Cytological investigations on Bulgarian phanerogams

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Source: Willdenowia, 36(1) : 205-216

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.36.36117

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Abstract

Baltisberger, M.: Cytological investigations on Bulgarian phanerogams. – Willdenowia 36 (Special Issue): 205-216. – ISSN 0511-9618; © 2006 BGBM Berlin-Dahlem.
doi:10.3372/wi.36.36117 (available via http://dx.doi.org/)

Chromosome numbers are given for 35 species of angiosperms from Bulgaria, nine of which are the first reports on Bulgarian material; for *Geum bulgaricum* a new ploidy level is reported. The karyotypes are presented for several species of mainly *Achillea* and *Ranunculus.* Taxonomic and phytogeographical aspects are discussed.

Key words: flowering plants, chromosome numbers, karyotype, chromosome morphology, ploidy level.

Introduction

The Organization for the Phyto-Taxonomic Investigation of the Mediterranean Area (OPTIMA) usually holds every three years a meeting in a country of the region of the Mediterranean Sea. In 1993 the OPTIMA Meeting was organized in Borovec, Bulgaria. During the meeting and especially on the post-congress excursion living plants or seeds of interesting species were sampled. The results of the cytological investigations on these plants are presented here.

Werner Greuter, the founder of OPTIMA, also joined the meeting in Borovec. To him I dedicate this paper on the occasion of his retirement.

Material and methods

Root tips were pretreated with colchicine (0.05 %) for 0.5-2 hours, then fixed in ethanol/acetic acid (3 : 1) and stained and squashed in lacto-propionic orcein (Dyer 1963). 5-10 metaphases were counted for each individual to determine the chromosome number, and, where possible, several individuals were investigated of each species and site. Karyotypes are described using the terminology for chromosome morphology proposed by Levan & al. (1964).

The taxa are arranged in alphabetical order by families, genera and species. The nomenclature follows "Flora Europaea" (Tutin & al. 1968-80, 1993) unless otherwise stated.

The cited vouchers (with the collecting number of the author) are deposited in the united herbarium of the University Zürich (Z) and the ETH Zürich (ZT); duplicates of some *Achillea* specimens are deposited in M.

Literature concerning chromosome numbers was checked using the indexes by Fedorov (1969), Van Loon (1987), Moore (1973-77), Goldblatt (1981-88) and Goldblatt & Johnson (1990-2003).

Results

Asteraceae

Achillea ageratifolia (Sm.) Boiss. – $2n = 2x = 18$

W of Dobrostan, SSE of Asenovgrad, N of Hotel Martziganitza, 1500 m, rocks and rocky places, 27.7.1993, *12762, 12896*.

Achillea ageratifolia is a variable species confined to the Balkan Peninsula. Three subspecies are recognized (Franzen 1986). The plants investigated here belong to subsp. *ageratifolia,* which is widely distributed throughout the range of the species and grows mainly at high altitudes. The counts corroborate previous reports in the literature (including Kuzmanov & Nikolova 1980 on Bulgarian plants). The karyotype consists of 14 metacentric and 4 submeta- to subtelocentric chromosomes, the latter with satellites (Fig. 1A). The same karyotype was found in subsp. *aizoon* (Griseb.) Heimerl (Baltisberger 1994a).

The same haploid karyotype with the basic chromosome number of 9 seems to occur in all taxa of *Achillea* (Baltisberger 2002, and see below).

Achillea chrysocoma Friv. – $2n = 6x = 54$

Pirin Mts, N of Popovi livadi, NW of Goce Delcev, S slope of Oreljak, 1900-2000 m, rocky meadow, 29.7.1993, *12778*.

Achillea chrysocoma is a mountain species of Albania, FYR Makedonija, Greece and Bulgaria. Two cytotypes are known, a hexaploid ($2n = 6x = 54$, Baltisberger 1992, plants from FYR Makedonija) and an octoploid ($2n = 8x = 72$; Baltisberger & Baltisberger 1995, Baltisberger 2002, both on plants from Albania). Bulgarian plants are investigated for the first time.

Achillea clusiana Tausch (confirm. W. Lippert, München) – $2n = 2x = 18$

Rila Mts, meadow NE of Musala, 2850 m, 25.7.1993, *12741, 12973;* Rila Mts, NNE of Musala, meadow on the path from Jastrebetz to the Musala lakes, 2380 m, 25.7.1993, *12750* (M), *13179*.

Achillea clusiana grows in meadows and screes on the mountains in the E Alps and southwards to Albania, N Greece and Bulgaria as well as on Ulu Dağ in Turkey. The separation of plants from Ulu Dağ and the Balkan Peninsula as *A. multifida* DC. is not generally accepted. The counts corroborate previous records in the literature (including Kuzmanov & Kozuharov 1970 on Bulgarian plants). The karyotype (Fig. 1B) is as described for *A. ageratifolia*, above.

Achillea clypeolata Sm. – $2n = 2x = 18$

W of Dobrostan, SSE of Asenovgrad, N of Hotel Martziganitza, 1300-1500 m, rocky meadow, 27.7.1993, *12758, 12884;* S of Devin, rocky slope near Trigrad, 1100-1300 m, 28.7.1993, *12764, 12898;* Pirin Mts, W of Goce Delcev, rocky slope above Popovi livadi, 1550-1650 m, 29.7.1993, *12773, 12975*.

Achillea clypeolata grows in dry, rocky meadows mainly in the lowlands of the Balkan Peninsula northwards to S Hungary and Romania. The counts corroborate previous reports (including Kuzmanov & Kozuharov 1970 and Nedelcheva 1995 on Bulgarian plants). The karyotype (Fig. 1C) is as described for *A. ageratifolia,* above, and as given by Nedelcheva (1995).

Achillea coarctata Poir. – $2n = 2x = 18$

Pirin Mts, W of Goce Delcev, roadside near Popovi livadi, 1500 m, 29.7.1993, *12771, 12926*.

Achillea coarctata is closely related to and has a similar geographical distribution and ecology as *A. clypeolata*. Two cytotypes are reported in the literature for *A. coarctata,* a diploid with $2n = 18$ and a tetraploid with $2n = 36$, and both ploidy levels are indicated for Bulgaria (Nedelcheva 1995 and presents counts, diploid; Kuzmanov & Kozuharov 1970, tetraploid).

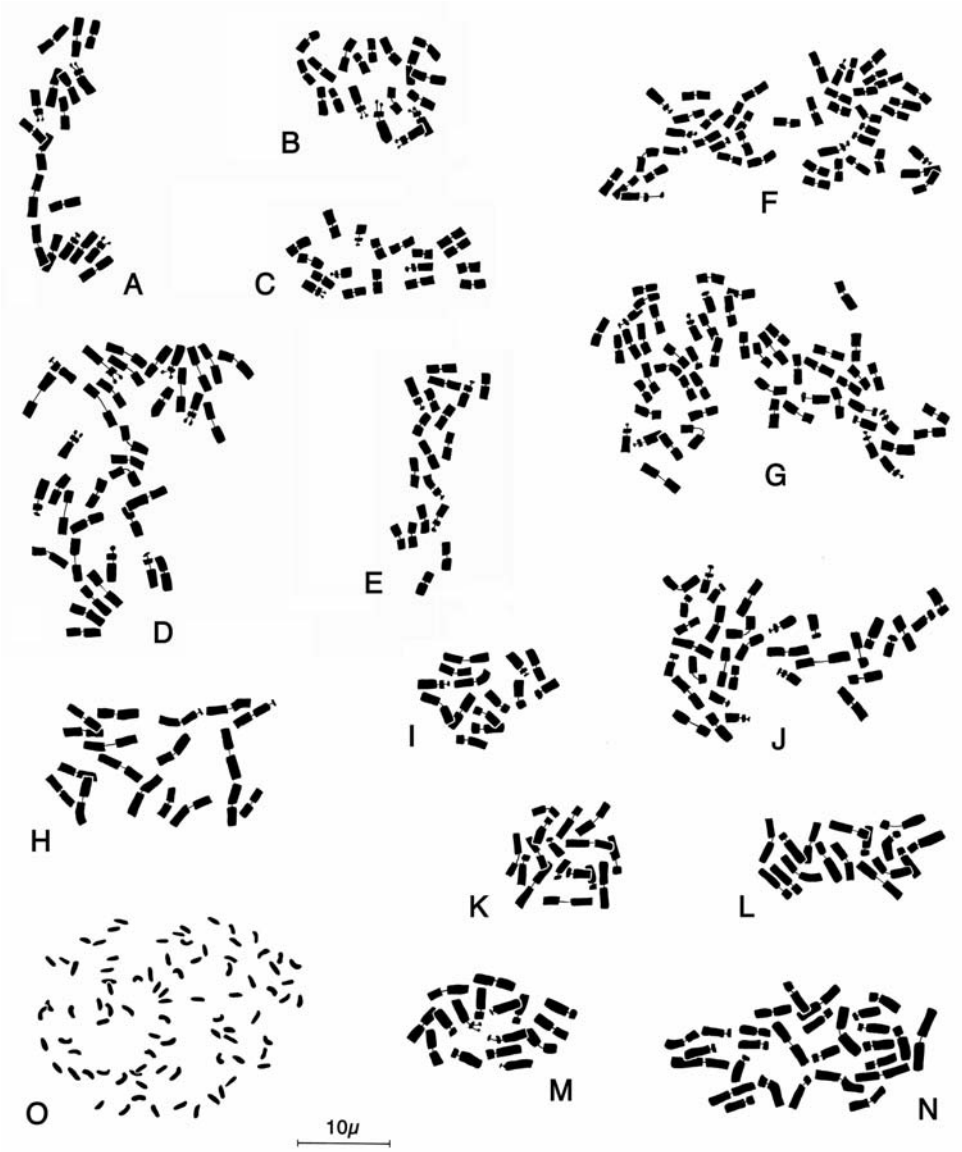

Fig. 1. Somatic metaphases – A: *Achillea ageratifolia* (2*n* = 18); B: *A. clusiana* (*12750,* 2*n* = 18); C: *A. clypeolata* (*12773,* 2*n* = 18); D: *A. collina* (*12738,* 2*n* = 36); E: *A. crithmifolia* (*12775,* 2*n* = 18); F: *A. millefolium 12777* (2*n* = 45); G: *A. millefolium 12774* (2*n* = 54); H: *Tanacetum macrophyllum* (2*n* = 18). I: *Ranunculus acris* (*12731,* 2*n* = 14); J: *R. auricomus* s.l. (2*n* = 32); K: *R. crenatus* (2*n* = 16); L: *R. montanus* s.l. (2*n* = 16); M: *R. polyanthemoides* (2n = 16); N: *R. serbicus* (2*n* = 28); O: *Geum bulgaricum* (2*n* = 84).

Achillea collina Rchb. (det. W. Lippert, München) – 2*n* = 4x = 36
Borovec, meadow near Hotel Rila, 1300 m, 20.7.1993, *12738, 13118;* SSW of Batak, meadow SW of Orlovetz, 1500 m, 26.7.1993, *12752* (M), *12972;* W of Dobrostan, SSE of Asenovgrad, N of Hotel Martziganitza, 1300-1500 m, rocky meadow, *27.7.1993, 12756, 13266;* S of Devin, roadside near Trigrad, 1150 m, 28.7.1993, *12768* (M), *13182*.

Achillea collina is a species of the *A. millefolium* group (see below) in SE Europe, growing in forest openings, disturbed places and on roadsides. It is allotetraploid and probably originates from hybridisation between *A. asplenifolia* Vent. and *A. setacea* Waldst. & Kit. (Ehrendorfer 1959). The counts confirm previous reports (including Kuzmanov & Kozuharov 1970 on Bulgarian plants). The haploid karyotype (Fig. 1D) is as described above for *A. ageratifolia.*

Achillea crithmifolia Waldst. & Kit. (confirm. W. Lippert, München) – $2n = 2x = 18$, $2n = 4x = 36$
Clearing in forest S above Borovec, 1700 m, 20.7.1993, *12732* ($2n = 36$); W of Dobrostan, SSE of Asenovgrad, N of Hotel Martziganitza, 1300-1500 m, rocky meadow, 27.7.1993, *12755, 12971* ($2n = 18$); Pirin Mts, N of Popovi livadi, NW of Goce Delcev, S slope of Oreljak, 1800 m, rocky meadow, 29.7.1993, *12775, 12976* ($2n = 18$).

Achillea crithmifolia occurs from S Slovakia southwards to Greece and European Turkey. It grows in meadows and scrubs, mostly in the mountains. Diploid and tetraploid chromosome numbers are reported in the literature also for Bulgarian plants (Kuzmanov & al. 1989, Van Loon & Van Setten 1982). In the present study the plants from Dobrostan and Oreljak are diploid, the plants from Borovec tetraploid. The haploid karyotype (Fig. 1E) is as described above for *A. ageratifolia*.

Achillea millefolium L. s.l. (det. W. Lippert, München) – $2n = 5x = 45$, $2n = 6x = 54$
Pirin Mts, N of Popovi livadi, NW of Goce Delcev, S slope of Oreljak, 1800 m, rocky meadow, 29.7.1993, *12774, 13507* (M) ($2n = 54$); ibid., 1900-2000 m, rocky meadow, 29.7.1993, *12777* (M), *13184* ($2n = 45, 54$).

Achillea millefolium s.l. is a very difficult polyploid complex occurring in Europe, W Asia and North America. The Central European taxa are rather well understood, otherwise the knowledge of the complex is incomplete. Introgression and hybridization seem to be frequent, making identification difficult, uncertain or even impossible. The two populations from Oreljak are rather similar. They combine characters of different taxa and are therefore identified as *A. millefolium* s.l. (W. Lippert, München, in litt. 2005). The six plants from the first site were all hexaploid (Fig. 1G). One plant from the second site also showed $2n = 54$, but six plants proved to have $2n = 45$ (Fig. 1F). Both ploidy levels are already known (Dabrowska 1982). The haploid karyotype is as described for *A. ageratifolia* above. Not all satellites are always visible, which is also the case in other *Achillea* species with high ploidy levels: hexaploid (Baltisberger 1992) and octoploid *A. chrysocoma* (Baltisberger & Baltisberger 1995, Baltisberger 2002); hexaploid *A. distans* Waldst. & Kit. and a decaploid *A.* cf. *clusiana* (Baltisberger 1992). Perhaps the numerous rather small satellites are easily overlooked between the high number of chromosomes.

Aster alpinus L. – $2n = 2x = 18$
Pirin Mts, N of Popovi livadi, NW of Goce Delcev, S slope of Oreljak, 1900-2000 m, rocky meadow, 29.7.1993, *12779, 12928*.

Aster alpinus is a variable species or a complex of species and grows mostly in the mountains of Europe, Asia and North America. Both diploid and tetraploid cytotypes are indicated in the numerous counts published. The investigated plants are diploid confirming previous reports on plants from Bulgaria by Andreev (1981) and Kuzmanov & al. (1986).

Gnaphalium supinum L. (≡ *Omalotheca supina* (L.) DC.) – $2n = 28$
Rila Mts, meadow NE of Musala, 2850 m, 25.7.1993, *12742, 12979;* Rila Mts, NNE of Musala, meadow on the path from Jastrebetz to the Musala lakes, 2380 m, 25.7.1993, *12749, 12993*.

Gnaphalium supinum is calcifuge and grows in snow-patches and wet open habitats in the mountains of Europe, Asia and North America. Plants from the southernmost part of the range are white-lanate and have often only one capitulum (Holub in Tutin & al 1976; for generic taxonomy see Greuter 2003). This is also true for the plants from Bulgaria growing in the natural habitat but cultivated in the greenhouse they are taller and have several capitula. The counts correspond with the data given in the literature (including Kuzmanov & al. 1986 on Bulgarian plants).

Senecio carpathicus Herbich – 2*n* = 40
Rila Mts, NNE of Musala, meadow on the path from Jastrebetz to the Musala lakes, 2380 m, 25.7.1993, *12748*.

Senecio carpathicus belongs to the group or is probably a subspecies of *S. abrotanifolius* L. and grows on mountain slopes in the Carpathians and on the Balkan Peninsula. The first report from Bulgarian plants given here corresponds with the reports on plants from Slovakia (Vachova 1978), from Greece (Strid & Franzen 1983a), from Albania and former Yugoslavia (Baltisberger 1992), as well as with the chromosome number of *S. abrotanifolius*.

Tanacetum macrophyllum (Waldst. & Kit.) Sch. Bip. – 2*n* = 2x = 18
Forest near Borovec, 1300 m, 20.7.1993, *12737*.

Tanacetum macrophyllum grows in mountain woods from the Carpathians southwards to FYR Makedonija and Bulgaria. In the literature 2*n* = 14 (Kuzmanov & al. 1981, plants from Bulgaria), 2*n* = 18 (Dowrick 1952 and Reese 1953, plants from unknown provenience; Mesicek 1992, plants from Czechoslovakia) and 2*n* = 36 (Sz.-Borsos 1970, plants from former Yugoslavia) are reported. The counts on Bulgarian plants revealed 18 chromosomes; the basic chromosome number of 9 seems to be common in *Tanacetum* and related genera. The number found is in contrast to the above quoted only count given for Bulgarian plants before. The karyotype (Fig. 1H) is rather homogenous with 18 metacentric chromosomes (2 of them somewhat smaller than the others, 2 others with satellites)

Caryophyllaceae
Silene vulgaris (Moench) Garcke – 2*n* = 2x = 24
S of Devin, roadside near Trigrad, 1150 m, 28.7.1993, *12900*.

Silene vulgaris belongs to *S.* sect. *Behen* Dumort., characterized by an inflated calyx at anthesis. *S. vulgaris* s.l. is a critical complex of taxa treated on various taxonomic levels. It occurs in Europe, extratropical Asia, N Africa and the Atlantic islands, and is naturalized in the Americas, S Africa and Australia (Greuter 1997). All taxa of this complex have a basic chromosome number of 12, and most of the taxa are diploid (Baltisberger & Aeschimann 1988) as also indicated by Kozuharov & Petrova (1974) and Van Loon & Van Setten (1982) as well as in the single plant from Bulgaria investigated here.

Dipsacaceae
Scabiosa rhodopensis Stoj. & Stefanov – 2*n* = 2x = 18
W of Dobrostan, SSE of Asenovgrad, N of Hotel Martziganitza, 1500 m, rocks and rocky slope, 27.7.1993, *12763, 12989*.

Scabiosa rhodopensis grows in N Greece and S Bulgaria. With its linear leaves it is closely related to *S. graminifolia* L., which has a wider distribution in S Europe. The count of 2*n* = 18 agrees with the few reports in the literature (Frey 1970, plants from Bulgaria; Verlaque 1977, plants from N Greece). For *S. graminifolia* the same number is known.

Lamiaceae
Marrubium friwaldskyanum Boiss. – 2*n* = 34
W of Dobrostan, SSE of Asenovgrad, N of Hotel Martziganitza, 1300-1500 m, rocky meadow, 27.7.1993, *12757, 12886;* S of Devin, rocky slope near Trigrad, 1100-1300 m, 28.7.1993, *12765*.

Marrubium friwaldskyanum is endemic to Bulgaria and rather similar to *M. velutinum* Sm. from Greece (Peloponnisos to N Pindhos). So far no chromosome number has been reported for *M. friwaldskyanum*. The chromosome number of *M. velutinum* is 2*n* = 34 (Markova & Ivanova 1971, Baltisberger 1991a, 1994a, 1999, Franzen 1991), as is the number revealed here for *M. friwaldskyanum*. The report by Markova & Ivanova (1971) is probably referable to *M. friwaldskyanum* as the plants investigated originate from Bulgaria.

Sideritis scardica Griseb. – 2*n* = 32
S of Devin, rocky slope near Trigrad, 1100-1300 m, 28.7.1993, *12766, 12899*.

Sideritis (sect. *Empedoclia* (Rafin.) Benth.) *scardica* is a rather variable species growing in the mountains of the central Balkan Peninsula (Papanikolaou & Kokkini 1982). The taxa of this section are widely used for "mountain tea" (Baden 1991a). The counts of the plants from Bulgaria revealed $2n = 32$ and corroborate previous reports on plants from Bulgaria (Kozuharov & Kuzmanov 1965) and Greece (Contandriopoulos 1978, Strid & Franzen 1983b, Baltisberger 1994a). Section *Empedoclia* is taxonomically difficult but all taxa have $2n = 32$.

Stachys alpina L. – $2n = 30$
Forest S above Borovec, 1600 m, 20.7.1993, *12733;* Pirin Mts, N of Popovi livadi, NW of Goce Delcev, S slope of Oreljak, 1900-2000 m, rocky meadow, 29.7.1993, *12776, 13183*.

Stachys alpina is widespread in the mountains of Central and S Europe. It belongs to the group of *S. germanica* (see below), which comprises about 10 species in Europe and is part of *S.* sect. *Eriostomum* (Hoffmanns. & Link) Dumort. (Ball in Tutin & al.1972). Most taxa are taxonomically difficult but *S. alpina* is well defined by its glandular hairs on the stems. All species in *S.* sect. *Eriostomum* have $2n = 30$ (including Andreev 1981 on *S. alpina* from Bulgaria).

Stachys atherocalyx K. Koch – $2n = 34$
W of Dobrostan, SSE of Asenovgrad, slope N of Hotel Martziganitza, 1500 m, rocks and rocky meadow, 27.7.1993, *12761, 12895*.

Stachys atherocalyx belongs (like *S. baldaccii* and *S. beckeana*, see below) to the taxonomically difficult group of *S. recta* L., which comprises about 15 species (Bhattacharjee 1980, Lenherr 1983). Representatives occur in Central and S Europe, with the centre of diversity in the Balkan Peninsula. *S. atherocalyx* is widespread in the Balkans and also occurs in Turkey (Ball in Tutin & al. 1972) and eastwards to the Caucasus region. It is probably conspecific with *S. albanica* Markgr. (endemic on the mountain Mali i Snoit in central Albania), which differs only in the colour of the corolla (Lenherr & Baltisberger 1984). *S. atherocalyx* has $2n = 34$ (Magulaev in Goldblatt 1981, plants from N Caucasus; Guinochet & Lefranc 1981, plants from Azerbaidjan; Baltisberger & Lenherr 1984, plants from Albania), as all taxa of the *S. recta* group. The same number is reported here for the first time from Bulgarian plants.

Stachys baldaccii (Malý) Hand.-Mazz. – $2n = 34$
Pirin Mts, W of Goce Delcev, rocky slope above Popovi livadi, 1550-1650 m, 29.7.1993, *12772, 12925*.

Stachys baldaccii belongs to the group of *S. recta* L. (see *S. atherocalyx* above). It grows in Bosnia-Herzegovina, Montenegro, N Albania (Lenherr 1983) and in Greece (Baden 1991b), and similar plants occur in S Italy (Baltisberger 1990). The plants from Popovi livadi in Bulgaria match with plants from other parts of the Balkans. The counts reported here are the first from Bulgarian plants and confirm previous reports on plants from Albania and former Yugoslavia (Baltisberger & Lenherr 1984; Baltisberger 1991b, 2002).

Stachys beckeana Dörfl. & Hayek – $2n = 34$
SSW of Batak, meadow SW of Orlovetz, 1500 m, 26.7.1993, *12751, 12881;* W of Dobrostan, SSE of Asenovgrad, rocky meadow N of Hotel Martziganitza, 1300-1500 m, 27.7.1993, *12753, 13117*.

Stachys beckeana belongs to the group of *S. recta* L. (see *S. atherocalyx* above) and is known from Bosnia-Herzegovina, Montenegro and N Albania (Lenherr 1983). The plants from Bulgaria, however, apparently also belong to *S. beckeana*. They show the same chromosome number as reported on plants from Albania and former Yugoslavia (Baltisberger & Lenherr 1984, Lenherr & Baltisberger 1984).

Stachys germanica L. s.l. – $2n = 30$
W of Dobrostan, SSE of Asenovgrad, rocky meadow N of Hotel Martziganitza, 1300-1500 m, 27.7.1993, *12754, 12883*.

Stachys germanica has a wide distribution in Central, W and S Europe and was divided into several subspecies (e.g. Bhattacharjee 1974, Baden 1991b), but the delimitations are obscure and many intermediates occur. The plants from Bulgaria show the same chromosome number as was

previously reported from Bulgarian plants (Van Loon & Van Setten 1982) and as all taxa of *S.* sect. *Eriostomum*.

Teucrium chamaedrys L. – 2*n* = 62
S of Devin, rocky slope near Trigrad, 1100-1300 m, 28.7.1993, *12767, 12897*.

Teucrium chamaedrys occurs in Central and S Europe, SW Asia and N Africa. The very variable taxon was divided into several infraspecific taxa, which mostly are not recognized. Many different chromosome numbers have been reported viz. 2*n* = 32, 58, 60, 62, 64, 65, 72, 80, 96. No apparent correlation exists between chromosome number and geographical distribution, and beside 2*n* = 62, the numbers 58, 60, 64, 65 and 96 also occur in Bulgaria (Baltisberger 1995).

Poaceae
Melica ciliata L. – 2*n* = 18
S of Devin, rocky slope near Trigrad, 1100-1300 m, 28.7.1993, *13181*.

Melica ciliata is a Mediterranean species extending to Central and N Europe. It grows in dry and stony, mostly open habitats. The counts on plants from Bulgaria confirm the numerous previous reports (including Kozuharov & Petrova 1973 and Van Loon & Van Setten 1982 on Bulgarian plants).

Ranunculaceae
Ranunculus acris L. – 2*n* = 2x = 14
Meadow S above Borovec, 1750-1800 m, 20.7.1993, *12731;* SSW of Batak, meadow SW of Orlovetz, 1500 m, 26.7.1993, *12882*.

Ranunculus acris is widespread in Europe and introduced as a weed and ruderal into, e.g., North America. It belongs to a group of about half a dozen taxa that are treated as species or sometimes (at least some of them) as subspecies; all have a basic chromosome number of 7, which is uncommon in *Ranunculus* with mostly x = 8. The counts on plants from Bulgaria confirm the numerous previous reports (including Kuzmanov & Kozuharov 1969 and Van Loon & Van Setten 1982 on Bulgarian plants). The karyotype (Fig. 1I) consists of 6 metacentric and 8 submeta- to subtelocentric chromosomes, one pair of the latter bearing satellites. Similar karyotypes are given by Gregson (1965), Goepfert (1974), Marchi & al. (1975), Diosdado & Pastor (1992) and Baltisberger & Baltisberger (1995).

Ranunculus auricomus L. s.l. – 2*n* = 4x = 32
Beglika, SSW of Batak, roadside, 1500 m, 26.7.1993, *13151*.

Ranunculus auricomus is a polyploid complex with a large number of taxa, especially in Scandinavia and Central Europe. The respective taxa show small differences, important characters are, e.g., sequence of leaf shape (mostly of basal leaves). Many taxa reproduce apomictically and have a very restricted distribution area. *R. auricomus* is rare in the Balkan Peninsula and systematically not well investigated.

At the beginning of the growing season the plants from Bulgaria produce undivided and sharply crenate leaves, later in the season the leaves get more and more divided. The flowers show no or only few honey leaves, a character typical for many apomicts of *Ranunculus auricomus* s.l. (e.g. Borchers-Kolb 1985, Brodtbeck1998), which can also be observed in other apomictic groups within *Ranunculus* (Vuille & Küpfer 1985, Huber 1988). Most of the apomictic *R. auricomus* s.l. is tetraploid; only diploids reproduce sexually. The present report is the first from Bulgarian plants.

Within the *Ranunculus auricomus* complex not all taxa (and sometimes even not all populations of a given taxon; see Vuillemin 1990) show exactly the same karyotype. The karyotype of the Bulgarian plants consists of 16 metacentric, 8 submetacentric and 8 subtelocentric chromosomes, 4 of the latter with satellites and being the smallest chromosomes (Fig. 1J). This is rather similar to the karyotypes (but partly on other ploidy levels) given by Goepfert (1974), Vuillemin (1990) and Hörandl & al. (1997).

Ranunculus crenatus Waldst. & Kit. – $2n = 2x = 16$
Rila Mts, summit region of Musala, 2900-2925 m, meadow, 25.7.1993, *12739, 13178*.

The group of *Ranunculus alpestris* L., to which *R. crenatus* belongs, comprises six white-flowered species of the central and southern European mountains (Baltisberger 1994b). *R. crenatus* occurs in the Carpathians, in the mountains of the Balkan Peninsula, and in two isolated sites in the E Alps. It is a calcifuge species growing mostly in the alpine zone. The counts reported here are the first from Bulgarian plants and confirm the previous reports for this species and all taxa of the group (compilation see Baltisberger 1994b). With 4 pairs of metacentric, 2 pairs of submetacentric, and 2 pairs of rather small subtelocentric chromosomes (Fig. 1K) the karyotype agrees with the literature (compilation see Baltisberger 1994b).

Ranunculus montanus Willd. s.l. – $2n = 2x = 16$
SSW of Batak, meadow SW of Orlovetz, 1500 m, 26.7.1993, *13265*.

The *Ranunculus montanus* group comprises about 25 diploid or tetraploid species (Hess & al. 1977) and is taxonomically difficult, especially within the Balkans (Strid 2002). The plants from Bulgaria proved to be diploid with $2n = 16$. The same number and ploidy level was found by numerous authors including Ceschmedjiev (1994) on plants from Bulgaria (Rhodope Mts) but whether these plants belong to the same taxon is unclear. The karyotype consists of 6 metacentric, 6 submetacentric, and 4 subtelocentric chromosomes (Fig. 1L), which corresponds with karyotypes given in the literature for different taxa of the *R. montanus* group (compilation see Baltisberger 1984).

Ranunculus polyanthemoides Boreau – $2n = 2x = 16$
W of Dobrostan, SSE of Asenovgrad, open forest N of Hotel Martziganitza, 1350 m, 27.7.1993, *12760, 12894*.

The group of *Ranunculus polyanthemos* L., to which *R. polyanthemoides* belongs, consists of about eight diploid taxa. *R. polyanthemoides* is probably hybridogenous and occurs in Central, N and in S Europe on the Balkan Peninsula southwards to Albania and N Greece (Baltisberger & Hess 1986). In Bulgaria it seems to be rather rare. The counts reported here are the first for Bulgaria. The same number is found in all taxa of the group. The karyotype consists of 3 pairs of metacentric chromosomes, 4 pairs of subtelocentric chromosomes, 1 pair with satellites, and 1 pair of satellited telocentric chromosomes (Fig. 1M). The same karyotype has been reported previously by Baltisberger (1980, 2002).

Ranunculus repens L. – $2n = 4x = 32$
S above Borovec, 1600 m, wet place in open forest, 20.7.1993, *12734, 12879*.

Ranunculus repens is very frequent and widespread in Eurasia and introduced as a weed and ruderal into, e.g., North America. The very numerous reports in the literature mostly give the tetraploid number $2n = 32$ (including Ceschmedjiev 1994 on plants from Bulgaria) but diploid plants also occur, in Bulgaria, too (Kuzmanov & Kozuharov 1969). The plants investigated from Borovec proved to be tetraploid.

Ranunculus serbicus Vis. – $2n = 4x = 28$
S above Borovec, 1300 m, wet place in open forest, 20.7.1993, *12736, 12880*.

Ranunculus serbicus occurs in S Italy and the Balkan Peninsula. It belongs to the same group as *R. acris* (see above) but is tetraploid, which is confirmed here for the first time on Bulgarian plants. The karyotype consists of 8 large and 4 medium-sized metacentric and 16 subtelocentric chromosomes (Fig. 1N). A similar karyotype has been reported by Goepfert (1974), Marchi & al. (1975) and Baltisberger & Baltisberger (1995). *R. acris* shows the same types of chromosomes (but on the diploid level), confirming the relationship between the two taxa.

Rosaceae
Geum bulgaricum Pančić – $2n = 12x = 84$
Rila Mts, NE of Musala, 2500-2600 m, wet places in rocky meadow, 25.7.1993, *12743, 13267*.

Geum bulgaricum belongs to *G.* subg. *Oreogeum* (Ser.) F. Bolle, which includes *G. montanum* L. and *G. reptans* L., all three taxa growing in the mountains of Central and S Europe. *G. bulgaricum* occurs in the central Balkan Peninsula, from Albania to Bulgaria. The only previous report published (Gajewski 1952, 1957; plants from Bulgaria) gives $2n = 70$. The plants investigated here revealed $2n = 84$ (Fig. 1O). The basic chromosome number within *Geum* is said to be 7 (Kalkman 2004), so $2n = 70$ and 84 indicate a deca- and dodecaploid cytotype, respectively.

Geum urbanum L. – $2n = 42$
W of Dobrostan, SSE of Asenovgrad, meadow N of Hotel Martziganitza, 1450 m, 27.7.1993, *12759, 13180*.

Geum urbanum is frequent and widespread in Eurasia. The numerous reports in the literature mostly give $2n = 42$ (including Ceschmedjiev 1976 and Van Loon & Van Setten 1982 on Bulgarian plants), which is confirmed by the counted Bulgarian plants.

Potentilla haynaldiana Janka – $2n = 14$
Rila Mts, rocky meadow NE of Musala, 2500-2600 m, 25.7.1993, *12744*.

Potentilla haynaldiana occurs in the S Carpathians (Romania) and the mountains of Bulgaria. $2n = 14$ as found in the plants from Bulgaria is a common number within *Potentilla*. The reports in the literature are confusing: Moore (1971, 1973) give Titz (1969), a work dealing with *Arabis,* as reference for *P. haynaldiana,* probably by confusion with Tombal (1969; see below). Fedorov (1969) cites Contandriopoulos (1962), which deals with endemic plants of Corse where *P. haynaldiana* does not occur and therefore is not included. Van Loon (1987) lists Tombal (1966) by error for Tombal (1969), which is the hitherto only report of a chromosome number of *P. haynaldiana.*The counts on plants from Bulgaria reported here confirm this report.

Saxifragaceae
Saxifraga ferdinandi-coburgi Kellerer & Sünd. – $2n = 26$
Pirin Mts, N of Popovi livadi, NW of Goce Delcev, 2000 m, crevices on rocks, Oreljak, 29.7.1993, *12780, 13185*.

Saxifraga ferdinandi-coburgi grows in the mountains of N Greece and Bulgaria. The count of $2n = 26$ confirms earlier reports for Greece (Van Loon 1982) and Bulgaria (Nikolov 1991).

Saxifraga stribrnyi (Velen.) Podp. – $2n = 26$
S of Devin, 1300 m, crevices on calcareous rocks above Trigrad, 28.7.1993, *12770, 12927*.

Saxifraga stribrnyi occurs in the mountains of N Greece and Bulgaria. The counts of $2n = 26$ confirm previous reports (Skovsted 1934, origin of the plants not indicated; Nikolov 1991, plants from Bulgaria).

Acknowledgements

I thank Dr W. Lippert (Munich, Germany) for the identification of some *Achillea* species, and Tino Fotsch who took care of the plants in our greenhouse. I also thank Prof. Dr Georgia Kamari (Patras, Greece) as well as an anonymous reviewer for critical comments on the manuscript.

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