (PIGNATTI 1982, JUNIKKA and UOTILA 2002), as well in *Campanula* taxa (DAMBOLDT 1965a, FRIZZI 1988, BERNINI et al. 2002), which comprise a large share of the genus' diversity and endemicity in both European and Mediterranean checklists. Circum-Adriatic campanulas share morphological characteristics and the similar vegetation conditions of the karstic Mediterranean-mountainous region, i.e. heliophytic *chasmophyta* of mountain rock crevices, scree and rubble. Cytological investigations have confirmed high similarity in number and form of chromosomes (GUTERMANN 1961, MERXMÜLLER and DAMBOLDT 1962, BÖCHER 1963, GADELLA 1964, PODLECH and DAMBOLDT 1964): campanulas of this region are primary diploids, often endemics and/or relicts reduced to small geographic areas, sometimes listed in the local Red Books.

The distribution of *Campanula* species and subspecies in the countries of the eastern Adriatic and western Balkan region is given in table 1. Nomenclature is adjusted according to the data of FEDOROV and KOVANDA (1976) and GESLOT (in GREUTER et al. 1984), and supplemented by local floras and research of Italy (PIGNATTI 1982, LUCCHESE 1993), Slovenia (MARTINČIČ 1999, JOGAN ed. 2001), Croatia (LOVAŠEN-EBERHARDT 2000), Bosnia and Herzegovina (BJELČIĆ 1983, ŠILIĆ 2000, ŠOLJAN 2002), Former Yugoslav Republic of Macedonia (NIKOLOV 2004), Serbia and Montenegro (ROHLENA 1942, OBRADOVIĆ 1974,

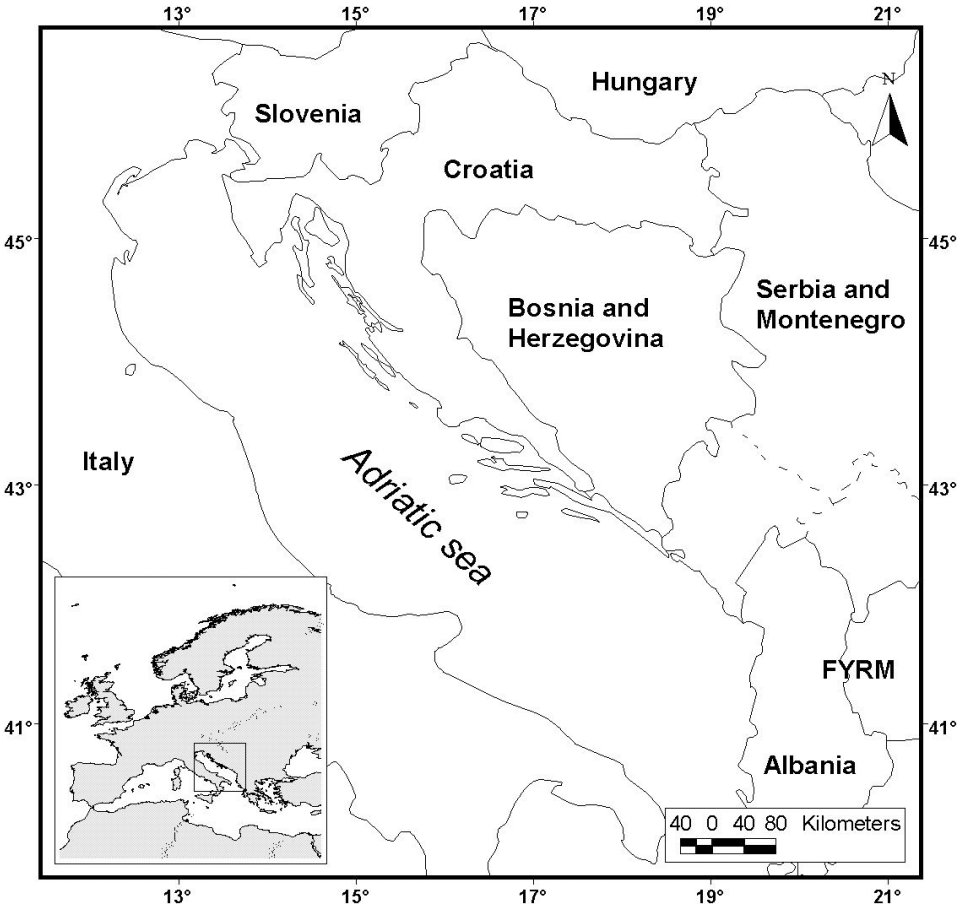

Fig. 1. Position of the circum-Adriatic and west Balkan countries in Europe.

DIKLIĆ 1977, GAJIĆ 1986, RANĐELOVIĆ and ZLATKOVIĆ 1998) and Albania (HAYEK 1923, DEMIRI 1981, QUOSIA 1996). Endemicity and polymorphism are noted to illustrate each taxon's evolutionary pattern and range of variability.

According to the data in table 1, the flora of the circum-Adriatic and western Balkan region contains 84 *Campanula* taxa: 65 species and 19 subspecies. This number is not final, while the immense range of lower taxa of uncertain taxonomical status (hereafter called the »incipient« species) is neglected. The flora of Serbia and Montenegro contains 48 *Campanula* species and subspecies, of north-eastern Italy 42, of Albania 37, of Croatia 35 (discussed separately), of Bosnia and Herzegovina 33, of FYR Macedonia 33, and of Slovenia 26 (Fig. 2), but these numbers are not final. Italian campanulas of northwest and southwest distribution, absent from the other countries in the region, were not listed: these are (according to PIGNATTI 1982) *C. bertolae* Colla, *C. cenisia* L., *C. elatines* L., *C. elatinoides* Moretti, *C. fragilis* Cyr., *C. forsythii* (Arcang.) Podlech, *C. isophylla* Moretti, *C. macrorrhiza* Gay ex DC., *C. pollinensis* Podlech, *C. pseudostenocodon* Lacaita, *C. rhomboidalis*

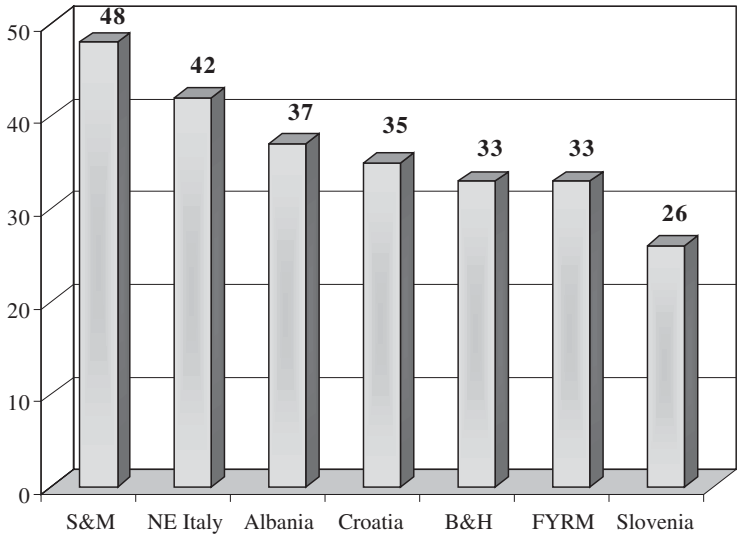

Fig. 2. Number of *Campanula* species and subspecies in countries of the circum-Adriatic and western Balkan region.

L., *C. sabatia* De Not., and *C. stenocodon* Boiss. et Reuter. Taxa stated as cultivated or dubious were excluded. As many as 63 taxa (75%) listed in Table 1 are indigenous to the region, and many of them subendemics with tiny distributions. About 35% of the species are variable, some of them tremendously so (e.g. *C. rotundifolia*, *C. glomerata* L., *C. patula* L.). Comparative experimental investigations using modern methods have rarely been conducted among the southeast European campanulas (FRIZZI 1988, KOVAČIĆ et al. 2003), which makes sub-generic systematization extremely difficult.

The genus *Campanula* in Croatia

According to the data of LOVAŠEN-EBERHARDT (2000), the genus *Campanula* is represented in Croatia by 38 species and 8 subspecies, as shown in table 2. Lovašen-Eberhardt marked taxa that she considered to be of dubious taxonomic status or controversial occurrence in Croatia with »?«. She also treated *C. fenestrellata* Feer subsp. *istriaca* (Feer) Damboldt as species *C. istriaca* Feer, which is not considered valid by most of the recent authors. Complex subgeneric delimitation is adjusted by the present author, following the most prominent works of DAMBOLDT (1965a, 1968), FEDOROV (1957), KOVANDA (1970b, 1977), FEDOROV and KOVANDA (1976) and GESLOT (1984), in order to represent the variety of different views concerning the inter-taxonomic relationships of the genus. Additional literature on *Campanula* and Campanulaceae in Croatia should be found in NIKOLIĆ (2000).

Based on my research, I suggest that 7 species and 3 subspecies of *Campanula* are of highly dubious existence in Croatia and should be removed from the Croatian checklist pending further investigation. In table 2 I compare data presented by LOVAŠEN-EBERHARDT (2000) to those of the most outstanding older researchers of Croatian flora: VISIANI (1847,

Tab. 1. *Campanula* species and subspecies distribution in the circum-Adriatic and west Balkan countries: northeastern Italy, Slovenia, Croatia, Bosnia & Herzegovina, Serbia & Montenegro, FYR Macedonia, and Albania. E = endemic taxon, pt = polymorphic taxon, grey cells = unreliable reference, cult. = taxon stated as cultivated,? = taxon stated as dubious.

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia &	Herzegovina	Serbia &	Montenegro	FYR Macedonia	Albania
1	*albanica*	Witasek	Magyar Bot. Lap. 5: 246 (1906)	*C. linifolia* ssp. *albanica* (Witasek) Hayek, *C. rotundifolia* ssp. *hellenica* Hayek, *C. hellenica* Hayek	✓	✓						✓	✓	✓	✓
2	*alpestris*	All.	Auct. Syn. Stirp. Horti Taur. 11 (1773)	*C. allionii* Vill.	✓		✓								
3	*alpina* ssp. *alpina*	Jacq.	Enum. Stirp. Vindob. 36: 210 (1762)		✓	✓	?	✓				✓	?	✓	✓
4	– ssp. *orbelica*	(Pančić) Urum.	Spis. Balg. Akad. Nauk, 28: 147 (1923)	*C. alpina* Jacq. ssp. *orbelica* Pančić	✓							✓			✓
5	*barbata*	Linne	Syst. Nat. ed 10: 926 (1759)	*C. firmiana* Vandelli		✓	✓	✓	?						
6	*beckiana*	Hayek	Fl. Steierm. 2(1): 455 (1912)	*C. hostii* Baumg., *C. baumgartenii* J. Becker ssp. *beckiana*	✓			✓	?			✓			
7	*bononiensis*	Linne	Sp. Pl. 165 (1753)	?*C. obliquifolia* Ten., *C. ruthenica* Bieb., *C. simplex* Lam. non Stev., incl. var. *cana* Simonkai, var. *concolor* Pančić		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	*calycialata**	Ranđelović et Zlatković	Flora Medit. 8, 85-92 (1998)		✓							✓			

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
9	*carnica*	Schiede ex Merth. et Koch	Deutschl. Fl. 3(2): 158 (1826)	*C. linifoli*a Scop. non L., *C. scheuchzeri* Vill. var. *carnica*. Posp., *C. rotundifolia* Bertol p.p. *nec* L., *C. rotundifolia* L. var. *forsythii* Arcangeli, *C. macrorrhiza* Parl. p.p. *nec* Gay	✓	✓	✓	✓	✓						
10	*cervicaria*	Linne	Sp. Pl. 167 (1753)	var. *cervicaria*, var. *micrantha*			✓	✓	✓	✓	✓	✓	?	✓	✓
11	*cespitosa*	Scop.	Fl. Carniol. 2(1): 143 (1772)	incl. *C. caespitosa*	✓		✓	✓	✓						
12	*cochleariifolia*	Lam.	Encycl. Meth. Bot. 1:578 (1785)	*C. pusilla* Haenke, *C. pusilla* ssp. *croatica* Hruby, *C. hochstetteri* Schott et al., *C. notata* Schott et al., *C. tenella* Jordan, *C. caespitosa* Vill. non Scop., *C. bellardii* Allioni	✓	✓	✓	✓	✓	✓	✓		✓		✓
13	*crassipes*	Heuffel	Österr. Bot. Zeitsch. 8: 27 (1858)		✓							✓			
14	*dichotoma*	Linne	Cent. Pl. 2: 10 (1756)			✓	✓								
15	*erinus*	Linne	Sp. Pl 169 (1753)	*Roucela erinus* (L.) Dumort, *C. nanella* P. A. Smirn.			✓		✓		✓		✓		✓
16	*fenestrellata* ssp. *fenestrellata*	Feer	J. Bot. 28: 272 (1890)	*C. garganica* Vis. non Ten., *C. garganica* Ten. ssp. *fenestrellata* (Feer) Hayek, *C. lepida* Feer	✓	✓			✓				✓		

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
17	– ssp. *debarensis*	(Rech.f.) Damboldt	Bot. Jahrb. Syst. 84: 358 (1965)	*C. debarensis* Rech.f.	✓							✓	✓
18	– ssp. *istriaca*	(Feer) Damboldt	Jour. Bot. 28: 271 (1890)	*C. istriaca* Feer, *C. garganica* Ten. ssp. *istriaca* (Feer) Hayek, *C. fenestrellata* Feer ssp. *istriaca* (Feer) Fed.	✓				✓				
19	*foliosa*	Ten.	Fl. Nap. 1, Prodr. 16 (1811)		✓		✓	?	✓	✓	✓	✓	✓
20	*formanekiana*	Degen et Dörfl.	Denkschr. Akad. Wiss. Math.-Nat. Kl. (Wien) 54: 728 (1899)		✓							✓	
21	*garganica*	Ten.	Cat. Sem. Horti Nap. (1827)	*C. barbeyi* Feer	✓	✓	✓						
22	*glomerata* ssp. *glomerata*	Linne	Sp. Pl. 166 (1753)	*C. aggregata* Willd., *C. speciosa* Hoenem non Pourr. *C. viridis* Rchb. (=var. *mediterranea* Borb.), *C. cephalotes* Fischer; div. var. et f.		✓	✓	✓	✓	✓	✓	✓	✓
23	– ssp. *cervicarioides*	(Schult.) P. Fourn.	Quatre Fl. Fr. 914 (1939)	*C. cervicarioides* Schult.	✓		✓		✓		✓		✓
24	– ssp. *elliptica*	(Kit. ex Schult.) O. Schwarz	Mitt. Thür. Bot. Ges. 1(1): 118 (1949)	*C. elliptica* Schult.	✓		✓				✓		

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
25	– ssp. *farinosa*	(Rochel) Kirschl.	Fl. Alsace 1: 378 (1852)	*C. farinosa* (Rochel) Andr., *C. glaucophylla* Schlosser et Vuk., *C. desertorum* Weinm.			✓		✓				
26	– ssp. *hispida*	(Witasek) Hayek	Prodr. Fl. Penins. Balcan. 2: 532 (1930)	*C. glomerata* f. *hispida* Witasek, *C. lamioides* Witasek					✓		✓	✓	✓
27	– ssp. *serotina*	(Wettst.) O. Schwarz	Mitt. Thür. Bot. Ges. 1(1): 118 (1949)	*C. serotina* Wettst.	✓		✓		✓				✓
28	*grossekii*	Heuffel	Flora (Regensburg) 16: 353 (1833)		✓						✓		
29	*hawkinsiana*	Hausskn. et Heldr.	Mitt. Georg. Ges. (Jena) 5(2): 87 (1887)	*C. halacsyana* Bald.	✓								✓
30	*hercegovina*	Degen et Fiala	Österr. Bot. Zeitsch. 44: 303 (1894)	?*C. tarana* K. Maly, div. var, subvar, f., subf.	✓	✓			✓	✓	✓		
31	*jordanovi*	Ančev et Kovanda	Preslia 61: 200 (1989)		✓							✓	
32	*justiniana*	Witasek	Magyar Bot. Lapok 5:245 (1906)	*C. linifolia* ssp. *justiniana* (Witasek) Hayek	✓			✓	✓				
33	*latifolia*	Linne	Sp. Pl. 165 (1753)	*C. eriocarpa* Bieb., incl. *C. latifolia* var. *macrantha* (A.DC.) Hornemann		✓	✓	✓	✓	✓	✓	✓	
34	*lingulata*	Waldst. et Kit.	Descr. Icon. Pl. Hung. 65 (1801)	*C. cichoriacea* Sm., *C. capitata* Sims., incl. var. *farinosa* Roch., *elliptica* Kit., *mediterranea* Borb., div. f. et subvar.	✓	✓			✓	✓	✓	✓	✓

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
35	*macrostachya*	Waldst. et Kit.	in Willd., Enum. Pl. Hort. Berol.: 213 (1809)	*C. multiflora* Waldst. et Kit.									✓
36	*marchesettii*	Witasek	Abh. K. K. Zool.-Bot. Ges. Wien 1(3): 32 (1902)	*C. scheuchzeri* ssp. *marchesettii* non Vill.	✓		✓	✓	✓		✓	✓	✓
37	*medium*	Linne	Sp. Pl. 167 (1753)		✓		(NW Italy)	cult.					cult.
38	*micrantha*	Bertol.	Fl. Ital. 7: 623 (1851)	*C. marchesettii* auct. Fl. It. Centr., *C. apennina* (Podlech) Podlech	✓		✓						
39	*moesiaca*	Velen.	Sitz. Königl. Böhm. Ges. Wiss. Prag, Math.-Nat. Cl. 1892: 385 (1893)	*C. hirsuta* Pant.	✓				✓	✓	✓	✓	✓
40	*moravica* ssp. *moravica*	(Spitzner) Kovanda	Folia Geobot. Phytotax. Bohem. 3: 409 (1968)	*C. rotundifolia* L. var. *moravica* Spitzn.	✓	✓			✓		?		
41	– ssp. *xylorrhiza*	(O. Schwartz) Kovanda	Folia Geobot. Phytotax. Bohem. 3: 409 (1968)	*C. rotundifolia* L. ssp. *xylorrhiza* O. Schwartz	✓				✓				

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
42	*morettiana*	Rchb.	Pl. Crit. 4: 18 (1826)		✓		✓						
43	*patula* ssp. *patula*	Linne	Sp. Pl. 163 (1753)	*C. monanthos* Pant., *C. flaccida* (Wallr.) Dalla Torre et Sarnth., *C. neglecta* Schult.; incl. *C. patula* ssp. *costae* (Willkomm.) Fed., *C.p.* ssp. *epigaea* (Janka) Hayek, div. f. et subf.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
44	– ssp. *abietina*	(Griseb. et Schenk.) Simonkai	Enum. Fl. Transsilv. 383 (1887)	*C. abietina* Griseb. et Schenk., *C. stefanoffi* F. Hermann, *C. vajdae* Penzes	✓							✓	✓	✓	✓
45	– ssp. *costae*	(Willk.) Fedorov	Bot. J. Linn. Soc. 67: 281 (1973)	*C. costae* Wullk.	✓		✓								
46	– ssp. *epigaea*	(Degen) Hayek	Repert. Spec. Nov. Regni Veg. Beih. 30(2): 546 (1930)	*C. epigaea* Degen, *C. velenovskyi* Adamović	✓							✓			
47	– ssp. *jahorinae*	(K. Maly) Greuter et Burdet	Willdenovia 11: 40 (1981)	*C. patula* f. *jahorinae* K. Maly	✓		✓			✓	✓				
48	*persicifolia* ssp. *persicifolia*	Linne	Sp. Pl. 164 (1753)	*C. cristallocalyx* Adamović, *C. hispida* Lej., *C. pumila* F. W. Schmidt, incl. div. var. et f.		✓	✓	✓	✓	✓	✓	✓	✓	✓	

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
49	– ssp. *sessiliflora*	(C. Koch) Greut. et Burd.	Willdenovia 12: 36 (1982)	*C. sessiliflora* K. Koch, *C. persicifolia* L. ssp. *eriocarpa* (K.Koch) U. Dettmann et Rothm.	✓			✓	?		✓	✓	
50	*petraea*	Linne	Syst. Nat. ed 10: 926 (1759)		✓		✓						
51	*phygria*	Jaub. et Spach	Ill. Pl. Orient. 3: 233 (1848)	*C. ramosissima* Griseb. non Sibth. et Sm.; div. f.	✓						✓	✓	✓
52	*portenschlagiana*	Schultes	in Römer et Schultes, Syst. Veg. 5:93 (1820)	*C. muralis* Portenschl., *C. hederaefolia* Portenschl, *C. morettiana* Vis. non Rchb.	✓				✓	✓	✓		
53	*poscharskyana*	Degen et Fiala	Magyar Bot. Lapok 7: 103 (1908)	*C. elatines* auct., non L. Reichenb.	✓				✓		✓		
54	*pyramidalis*	Linne	Sp. Pl. 164 (1753)		✓	✓	✓	✓	✓	✓	✓	✓	✓
55	*raineri*	Perpenti	Bibliot. Ital. 5: 134 (1817)		✓		✓						
56	*ramosissima*	Sibth. et Sm.	Fl. Graecae Prodr. 1: 137 (1806)	*C. loreyi* Pollini, *C. baldensis* Balb.	✓		✓		✓		✓	?	✓
57	*rapunculoides*	Linne	Sp. Pl. 165 (1753)	*C. trachelioides* M.Bieb., *C. cordifolia* C. Koch, *C. rhomboidea* Falk, *C. rhomboidalis* Gorter, *C. lunariaefolia* Reich., *C. setosa* Fischer; div. f.		✓	✓	✓	✓	✓	✓	✓	✓

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
58	*rapunculus*	Linne	Sp. Pl. 164 (1753)	*C. elatior* Hoffmans. et Link, *C. verruculosa* Hoffmans. et Link, incl. *C. rapunculus* ssp. *lambertiana* Boissier, *C.r.* var. *spiciformis* Boissier, div. var, f. et subf.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
59	*reatina*	Lucchese	Fl. Medit. 3: 266 (1993)		✓		✓								
60	*rotundifolia (s.l.)*	Linne	Sp. Pl. 163 (1753)	? *C. polymorpha* (Witasek) Tacik, ? *C. tarana* K. Maly, *C. scheuchzeriformis* Hayek, *C. lobata* Schloss. et Vuk., *C. racemosa* (Krašan) Witasek, *C. pinifolia* Uechtr.; div. ssp., var. et f.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
61	*scheuchzeri*	Villars	Prosp. Hist. pl. Dauph. 22 (1779)	*C. linifolia* Haenke non Scop., *C. rotundifolia* L. ssp. *balcanica* (Adamović) Stoj. et Stefanov, *C. uniflora* Vill. non L.		✓	✓	✓	✓	✓	✓	✓	✓		✓
62	*scutellata*	Griseb.	Spic. Fl. Rumel.2: 282 (1846)		✓							✓	?	✓	
63	*secundiflora*	Visiani et Pančić	Mem. Imp. Reale Inst. Veneto Sci. 10: 442 (1861)		✓							✓			
64	*serrata*	(Kit.) Hendrych	Taxon 11: 123 (1962)	*C. pseudolanceolata* Pant., *C. napuligera* Schurr., *Thesium serratum* Schultes (basion.)		✓			✓	✓	✓	✓			

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
65	*sibirica* ssp. *sibirica*	Linne	Sp. Pl. 167 (1753)	*C. hohenackeri* Fisch., *C. parviflora* Lam., *C. sibirica* ssp. *taurica* Juz.		✓	✓	✓	✓	✓	✓	✓	✓
66	– ssp. *divergentiformis*	(Jav.) Domin	Preslia 13-15: 222 (1936)	*C. divergens* W. et Kit. in Willd., *C. sibirica* var. *divergentiformis* Jav., *C. spathulata* W. et K.	✓		✓		✓	✓	✓	✓	✓
67	*sparsa* ssp. *sparsa*	Friv.	Magyar Tud. Tars. Evk. 4(2): 201 (1840)	*C. expansa* Friv., *C. sparsa* ssp. *frivaldsky* (Steudel) Hayek	✓	✓				✓	✓	✓	✓	✓	✓
68	– ssp. *sphaerothrix*	(Griseb.) Hayek	Repert. Spec. Nov. Regni Veg. Beih. 30(2): 547 (1930)	*C. sphaerothrix* Gris., *C. expansa* var. *sphaerothryx* Boiss.	✓					✓		✓	✓	✓	
69	*spatulata* ssp. *spatulata*	Sibth. et Sm.	Fl. Graecae Prodr. 1: 137 (1806)	*C. sibthorpiana* Halacsy	✓							✓		✓	✓
70	– ssp. *spruneriana*	(Hampe) Hayek	Repert. Spec. Nov. Regni Veg. Beih. 30(2): 545 (1930)	*C. spruneriana* Hampe	✓									✓	✓
71	*spicata*	Linne	Sp. Pl. 166 (1753)		✓		✓	✓	✓	✓					
72	*tanfanii*	Podlech		*C. macrorrhiza* Gay ex DC. var. *angustiflora* Tanfani	✓		✓								
73	*thyrsoides* ssp. *thyrsoides*	Linne	Sp. Pl. 167 (1753)		✓		✓		✓	✓		✓			

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
74	– ssp. *carniolica*	(Sünd.) Podlech	Ber. Bayer. Bot. Ges. 37: 111 (1964)	*C. th.* var. *carniolica* Sünd.	✓		?	✓	✓				
75	*tommasiniana*	C. Koch	Arch. Fl. France Allemagne 229 (1852)	*C. waldsteiniana* R. et S. var. *tubulosa* DC., *C. waldsteiniana* R. et S. var. *freyeri* Reichenb., *C. tommasiniana* Reuter, *C. waldsteiniana* R. et S. var. *tommasiniana* (Reuter) Arcangeli	✓				✓				
76	*trachelium* ssp. *trachelium*	Linne	Sp. Pl. 166 (1753)	*C. urticifolia* F. W. Schmidt, *C. trachelioides* Bieb., *C. athoa* Boiss. et Heldr., incl. *C. trachelium* var *orientalis* Boiss., div. f.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
77	– ssp. *athoa*	(Boiss. et Heldr.) Hayek	Prodr. Fl. Penins. Balcan. 2: 541 (1930)	*C. athoa* Boiss. et Heldr.	✓				?	✓				✓	✓
78	*trichocalycina***	Ten.	Cat. Pl. Hort. Neap. App. 1: 35 (1815)	*Asyneuma trich.* (Ten.) K. Maly, *Podanthum trich.* (Ten.) Boiss., *Phyteuma trich.* (Ten.) Tanfani, *C. minae* Strobl	✓	✓	(SW Italy)		✓	✓	✓			✓	✓
79	*tymphea*	Hausskn.	Mitt. Georg. Ges. (Jena) 5(2): 87 (1887)		✓									✓	✓

Tab. 1. – continued

Nr	*Campanula* L.	Author	Source	Synonyms, included taxa	E	pt	NE Italy	Slovenia	Croatia	Bosnia & Herzegovina	Serbia & Montenegro	FYR Macedonia	Albania
80	*velebitica*	Borbas	Math. Termeszettud. Ertesitö 1: 81 (1883)	*C. farinulenta* A. Kern. et Wettst., *C. bulgarica* Witasek, *C. balcanica* Hruby p.p., *C. rotundifolia* L. ssp. *velebitica* (Borbas) Hayek, *C.r.* ssp. *bulgarica* (Witasek) Hayek, div. var. et f.		✓			✓	✓	✓	✓	
81	*versicolor*	Andrews	Bot. Repos. 6: 396 (1804)	*C. tenorii* Moretti, *C. mrkwickiana* Velen.	✓	✓	✓				✓	✓	✓
82	*waldsteiniana*	Schultes	Syst. Veg. 5:99 (1820)	*C. flexuosa* Waldst. et Kit. non Michx.	✓				✓	✓			
83	*witasekiana*	Vierh.	Mitt. Naturwiss. Vereins Univ. Wien, 2(4): 72 (1906)	?*C. inconcessa* Schott et al. nom ambig., *C. scheuchzeri* Vill. ssp. *witasekiana* (Vierh.) Hayek, div. var. et f.		✓	✓	✓	✓	✓	✓		
84	*zoysii*	Wulf.	Collect. Bot. 2: 122 (1789)		✓		✓	✓					

* extinct in the wild (Randelović, pers. cont.)
** *Asyneuma pichleri* acc. to LAKUŠIĆ and CONTI (2004)

1872), NEILREICH (1868, 1869), SCHLOSSER and VUKOTINOVIĆ (1869), HIRC (1908, 1912), ROSSI (1924), JAVORKA (1925), ROSSI (1930), DEGEN (1938) and DOMAC (1950, 1994). Herbaria specimens of the Croatian Natural History Museum (CNHM), the Vienna Natural History Museum (W), Vienna University (WU, including Herbarium Halaczy), Zagreb University (ZA) and the Professor Ivo and Marija Horvat Herbarium (ZAHO) were examined. As campanulas of common occurrence in Croatian flora are present in all of the named Herbaria, and dubious taxa just in ZA and WU, these two collections are listed as exemplary in table 2. Just species and subspecies were taken into consideration.

In his »Flora Dalmatica« VISIANI (1847, suppl. 1872) listed all taxa of the Campanulaceae family as various sections of the genus *Campanula*. He registered 24 *Campanula* species and subspecies, while some were included in the range of other taxa (e.g. *C. portenschlagiana* Schult. as *C. morettiana* Reichenb.). NEILREICH (1868, suppl. 1869) again assigned 24 taxa to the Croatian flora, with *C. pulla* L. (according to the localities, it could have been *C. justiniana* Witasek), *C. beckiana* Hayek (probably some other incipient taxon of the *Rotundifolia* group) and *C. barbata* L. (most likely cultivated). SCHLOSSER and VUKOTINOVIĆ (1869) in their »Flora Croatica« quoted 23 species and subspecies known in recent times in the Croatian flora. There were again *C. barbata*, *C. beckiana, C. pulla* (perhaps misspelled *C. pusilla* Haenke, syn. for *C. cochleariifolia* Lam., acc. to HIRC 1908), *C. morettiana* (= *C. portenschlagiana*) and *C. macrostachya* Willd. found around Zemun in Vojvodina, western Serbia. It is important to emphasize the good reasons for including recently absent taxa into the Croatian flora of that time. Firstly, there was a lack of efficient determination keys and scientifically recognized taxa in the region (i.e.? many heterophyllous taxa were referred as *C. rotundifolia*, and isophyllous taxa as *C. garganica* Ten.). Secondly, Croatian borders changed considerably over the years, expanding to include parts of recent Serbia and Montenegro, and Bosnia and Herzegovina, while ceding the Istria peninsula, Dalmatian coast and islands to Italy.

HIRC (1908, 1912) in his revisions of older authors corrected most of the misinterpretations and quoted 32 *Campanula* species and subspecies known in recent times. In his »Materials for the flora of southern Croatia« (1924) ROSSI listed 21 *Campanula* taxa, and in the »Flora of Hrvatsko Primorje« (1930) 26 taxa. He wrongly assigned *C. albanica* Witasek (most probably *C. velebitica* Borbas) to the Croatian flora, and stated that some taxa were dubious. JAVORKA (1925) investigated the Croatian flora as a part of his »Magyar Flora«, in which the magnificent »Iconographia« is still valuable for this part of Europe. He regarded 34 *Campanula* species and subspecies as belonging to Croatia, including *C. barbata*, *C. spicata* L., *C. serrata* (Kit.) Hendrych and *C. alpina* Jacq., as dubious. HAYEK (1931), exploring the flora of the Balkans, listed 29 *Campanula* species and subspecies (with a number of lower taxa) for the Croatian area of that time. DEGEN (1938) noted 25 campanulas for the Velebit mountain region (*C. spicata* L. as dubious), with three taxa absent today (but possible, and very interesting): *C. trachelium* L. subsp. *athoa* (Boiss. et Heldr.) Hayek, *C. x murrii* Dalla Torre et Sarnth. (hybrid between *C. cochleariifolia* and *C. scheuchzeri* Vill.) and *C.* »staubii« Uechtr. (a common monstrosity of *C. pyramidalis* L.). *Campanula barbata* and *C. medium* were listed as cultivated. DOMAC quoted (1994) 29 *Campanula* species of recent circumscription. The Herbaria of Zagreb (ZA) and Vienna (WU) Universities have most of the *Campanula* taxa listed by LOVAŠEN-EBERHARDT (2000), but lack those that are missing in the works of the aforementioned authors.

Tab. 2. *Campanula* species and subspecies distributed in Croatia (acc. to LOVAŠEN-EBERHARDT 2000) with subgeneric delimitations, diploid chromosome number (2n) and life forms, compared to older literature and herbaria data. Hb = Hemichryptophyta-biennial, Hp = Hemichryptophyta-perennial, T = Therophyta (annual); grey cells = unreliable reference or reference from a recently non-Croatian locality, cult. = taxon stated as cultivated,? = taxon stated as dubious.

Subgeneric delimitations				Lovašen-Eberhardt (2000)			*Campanula* – references by older authors										HERBARIA		
Section (Fedorov and Kovanda 1976)	Section (Fedorov 1957)	Subsection (Fedorov 1957)	syn. Subsection, Series, Group, Aggregate	*Campanula* species and subspecies	2n	life form	Visiani 1847 /1872/	Neilreich 1868 /1869/	Schloss.-Vuk. 1869	Hirc 1908 /1912/	Rossi 1924	Javorka 1925	Rossi 1930	Hayek 1931	Degen 1938	Domac 1950 /1994/	ZA	WU	member of Croatian flora (Kovačić)
Rapunculus Dumort.	*Rapunculus* (Fourr.) Boiss.	*Campanulastrum* (Fourr.) Fedorov		*persicifolia* L., Sp. Pl. 164 (1753), ssp. *persicifolia*	16	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				rapunculus L., Sp. Pl. 164 (1753)	20	Hb	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				patula L., Sp. Pl. 163 (1753), ssp. *patula*	20 (40)	Hb		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				ramosissima Sibth. et Sm., Fl. Graecae Prodr. 1: 137 (1806)	20	T	✓		✓	✓				✓		✓	✓	✓	

Tab. 2. – continued

Campanula Medium DC.

Subgeneric delimitations		Lovašen-Eberhardt (2000)			*Campanula* – references by older authors									HERBARIA		member of Croatian flora (Kovačić)
Section (Fedorov and Kovanda 1976)	Section (Fedorov 1957)	Subsection (Fedorov 1957)	syn. Subsection, Series, Group, Aggregate	*Campanula* species and subspecies	2n	life form	Visiani 1847 /1872/	Neilreich 1868 /1869/	Schloss.-Vuk. 1869	Hirc 1908 /1912/	Rossi 1924	Javorka 1925	Rossi 1930	Hayek 1931	Degen 1938	Domac 1950 /1994/	ZA	WU	
	Quinquelocula-r(es) Boiss.			*medium* L., Sp. Pl. 167 (1753)	34	Hb						cult.			cult.	cult.			
		Trilocularis Boiss.		*sibirica* L., Sp. Pl. 167 (1753), ssp. *sibirica*	34	Hb(p)	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓
				– ssp. *divergentiformis* (Jav.) Domin, Preslia 13-15: 222 (1936)	34	Hb(p)	✓	✓		✓		✓		✓	✓		✓	✓	✓
				lingulata Waldst. et Kit., Descr. Icon. Pl. Hung. 65 (1805)	34	Hb	✓	?	✓	✓		✓	?	✓	✓	✓	✓	✓	✓
		Annuae (Boiss.) Fed.	*Rouy* (*Dumort.*) *Damboldt*	*erinus* L., Sp. Pl. 169 (1753)	28	T	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Involucratae (Fomin) Fedorov	*Cervicaria Gris., Glomeratae Schur*	*spicata* L., Sp. Pl. 166 (1753)	34	Hb		✓	✓	✓		?	✓		?	✓	✓	✓	✓
				thyrsoides L., Sp. Pl. 167 (1753), ssp. *thyrsoides*	34	Hb		✓	✓	✓	✓	✓	?		✓	✓	✓		✓
				–?ssp. *carniolica* (Sünd.) Podlech, Ber. Bayer. Bot. Ges. 37: 111 (1964)	34	Hb											✓	✓	?

Tab. 2. – continued

Subgeneric delimitations		Lovašen-Eberhardt (2000)			*Campanula* – references by older authors									HERBARIA		member of Croatian flora (Kovačić)
Section (Fedorov and Kovanda 1976)	Section (Fedorov 1957)	Subsection (Fedorov 1957)	syn. Subsection, Series, Group, Aggregate	*Campanula* species and subspecies	2n	life form	Visiani 1847 /1872/	Neilreich 1868 /1869/	Schloss.-Vuk. 1869	Hirc 1908 /1912/	Rossi 1924	Javorka 1925	Rossi 1930	Hayek 1931	Degen 1938	Domac 1950 /1994/	ZA	WU	
				cervicaria L., Sp. Pl. 167 (1753)	34	Hb	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				?*moesiaca* Velen., Sitz.-Ber. Böhm. Ges. Wiss. (Math.-Nat. Kl.) 385 (1893)	34	Hb													
				?*foliosa* Ten., Fl. Nap. 1, Prodr. 16 (1811)	34	Hp													
				glomerata L., Sp. Pl. 166 (1753), ssp. *glomerata*	30	Hp	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
				– ssp. *cervicarioides* (Schult.) Arcang., Comp. Fl. Ital. 456 (1882)	30	Hp				✓									✓
				– ssp. *elliptica* (Schult.) Kirschl., Fl. Alsace 1: 375 (1852)	30	Hp	✓	✓		✓	✓	✓	✓	✓	✓		✓		✓
				– ssp. *farinosa* (Andr.) Kirschl., Fl. Alsace 1: 378 (1852)	30	Hp		✓	✓	✓		✓		✓			✓		✓
				– ssp. *hispida* (Witasek) Hayek, Repert. Spec. Nov. Regni Veg. Bieb. 30(2): 532 (1930)	30	Hp													
				–?ssp. *serotina* (Wettst.) O. Schwarz, Mitt. Thür. Bot. Ges. 1(1): 118 (1949)	30	Hp													

Campanula L.

Medium DC.

Involucrate (Fomin) Fedorov

Cervicaria Gris., Glomerate Schur

Tab. 2. – continued

Subgeneric delimitations		Lovašen-Eberhardt (2000)			*Campanula* – references by older authors										HERBARIA		member of Croatian flora (Kovačić)
Section (Fedorov and Kovanda 1976)	Section (Fedorov 1957)	Subsection (Fedorov 1957)	syn. Subsection, Series, Group, Aggregate	*Campanula* species and subspecies	2n	life form	Visiani 1847 /1872/	Neilreich 1868 /1869/	Schloss.-Vuk. 1869	Hirc 1908 /1912/	Rossi 1924	Javorka 1925	Rossi 1930	Hayek 1931	Degen 1938	Domac 1950 /1994/	ZA	WU	
Campanula	*Medium* DC.	Eucodon Fedorov	*Trachelium Jav., Rapunculoides Schur*	*trachelium* L., Sp. Pl. 166 (1753), ssp. *trachelium*	34	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
				latifolia L., Sp. Pl. 165 (1753)	34	Hp				✓		✓				✓	✓	✓	✓
				bononiensis L., Sp. Pl. 165 (1753)	34	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				rapunculoides L., Sp. Pl. 165 (1753), ssp. *rapunculoides*	68, 102	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
			(Asyneuma)	*trichocalycina* Ten., Cat. Pl. Hort. Neapol. App. 1: 35 (1815)	32	Hp													
			Pyramidalis (agg. Gestol 1984)	*pyramidalis* L., Sp. Pl. 164 (1753)	34	Hp(b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			Waldsteiniana (agg. Gestol 1984)	*tommasiniana* C. Koch in F.W. Schultz, Arch. Fl. Fr. Allem. 229 (1852)	34	Hp	✓	✓					✓			✓	✓	✓	✓
				waldsteiniana Schult. in Roem. et Schult., Syst. Veg. ed. nov. 15(5): 99 (1819)	34	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Tab. 2. – continued

Subgeneric delimitations			Lovašen-Eberhardt (2000)				*Campanula* – references by older authors									HERBARIA		
Section (Fedorov and Kovanda 1976)	Section (Fedorov 1957)	Subsection (Fedorov 1957)	syn. Subsection, Series, Group, Aggregate	*Campanula* species and subspecies	2n	life form	Visiani 1847 /1872/	Neilreich 1868 /1869/	Schloss.-Vuk. 1869	Hirc 1908 /1912/	Rossi 1924	Javorka 1925	Rossi 1930	Hayek 1931	Degen 1938	Domac 1950 /1994/	ZA	WU	member of Croatian flora (Kovačić)
Campanula Medium D.C.	*Heterophylla* Fedorov		Subsect. Isophylla Dambolt (series Garganicae Trinajstić)	*portenschlagiana* Schult. in Roem. et Schult., Syst. Veg. 5: 93 (1819)	34	Hp	✓		✓	✓				✓		✓	✓	✓	✓
				poscharskyana Deg., Magyar Bot. Lapok 7: 103 (1908)	34	Hp								✓			✓	✓	✓
				fenestrellata Feer, J. Bot. 28: 272 (1890)	34	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				– (ssp.) *istriaca* Feer, Jour. Bot. 28: 271 (1890)	34	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			Alpicolae (Kovanda 1970b)	*cespitosa* Scop., Fl. Carniol. ed. 2(1): 143 (1771)	34	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				cochleariifolia Lam., Encycl. Meth. Bot. 1: 578 (1785)	34	Hp	✓	✓	?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			Lanceolatae (Kovanda 1970b)	*serrata* (Kit.) Hendrych Taxon 11: 123 (1962)	34	Hp						?		✓		✓			
				witasekiana Vierh., Mitt. Naturwiss. Vereins Univ. Wien. 2(4): 72 (1906)	34	Hp				✓	✓	✓			✓	✓	✓	✓	✓
			Scheuchzer-ianae (Kovanda 1977)	*scheuchzeri* Vill., Prosp. Hist. Pl. Dauph. 22 (1779)	68 (102)	Hp	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓

Tab. 2. – continued

Subgeneric delimitations		Lovašen-Eberhardt (2000)			*Campanula* – references by older authors									HERBARIA		member of Croatian flora (Kovačić)
Section (Fedorov and Kovanda 1976)	Section (Fedorov 1957)	Subsection (Fedorov 1957)	syn. Subsection, Series, Group, Aggregate	*Campanula* species and subspecies	2n	life form	Visiani 1847 /1872/	Neilreich 1868 /1869/	Schloss.-Vuk. 1869	Hirc 1908 /1912/	Rossi 1924	Javorka 1925	Rossi 1930	Hayek 1931	Degen 1938	Domac 1950 /1994/	ZA	WU	
Campanula	*Medium* DC.	*Heterophylla* Fedorov	Saxicolae (Kovanda 1970b)	*carnica* Schiede ex Merth. et Koch in Röhling, Deutschl. Fl. ed. 3(2): 158 (1826), ssp. *carnica*	34	Hp	✓			✓		✓	✓	✓		✓	✓			✓
				justiniana Witasek Magyar Bot. Lapok 5: 245 (1906)	34	Hp				✓		✓	✓	✓			✓	✓	✓	✓
				?*hercegovina* Degen et Fiala, Österr. Bot. Zeitsch. 44: 303 (1894)	34	Hp								✓				✓	✓	✓
				marchesettii Witasek Abh. Zool.-Bot. Ges. Wien 1(3): 32 (1902)	(34) 68	Hp						✓	✓				✓	✓	✓	✓
				velebitica Borbas Math. Termesz. Ertesitö 1: 81 (1883)	(34) 68	Hp				✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
				morawica (Spitzn.) Kovanda, Folia Geobot. Phytotax. (Praha) 3: 409 (1968), ssp. *morawica*	68	Hp														
				– ssp. *xylorrhiza* (O. Schwartz) Kovanda, Folia Geobot. Phytotax. (Praha) 3: 409 (1968)	102	Hp														
			Vulgares (Kovanda 1977)	*rotundifolia* L., Sp. Pl. 163 (1753)	34, 68 (102)	Hp	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Considering the data in table 2, it is obvious that several *Campanula* species are indeed highly dubious for Croatian flora. *Campanula ramosissima* Sibth. et Sm. is an annual species distributed in the southern Balkans and northern Italy (where it might be introduced, acc. to PIGNATTI 1982). This species was originally referred to by all authors for the Kotor region, which today is part of Montenegro. Several ambiguous herbaria samples localized to »Dalmatien« (ZA) or »the border of Dalmatia and Montenegro« (WU) are not enough to keep this taxon as a member of the Croatian flora, while no data on recent Croatian localities exist. *Campanula medium* (native to central Italy and southern France) is regarded as cultivated in Croatia, like *C. barbata* in the past. As HIRC (1908) removed *C. barbata* from the Croatian Flora, I recommend that *C. medium* be removed too. This biennial is not often cultivated in Croatia and hardly ever escapes from gardens. The tall *C. thyrsoides* L. subsp. *carniolica* (Sünd.) Podlech is, at best, very rare in Croatia (only one dubious sample in WU), while the typical subspecies seems completely to prevail in Croatia. Sessile-flowered *C. moesiaca* Velen. and *C. foliosa* Ten. are taxa of the central Balkans and the central and southern Apennines, but are highly dubious for Croatia. At least two subspecies of the poorly investigated *C. glomerata* L. complex (subsp. *hispida* (Witasek) Hayek and subsp. *serotina* (Wettst.) O. Schwarz) could be excluded from the Croatian checklist until further notice, as well as *C. trichocalycina* Ten. This species of uncertain origin and taxonomic position, between *Campanula*, *Asyneuma* and *Phyteuma* (LAKUŠIĆ and CONTI 2004) requires further investigation for a possible Croatian occurrence. *Campanula serrata*, centred in the Carpathians, is unknown in recent Croatian phytocenological relevés, although often referred to by older botanists for the whole region. Actually, the entire subsection *Heterophylla* needs fundamental research in the west Balkans. *Campanula rotundifolia* L. is, according to KOVANDA (1970a), in its typical form absent from Southeast Europe. However, large amounts of Croatian material in all the investigated herbaria are (mis)labelled as *C. rotundifolia*. There is a strong possibility that some recently evolved heterophyllous incipient taxa are the local equivalents of *C. rotundifolia* in the Croatian flora, i.e.? *C. moravica* (Spitzner) Kovanda with its subspecies. Heterophyllous campanulas of all groups are poorly investigated in Croatia, so it might be better for the *C. rotundifolia* aggregate to be retained in the Croatian flora pending further research.

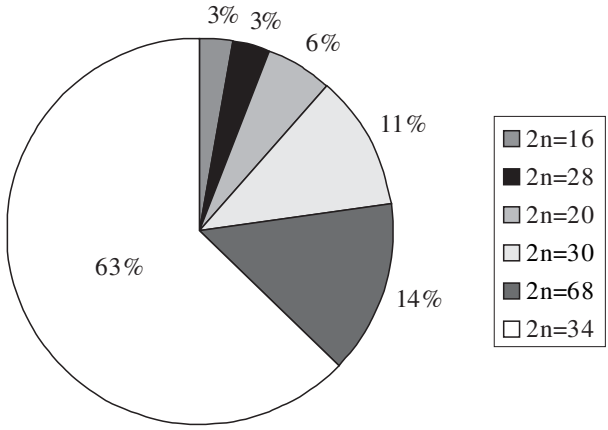

Fig. 3. Chromosome numbers (2n) of 35 Croatian *Campanula* species and subspecies.

After the expulsion of the aforementioned taxa from the recent checklist (LOVAŠEN-EBERHARDT 2000), the Croatian flora comprises 35 *Campanula* species and subspecies (42% of the regional campanulas). The prevailing diploid number is 2n = 34 (63%, in Fig. 3), while some uninvestigated taxa in Croatia could be represented by polyploid populations. Hemicryptophytes are dominant at 97% (Fig. 4).

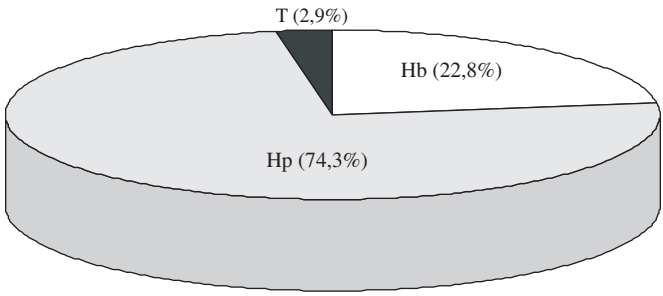

Fig. 4. Spectrum of the life forms among 35 Croatian *Campanula* species and subspecies: Hp = Hemichryptophyta-perennial, Hb = Hemichryptophyta-biennial, T = Therophyta (annual).

More than 30% of Croatian native campanulas are endemic. Only 3 species (Montenegrin *C. ramosissima* excluded) belong to the Section *Rapunculus* (sensu Dumort.): the polymorphous and broadly distributed *C. rapunculus* L., *C. patula* L. and *C. persicifolia* L.. The Croatian checklist indicates that these taxa are present only in their typical forms, which is highly unlikely: they are actually insufficiently investigated complexes of large distribution, with many included incipient taxa.. About 90% of Croatian campanulas are members of the *Campanula* Section (=*Medium* DC.), assembled in several more or less natural groups. There are only 3 (with the now excluded *C. trichocalycina* and *C. medium*) rather isolated taxa without closer relatives in the Croatian flora: *C. sibirica* L., *C. lingulata* Waldst. et Kit. (probably not closely related, though placed together in *Triloculares* by Boissier 1875) and *C. erinus* L. (part of the circum-Mediterranean subgenus *Roucela* (Dumort.) Damboldt). The subsection *Involucratae* (Fomin) Fedorov include sessile-flowered campanulas with thyrsiform (*C. thyrsoides*), spicate (*C. spicata*) and capitate (*C. cervicaria* L., *C. glomerata*, excluded *C. moesiaca* and *C. foliosa*) inflorescences. Also rather sessile-flowered are members of the subsection *Eucodon* Fedorov, as well as of the aggregate *Pyramidalis* (sensu GESLOT 1984). »Eucodons« are broadly distributed in European forests (*C. trachelium* L. and its relative *C. latifolia* L. of the higher altitudes) and open habitats (*C. rapunculoides* L. and its xerotherm relative *C. bononiensis* L.). *Pyramidalis*-taxa are of much narrower, south-European distribution, in Croatia represented only by the Illyrian-Adriatic/Balkan endemic *C. pyramidalis* L.. Together with its closest relatives, the southern Balkan/southern Italian *C. versicolor* Andrews and the Serbian subendemic *C. secundiflora* Visiani et Pančić, *C. pyramidalis* forms a unique group of »isophylloid« campanulas of Balkan origin. The *Pyramidalis* aggregate demonstrates the phytogeographic relations of the eastern Adriatic and west Balkan campanulas to southeast and central European floras. DAMBOLDT (1965a) excluded *Pyramidalis*-relatives from his *isophyllous* group of taxa (henceforth referred to as »subsection *Isophylla*« sensu Dam-

boldt), based on morphological differences. Then again, these two lineages must be related, taking into consideration crossing-experiments by MUSCH and GADELLA (1972), and some of the recent isoenzyme and molecular results (KOVAČIĆ et al. 2003, 2004). Close to this group stands the small, relict and subendemic aggregate *Waldsteiniana* (GESLOT 1984), whose relationships to all other campanulas remains rather controversial (FIORI 1927, HAYEK 1931, GADELLA 1964, DAMBOLDT 1965b). *Waldsteiniana* consists of two »isophylloid« Dinaric (Adriatic) Alps subendemic diploids: the Mt Velebit *C. waldsteiniana* Schult., and the Mt Učka *C. tommasiniana* C. Koch. These two species share certain morphological characteristics with both isophyllous and heterophyllous campanulas, but are well distinguished (DAMBOLDT 1965b). Waldstein's and Tommasini's campanulas do not hybridise with any other isophyllous or heterophyllous taxa, although the data on such hybrids are extensive in horticultural literature (cp. CROOK 1951, LEWIS and LYNCH 1998). There is a possibility, which requires a further research, that some isolated northeast Italian subendemics could be the closest relatives to this group (DAMBOLDT 1965b), i.e. *C. morettiana* and *C. raineri* Perpenti.

»Starbells« of the endemic subsection *Isophylla* are the most recognizable and most frequently cultivated campanulas of the western Balkan and circum-Adriatic region (CROOK 1951, LEWIS and LYNCH 1998, BERNINI et al. 2002). After the classical research of DAMBOLDT (1965a), the *Isophylla* are considered to be a natural group (this, however, was never proved via modern methods, nor critically tested after 1968), and consists of about 12 mutually isolated taxa, mainly distributed in the sub-Mediterranean area of the Adriatic, Ionian and Tyrrhenian coastal mountains. Cytological investigations (MERXMÜLLER and DAMBOLDT 1962, PODLECH and DAMBOLDT 1964) clearly distinguished two groups according to their diploid chromosome numbers: 32 or 34. According to TRINAJSTIĆ (in LOVAŠEN-EBERHARDT and TRINAJSTIĆ 1978), there are three groups (»series«) of isophyllous taxa, consistent with their distribution and morphology. The group *Fragiles* (2n = 32) includes the Tyrrhenian taxa *C. fragilis* and *C. isophylla*. The north Italian *C. elatines* and *C. elatinoides* are placed in the group *Elatines* (2n = 34). The Adriatic group *Garganicae* (2n = 34) includes Italian *C. garganica* Tenore (with two Greek subspecies and possibly the recently-discovered *C. reatina* Lucchese 1993), and the east Adriatic subendemics *C. portenschlagiana* Schultes, *C. poscharskyana* Degen and *C. fenestrellata* (with its subspecies'). These relicts and Tertiary schizoendemics are, according to DAMBOLDT (1965a), placed as a parallel lineage to the large and far more widely spread Subsection *Heterophylla* (Witasek) Fedorov and its group *Rotundifolia*.

KOVANDA (1970a, b, 1977) described five heterophyllous groups (»series«) gathered around the extremely polymorphous *C. rotundifolia* (group *Rotundifolia*), described as »too intricate to be solved« by BÖCHER (1963) and a »huge polyploid structure« by KOVANDA and ANČEV (1989). Such a collective taxon is, by Kovanda's opinion, in its typical form of »true« *C. rotundifolia* of the group *Vulgares* with its several closest relatives, of northern distribution. Kovanda assumed that in the mountains of the central Europe, western Balkan and circum-Adriatic region a number of neoendemic taxa of the groups *Saxicolae*, *Lanceolatae*, *Alpicolae* and *Scheuchzerianae* (Tab. 2) are developing, slowly replacing the typical *C. rotundifolia* of the North. Heterophyllous taxa (»harebells«) have so far received little attention in the region, although some must have been isolated for a long time and are undoubtedly determinable (e.g. the relict *C. hercegovina* or *C. cespitosa* Scop.). Yet, there are many members of this group that are so difficult to precisely recog-

nize (BUZAS 1998) and are today disregarded and included in the range of the well-differentiated collective species (although in typical form quite divergent, e.g. the incipient taxa of the polymorphous *C. velebitica* Borbas complex: *C. balcanica* Hruby, *C. farinulenta* A. Kern. et Wettst., *C. bulgarica* Witasek etc.). Unlike the well isolated »garganicas«, different »rotundifolias« in Croatia often share wild habitats (e.g. *C. scheuchzeri* Vill., *C. marchesettii* Witasek, *C. velebitica* s.l. and *C. witasekiana* Vierh.), and probably hybridise (KOVANDA 1999). Also, unlike *Garganicae*, western Balkan *Rotundifolia* have no known localities in the eastern Adriatic islands: they are exclusive members of the mainland mountainous communities of karstic meadows, pastures, rock fissures and crevices.

Though several *Campanula* taxa should be excluded from the recent Croatian Flora until further research is done, it is also highly possible that some taxa are yet unrecognized, have been disregarded, or included in other genera. Despite the isolated relicts, it seems that the large part of this perplexing collective genus is still evolving in this part of Europe, producing a number of local incipient species that are practically impossible to trace. Maybe the best way to deal with taxonomy of the young, still developing taxa is to assemble collective species of the closest relatives, while taxonomic expediency is more important than the recognition of dubious taxa. On the other hand, even populations that are recognisable only at the molecular level may be of value when it comes to conservation (EDDIE and INGROUILLE 1999). Many more biogeographical, morphological and molecular investigations – in both Croatia / Southeast Europe and globally – are needed, to increase our knowledge on the *Campanula* genus and its relatives' taxonomy and evolution.

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