Galium sect. *Leiogalium* (*Rubiaceae*) in the Bulgarian flora

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Abstract. The work contains the results from the investigation of morphological variation, chromosome numbers and ploidy levels, distribution, phytogeographic and phylogenetic relationships of the species of genus *Galium* sect. *Leiogalium*, occuring on the territory of Bulgaria. The section includes 18 species and two non-nominal subspecies. Morphologically, phytogeographically and supposedly phylogenetically related species are divided into five species groups. The species are cross-pollinated entomophilous plants, which reproduce sexually and vegetatively by underground runners.The mesophilous species with white flowers, *G. album, G. intermedium, G. lucidum, G. pashale*, and *G. procurrens,* are pollinated chiefly by flies of *Syrphidae, Muscidae* and *Larvivoridae*. The xerophilous *G. aegeum, G. mirum, G. asparagifolium, G. flavescens, G. rhodopeum* with pale yellowish to greenish corolla are visited mostly by small coleopterans of the genera *Strangalia, Agriotes, Mordelis,* etc. Six species are Balkan endemics: *G. mirum, G. macedonicum, G. rigidifolium, G. rhodopeum, G. aegeum* and *G. procurrens. Galium velenovskyi* is a local endemic, restricted in its occurence to the calcareous slopes of E Rhodopi Mts. The chromosome numbers and the ploidy levels of 18 species and two subspecies studied in 95 populations are reported in the article. Eight species are diploid, nine are tetraploid, and one is hexaploid, all with $x = 11$, the most common and probably original basic chromosome number in the genus. *G.* ×*pomeranicum* (*G. album* × *G. verum*) is polyploid with $2n = 44$.

Key words: Bulgaria, chromosome numbers, endemics, flora, *Galium,* hybridization, *Leiogalium,* phylogenetic relationships, polyploidy, reproductive biology

Introduction

Genus *Galium* in the Bulgarian botanical literature was treated with different taxonomic content. Velenovský (1891, 1898) reported 26 species in his *Flora Bulgarica* and *Supplementum* I to it. Stojanov & Stefanov (1925) included 21 species and six non-nominal subspecies in the first edition of the *Flora of Bulgaria*. That taxonomic structure remained almost unchanged in the following three editions of the *Flora of Bulgaria* (Stojanov & Stefanov 1933, 1948; Stojanov & al. 1967). In the next twenty years, the progress of cytotaxonomic investigations in systematic botany in Bulgaria had influenced the taxonomic studies of *Galium*. This resulted in taxonomic revisions published in a few papers (Ančev 1971, 1975, 1978; Anchev 1982; Ehrendorfer 1975) and subsequently included in *Flora RP Bulgaricae* (Ančev 1989). The accepted taxonomic structure followed *Flora Europaea* (Ehrendorfer & al. 1976), with morphologically well differentiated species and species groups, which included closely related taxa.

Galium is now represented in the Bulgarian flora by 38 species, four nothospecies, two non-nominal subspecies, six varieties, and seven forms. Thirty-one species are perennial plants, and seven are annuals, all classified into six sections: *Platigalium* Koch (3 spp.), *Apari-*

noides (Jord.) Gren. (3 spp.), *Hylaea* (Griseb.) Ehrend. (1 sp.), *Trachygalium* K. Schum. (1 sp.), *Galium* (3 spp.), *Leiogalium* Ledeb. (18 spp.), *Leptogalium* Lange (2 spp.), *Aparine* Lange (6 spp.), and *Pseudovalantia* Lange (1 sp.) (Ančev 1978, 1989). Sect. *Leiogalium,* which comprises some 50 % of all Bulgarian species in it, is the largest and taxonomically most complicated one.

In the present communication on sect. *Leiogalium*, we have summarized the accumulated knowledge on its species diversity in the Bulgarian flora, its distribution and ecology, geographical relations, chromosome numbers and ploidy levels, the polyploidy and its correlation with the root system (taproot or rootstock with underground runners). The role of hybridization and polyploidy is discussed for the variation and speciation in the genus.

Material and methods

The study is based on the herbarium material deposited in B, BP, COI, FI, G, GB, GOET, GZU, JE, LD, LI, LE, LTR, M, PRC, SO, SOA, SOM, W, and WU, as well as on field studies and plants collected in Bulgaria in the years 2006, 2007 and 2008. Distribution of the species and subspecies in Bulgaria is presented by floristic regions (Jordanov 1966). The species groups are informal, used for convenience to show very close morphology and probable phylogenetic relations between the species within the group (Greuter & al. 1986; Greuter 2008). The chromosome numbers were counted by both authors (Appendix 2). Karyotypes analysed by M. Anchev were observed on mitotic metaphase plates, obtained from seedling root tips and flower buds, the latter collected in the field and fixed in Carnoy´s, then stained with acetocarmine immediately before squashing. The root tips were fixed in 45 % acetic acid or ethanol:acetic acid (3:1), underwent hydrolizis, stained with haematoxylin after Gomori (Melander & Wingstrand 1953), and then squashed. The chromosome numbers (2*n*) are listed after the morphological description, and the numbers based on Bulgarian material are asterisked (*). A few dubious numbers are preceded by a question mark. The list of karyologically examined species and the origin of the material are given in Appendix 2. The number of voucher specimens marked with (+) reflect the chromosome number (metaphase I) counted in flower buds. The voucher specimens have been desposited in SOM and W.

Systematic treatment

Conspectus of *Galium* sect. *Leiogalium* species and subspecies in the Bulgarian flora

(with reference to the ploidy levels based on chromosome counts in Bulgarian populations, in square brackets; see also Appendix 2)

Sect. *Leiogalium* Ledeb.

1–2. *G. mollugo* group
- **1.** *G. lovcense* Urum. (incl. *G. protopycnotrichum* Ehrend. & Krendl) [2*x*]
- **2.** *G. album* Mill. [4*x*]
  - subsp. *album*
  - subsp. *pycnotrichum* (Heinr. Braun) Krendl
  - subsp. *prusense* (K. Koch) Ehrend. & Krendl
- **3.** *G. lucidum* All. [4*x*]

4–8. *G. asparagifolium* group
- **4.** *G. mirum* Rech. f. [2*x*]
- **5.** *G. macedonicum* Krendl [2*x*]
- **6.** *G. rigidifolium* Krendl [4*x*]
- **7.** *G. flavescens* Borbás [4*x*]
- **8.** *G. asparagifolium* Boiss. [4*x*]

9–11. *G. rhodopeum* group
- **9.** *G. rhodopeum* Velen. [2*x*, ?4*x*]
- **10.** *G. velenovskyi* Ančev [4*x*]
- **11.** *G. aegeum* (Stoj. & Kitan.) Ančev [4*x*]

12–14. *G. glaucum* group
- **12.** *G. octonarium* (Klokov) Pobed. [2*x*]
- **13.** *G. glaucum* L. [4*x*]
- **14.** *G. volhynicum* Pobed. [?2*n*]

15–18. *G. sylvaticum* group
- **15.** *G. pseudoaristatum* Schur [2*x*]
- **16.** *G. paschale* Forsskål [2*x*]
- **17.** *G. procurrens* Ehrend. [2*x*]
- **18.** *G. intermedium* Schult. (*G. schultesii* Vest) [6*x*]

Variation and diagnostic characters

The morphological variation of the species members of sect. *Leiogalium* concerns the root system, size and position of the stem, number, size and form of the leaves, position of the leaf margins toward the midrib, form and branching of the inflorescence, length of the flower/ fruit pedicel, form and diameter of the corolla, form of the corolla lobes. For a correct identification one needs plants with well preserved flowers.

The woody stock with a branched taproot without subterranean runners are characters differentiating *G. lovcense* (2*x*) from the related to it *G. lucidum* (4*x*) and narrow-leafy forms of *G. album* (4*x*). The well developed taproot differentiates *G. mirum* (2*x*) from *G. flavescens* (4*x*), as well as *G. octonarium* (2*x*) from *G. glaucum* (4*x*), and *G. paschale* (2*x*) from *G. procurrens* (2*x*).

The wide-leafy species, members of *G. mollugo* group and *G. sylvaticum* group, are mesophylous and xeromesophylous plants with oblanceolate to oblong-oblanceolate leaves. Their leaf size is a rather variable character, more or less related to the ecological characteristics of the habitat. The leaf form and the position of the leaf margin, together with the form of the corolla and corolla lobes, are important characters for the differentiation of the mesophilous and xeromesophilous species of *G. mollugo* group from the xerophilous species groups of *G. rhodopeum* and *G. asparagifolium*. The members of the *G. rhodopeum* group (*G. rhodopeum, G. velenovskyi* and *G. aegeum*) develop basal dense leafy shoots forming lax tufts. This feature, together with the narrow pyramidal inflorescence with short branches, differentiates *G. rhodopeum* group from *G. asparagifloium* group and the related *G. mirum, G. macedonicum, G. rigidifolium* and *G. flavescens*, which do not form basal tufts and have wide pyramidal inflorescences with long branches. The corolla form and diameter are diagnostic characters also of *G. octonarium, G. glaucum*, *G. procurrens* and *G. intermedium*.

Along with morphology, karyotype data and phytogeographical characteristics, some secondary plant substances, and above all iridoid glycosides, were used in the biosystematic investigations into sect. *Leiogalium* in Bulgaria. In these studies, the phylogenetic relationships among species and species groups were analyzed on the basis of iridoid glycosides and iridoid patterns (Mitova & al. 2002). The results from these analyses supported the close relationships among the species members of *G. mollugo* group, as well as the differentiation of *G. lovcense* from *G. album*. The obtained phytochemical evidence supported the close relationships among *G. rhodopeum, G. aegeum* and *G. asparagifolium,* on the one hand, and *G. mirum, G. macedonicum* and *G. rigidifolium,* on the other (Handjieva & al. 1996; Mitova & al. 1996a, b, 2002; Mitova 1999).

Ehrilch & Raven (1965: 601) emphasized that "secondary plant substances play the leading role in determining patterns of utilization. This seems true not only for butterflies, but for all phytophagous groups and also for those parasitic on plants". The results of our field observations in plant populations of *Galium* in the entire country demonstrate that, with two exceptions, there were no plants (leaves or flowers) damaged by insects. During more than four decades of field studies into the Bulgarian flora, only in two cases the junior author [here the first author] found plants of *G. album* subsp. *album* with heavily damaged leaves – in localities along the Black Sea Coast (north of the town of Varna) and in the Rhodopi Mts (*Eastern* – south of Kardzhali). Caterpillars of the moth *Macroglossa stellatarum* (*Sphingidae*) obviously feeded on the leaves of these plants. This supported the known information about the members of *Rubiaceae* differentiated by Merz (1959, after Ehrlich & Raven 1965: 600) together with other families into the group "Sphingidpflanzen": plants fed on by moths of the family *Sphingidae*. We suppose that in *Galium* chemical compounds of the secoiridoid glycosides and triterpene saponins probably play the role of protection against phytophagous insects.

It is remarkable that in the herbarium materials of broad-leaved species of *Galium*, most of the members of sect. *Leiogalium*, observed in the Bulgarian herbaria (SO, SOA, SOM), as well as in 12 other European herbaria, no plants damaged by insects were found. Traces of damages to plants of other genera and families were found accidentally, particularly in older herbarium collections, the insects being most often larvae of small herbarium beetles of the genera *Stegobium*, *Ptinus* and *Anthrenus* (cf. Skvortsov 1977). Personal collections of voucher specimens of *Galium*, occasionally left for a few years without chemical or temperature treatment, were never damaged by insects, which was impossible with plants of *Cruciferae* or *Campanulaceae*, the families the junior author works with.

Distribution and phytogeographical relations

The Bulgarian taxa of sect. *Leiogalium* pertain morphologically to two large groups – the first of them including wide-leaf, more or less mesophilous species, South-Central-European, East-Mediterranean and Balkan-Anatolian floral elements, related to *G. mollugo* group, with the diploid *G. lovcense* and polyploid *G. album*, and *G. sylvaticum* group, including the diploids *G. pseudoaristatum*, *G. paschale, G. procurrens* and the polyploid *G. intermedium* (*G. schultesii*).

The second, narrow-leaf group of species comprises narrow-leaf mesoxerophylous and xerophylous plants, Balkan-Anatolian, East-Mediterranean and Pontic-Balkan floral elements, related to the species groups of *G. asparagifolium, G. rhodopeum* and *G. glaucum*. The *G. asparagifolium* group includes the diploid *G. mirum* and *G. macedonicum* and the polyploid (tetraploid) *G. rigidifolium, G. flavescens* and *G. asparagifolium.* Three of these species, two diploid and one polyploid, are Balkan endemics, and *G. asparagifolium* has its area of distribution in the southeastern part of the Balkan Peninsula and W Anatolia. Members of the species group of *G. rhodopeum* are three Balkan endemics, one diploid and two polyploids, with areas of distribution in the southeastern part of the Balkan Peninsula.

All three members of the *G. glaucum* group (*G. octonarium, G. glaucum* and *G. volhynicum*) are European forest-steppe elements. *Galium octonarium* (2*x*) and *G. volhynicum* (4*x*) occur in SE Europe, and *G. glaucum* (4*x*) is distributed in the hilly plains and mountain foothills of W, C and S Europe.

The geographical distribution, species endemism and distribution of the diploids in the species groups suggest that the origin and the irradiation of the species members of sect. *Leiogalium* are related to the phytogeographical area of Southwest and West Anatolia, the primary center of origin and diversification of genus *Galium*. From that region, the species irradiated westwards and north-westwards to the Eastern Mediterranean, Balkan Peninsula and South Europe, where secondary centers of speciation and diversification arose (Ehrendorfer 1971; Ehrendorfer & Krendl 1976; Ehrendorfer & Shönbeck-Temesy 1982). The irradiation of species from the centers of speciation was most probably variably active in the different periods of their evolution. The species irradiated from South and Southeast through the Aegean pathway, where the Balkan-Anatolian exchange of floristic elements took place, closely connected to the East Mediterranean – a secondary center of speciation and species irradiation.

Formation of the contemporary species structure of section *Leiogalium* in the Bulgarian flora resulted from processes closely related in time – genesis and distribution of the Balkan endemic (autochtonous) element, and irradiation of species from adjacent floras. In these processes, species of pre-glacial origin were involved, as well as species that had arisen from Pleistocene and post-Pleistocene form differentiation in the flora of the Balkan Peninsula and South Europe.

Reproductive biology, chromosome numbers and hybridization

The species of sect. *Leiogalium* are entomophilous plants with protandrous flowers. The species with white flowers – *G. album, G. intermedium* (=*G. schultesii*), *G. pseudoaristatum, G. paschale* (=*G. bulgaricum*), *G. procurrens,* and *G. octonarium*, are pollinated mostly by flies of the families *Syrphidae, Muscidae* and *Larvivoridae*. The xerophilous species with yellowish or pale-yellowish corolla, members of the species groups of *G. asparagifolium* and *G. rhodopeum*, are visited chiefly by small coleopterans. This was the reason to speculate that there is a connection between pollinators and plants, related to habitats and distribution of mesophilous and xerophilous plant populations, on the one hand, and of dipteran and coleopteran insects, on the other (Anchev 1982).

Karyological studies of the chromosome number and ploidy level include all 18 Bulgarian species of sect. *Leiogalium*. Eight of them (44.4 %) are diploid ($2n = 22$), nine species (50 %) are tetraploid ($2n = 44$), and one (5.6 %) is hexaploid ($2n = 66$), all with $x = 11$ (Appendix 2), the most common and probably the original basic number in the genus. It is notable that all species which form rhizomes and reproduce sexually and vegetatively are polyploids. Such are *G. album*, *G. lucidum*, *G. asparagifolium*, *G. rigidifolium*, *G. flavescens*, *G. velenovskyi*, *G. aegeum*, *G. intermedium*, and *G. glaucum*. The three diploids *G. macedonicum*, *G. rhodopeum* and *G. procurrens* also form rhizomes with underground runners. The diploids *G. lovcense*, *G. mirum*, *G. pseudoaristatum*, and *G. octonarium* form taproot without runners and reproduce only by seeds.

The pattern of morphological variability in *Galium* is complicated by the interspecific, probably mostly introgressive hybridization. Because of the simple flower morphology, non-specialized insect pollination, partial reproductive compatibility even between morphologically distinct species taxonomically referred to different sections, combined with vegetative reproduction, hybridization is more or less common, where species grow in common habitats. In Bulgaria, *G.* ×*pomeranicum* Retz. (*G. album* × *G. verum*) occurs in the Forebalkan, Balkan Range (*Central*), Mt Vitosha Region, Rhodopi Mts (*Western*) and Mt Strandzha (Appendix 2). In Balkan Range (*Central*), *G.* ×*pomer-*

anicum occurs together with the parental species and forms populations above the timberline**.** The hybrid *G. humifusum* × *G. verum*, sect. *Galium*, known from the steppes of E Europe, occurs in Bulgaria in the northeastern part of the country, near Silistra, where it is distributed together with the parental species. It was also reported for the vicinity of Obraztsov Chiflik, Ruse district (Stojanov & al. 1967).

Besides these species, hybrid plants, result from hybridization between members of different sections and species groups, also occur. Probably they have a short life, being represented by small populations with few individuals only growing in habitats transitional to the typical ones for the parental species. Such are the hybrids *G. octonarium* × *G. rhodopeum* (Thracian Lowland, 500 m) and *G. pseudoaristatum* × *G. verum* (Mt Vitosha, 950 m) (Ančev 1989). We believe that in common habitats *G. album* subsp. *album* hybridises with *G. lucidum*.

Key to the species of *Galium* sect. *Leiogalium*

1 Corolla rotate **2**

1* Corolla cup-shaped **12**

2 Leaves (2)3–6 mm broad, oblong to broadly oblanceolate **3**

2* Leaves 0.5–2 mm broad, narrowly lanceolate, linear to acicular **5**

3 Plants with woody stock, without subterranean runners . . . . . **1**. *G. lovcense*

3* Plants with rootstock with subterranean runners . . . **4**

4 Leaves oblong to broadly oblanceolate . . . **2.** *G. album*

4* Leaves narrow oblanceolate or linear lanceolate . . . . . **3.** *G. lucidum*

5 Stems 60–150 cm; corolla pale-yellowish. **6**

5* Stems 10–50(100) cm; corolla pale-yellowish to greenish, seldom white (*G. velenovskyi*) **8**

6 Stems densly villous at base, hairs 1–2 mm long; partial inflorescence to 250 mm long. . . . . **4.** *G. mirum*

6* Stems with hairs 0.1–0.7 mm at the base; partial inflorescence 30–80 mm long **7**

7 Leaves 10–15(20) mm long; inflorescence with 6–9 patent branches; corolla 2–3(4) mm in diameter . . . . . **5.** *G. macedonicum*

7* Leaves 15–25 mm long; inflorescence with 2–5 patent branches; corolla 3–4 mm in diameter. . . . . **6.** *G. rigidifolium*

8 Leaves (20)25–40mm long. . . . . **7.** *G. flavescens*

8* Leaves 5–15(20) mm long **9**

9 Plant virgate; inflorescence with relatively long branches . . . . . **8.** *G. asparagifolium*

9* Plant not virgate; inflorescence with short branches. **10**

10 Leaves linear, curved near the apex . . . . **11.** *G. aegeum*

10* Leaves acicular, straight, not curved near the apex **11**

11 Leaves 0.5–0.7 mm wide; corolla pale-yellowish, 3.5–4.5 mm in diameter . . . . . **9.** *G. rhodopeum*

11* Leaves 0.7–1.0 mm wide; corolla white, 4–5 mm in diameter . . . . . **10.** *G. velenovskyi*

12 (**1***) Leaves 0.5–2 (3) mm wide; plant glaucous-pruinose **13**

12* Leaves (2)3–12 mm wide; plants green (*G. pseudoaristatum)* or glaucous-pruinose. **15**

13 Plants with woody stock; leave margin with several rows of teeth. . . . . **12.** *G. octonarium*

13* Plants with rootstock with subterranean runners; leave margin with 1–2 rows of teeth **14**

14 Corolla 3.5–4.5(6) mm in diameter; stem glabrous or occasionally hairy near the base . . . . . **13.** *G. glaucum*

14* Corolla 3–3.5(4) mm in diameter; stem hairy near the base . . . . . **14.** *G. volhynicum*

15 Leaves green, linear lanceolate; stock without runners **16**

15* Leaves glaucous-pruinose, broadly lanceolate; rootstock with runners **17**

16 Stem quadrangular, mostly pilose . . . . . **15.** *G. pseudoaristatum*

16* Stem rounded at the base, slightly quadrangular obove, glabrous . . . . . **16.** G. *paschale*

17 Corolla cup-shaped, mostly less than 3 mm in diameter; petals acute, not apiculate . . . . **17.** *G. procurrens*

17* Corolla more or less rotate, seldom flowers cup-shaped, mostly more than 4 mm in diameter; petals shortly apiculate . . . . . **18.** *G. intermedium*

Sect. *Leiogalium* Ledeb.

Perennial herbs with woody stock, more or less branched taproot or roooting stolons. Stems 4-angled or terete, glabrous or hairy, never retrorsely aculeate. Leaves in whorls of (4)6–10, with antrorsely directed papilliform teeth alnog the more or less revolute margins, incospicuous or prominent midrib and hyaline apiculum. Inflorescence mostly manyflowered, oblong, ovoid, conoid or corymbiform; flowers on short or long pedicels; corolla rotate or cup-shaped, white, whitish, pale-yellowish, occasionally greenish, seldom yellow, lobes acute to apiculate. Pollen grains stephanocolpate, elliptic to spheroidal, (5)6–10(11) colpate. Fruit dry, ovoid, glabrous.

1–2. *G. mollugo* group

Plants green (not pruinose). Stock with, or without subterranean runners. Stems (10)20–120(180) cm. Leaves in whorls of 6–8, oblong, oblanceolate, acumitate or almost rounded at the apex, scarcely scabrid along the flat to slightly revolute margin. Inflorescence broad or oblong pyramidate. Corolla 3–5 mm in diameter, white or greenish-white.

1. *G. lovcense* Urum., Österr. Bot. Z. 2 (49): 55 (1899); Schönb.-Tem. & Ehrend., Pl. Syst. Evol. 133: 110 (1979); Fl. Turkey 7: 792 (1982).

Lectotype: Bulgaria – in apricis rupium calcareis ad Baš-kulesi supra urbem Lovech, I. Urumov, 20.07.1898 (SOA 10698 !) (Ančev 1989: 64).

≡ *G. erectum* var. *lovcense* (Urum.) Stoj., Izv. Bulg. Bot. Druzh. 5: 109 (1932).

≡ *G. heldreichii* f. *lovcense* (Urum.) Ančev, Dokl. Bulg Akad. Nauk. 28: 1534 (1974).

= *G. protopycnotrichum* Ehrend. & Krendl, Bot. J. Linn. Soc. 68: 270 (1974). **Holotype:** Jugoslawien, Bosnien: 1 km SW Turbe, *ca*. 600 m; nährstoffreiche Eichenmischwälder,Sandstein.18.VI.1965, Ehrendorfer 6501; 4801 (W!; **Isotypes**: WU!).

≡ *G. heldreichii* subsp. *protopycnotrichum* (Ehrend. & Krendl.) Ančev, Dokl. Bulg. Akad. Nauk. 28(11): 1534 (1975); Fl. RP Bulg. 9: 64 (1989).

= *G. heldreichii* auct. Ančev, in Fl. RP Bulg. 9: 62 (1989), non Halácsy, 1897.

= *G. heldreichii* var. *glabratum* auct. Ančev, Fl. RP Bulg. 9: 64 (1989), non Halácsy, 1897.

Illustration: Table X, fig. 2 (Ančev, 1989: 59, as *G. heldreichii*).

Var. ***lovcense***, var. ***obovatum*** (Ančev) Ančev & Krendl. Stock woody, without subterranean runners, usually with many flowering shoots. Stems (10)20–60(80) cm, erect or ascending, acute 4-angled, glabrous or pilose, green or mostly on the lower part pale-violet. Leaves in whorls of 6–8, 10–20(30) × 1.5(5) mm, narrow oblanceolate or oblong elliptic, gradually narrowed towards the apex, margin slightly incurved, midrib narrow. Inflorescence elongate ovoid, branches patent; partial inflorescences narrow to broad conoid*;* pedicels 1–4 mm. Corolla (2)3–5 mm in diameter, whitish or yellowish-white, lobes with short, 0.3–0.4(0.5) mm long apiculus. $2n = 22^*$.

Distribution and ecology

In scattered localities along Black Sea Coast (*Northern*), Northeast Bulgaria, Forebalkan, Balkan Range, Znepole Region, West Frontier Mts, Valley of River Struma, Mt Belasitsa, Mt Slavyanka, Valley of River Mesta, Pirin Mts, Rhodopi Mts, Thracian Lowland, from 200 m up to about 1900 (2200) m a.s.l. In dry, open, gravelly, mostly limestone habitats and rocky terrains, on the slopes of foothills and mountains (Appendix 1). SE Europe (Balkan Peninsula: Albania, Bosnia and Herzegovina, Crete, Greece, Croatia, Macedonia, Montenegro, Serbia), SW Asia (W Anatolia).

Flowering June to July.

Note. 1. The problem with differentiation of *G. lovcense* from *G. protopycnotrichum* both diploids, is open to discussion. *Galium protopycnotrichum* was known mostly as a mesophylous plant with larger leaves, longer stems with more internodes, with pyramidal loose inflorescences, distributed mostly at the mountain foothils and mountains, on temperate wet and dry silicate and calcareus terrains. *Galium lovcense* is a species comprising more xeromorphic plants, growing mostly on dry calcareus terrains with a wide range of variation of the stem length, branching, leaf size, pedicel length, and corolla diameter demonstrated in ecologically different habitats on the slopes of the mountain foothills and low mountains. Because the extreme morphotypes, mesomorphic and xeromorphic plants, are not cleary differentiated geographically, and there is no morphological basis for their taxonomic differentiation, *G. protopycnotrichum* here is treated in the synonymy of the earlier described *G. lovcense.*

2. Low plants with short stem, obovate small leaves and short narow pyramidal inflorescence found in three localities in rocky calcareus habitats in NE Bulgaria (near Tabachka vill., Ruse district, and in the vicinity of Madara and Kyulevcha, Shumen district) were taxonomically differentiated and described as

Galium heldreichii subsp. *protopycnotrichum* var. *obovatum* Ančev (Ančev 1975: 1534). Here we propose a new combination *Galium lovcense* var. *obovatum* (Ančev) Ančev & Krendl, comb. nov.; *G. heldreichii* subsp. *protopycnotrichum* var *obovatum* Ančev, Dokl. Bulg Akad. Nauk. 28: 1534 (1975). **Holotype**: in rupestribus apricis, solo calcareo, ad pagum Tabačka, district Ruse, 16.07.1971, leg. *M. Anchev* (SOM 71674).

2. *G. album* Mill., Gard. Dict. ed. 8, no. 7 (1768); Krendl, Österr. Bot. Z. 114, 4/5: 537 (1967); Ehrend. & Krendl, Fl. Eur. 4: 24 (1976); Ančev, Fl. RP Bulg. 9: 64 (1989).

Type: England, London „common in Chelsea" (ex descr.). **Holotype**: BM?

Plants with branched rhizome with long rooting subterranean runners. Stems 50–150 cm, erect or ascending, branches ascending to spreading, short or long ramificate, glabrous or pilose, hairs 0.3–2 mm. Leaves in whorls of 6–8, 10–40 × 1.5–7 mm, oblong, oblanceolate, cuspidate acumitate or rounded and mucronate, scarcely scabrid along the flat to slightly incurved margin. Inflorescence broad, ovoid or oblong; partial inflorescences broad or narrow conoid; pedicels 1–5 mm. Corolla 3–5 mm in diameter, white or greenish-white (young flowers). 2*n* = 44, 44*.

Distribution and ecology

Scattered all over the country, from the sea level up to about 1900(2000) m. Occurs at roadsides and in fields, on river banks, in mounatin glades and meadows, in shrubby communities, in clearings and seldom mixed deciduous forests, on limestone, marble, gneiss, sandstone, crystalline, (Appendix 1). Widespread in Europe, Caucasus, SW and C Asia, W Siberia, Atlanic N America (adventive).

Flowering June to July (early August).

Key to the subspecies

1 Corolla whitish to yellowish; inflorescence oblong pyramidal with short branches; plants up to 60 (80) cm ..... subsp. ***prusense***

1* Corolla whitish; inflorescence broadly ovoid with long branches; plants often more than 80 cm ... **2**

2 Leaves oblanceolate, gradually narrowed towards the apex; plants often slender, predominatly glabrous ..... subsp. ***album***

2* Leaves oblong to broadly oblanceolate, abruptly narrowed towards the apex; plants robust, usually pilose ..... subsp. ***pycnotrichum***

G. album subsp. ***album***

= *G. erectum* Huds. Fl. Angl. ed 2, 68 (1778) et auct., non Huds. (1762), nom ambig. reject.

≡ *G. mollugo* var. *erectum* (Huds.) Briq., in Schinz & Kell., Fl. Schw. ed. 19, 489 (1900).

= *G. mollugo* var. *angustifolium* Leers, Fl. Helv. 52 (1789).

= *G. mollugo* var. *genuinum* Heinr. Braun., Österr. Bot. Z. 42: 131 (1892).

= *G. mollugo* subsp. *mollugo* sensu Hayek, in Hegi, Ill. Fl. Mitteleurop. 6/1, 212 (1914).

= *G. dumetorum* Jord., Pug. Plant. Nov. 78 (1852).

≡ *G. mollugo* var. *dumetorum* (Jord.) Heinr. Braun, Österr. Bot. Z. 42: 131 (1892).

= *G. mollugo* var. *brevifrons* auct. Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1049 (1925), non Borbás & Heinr. Braun.

= *G. erectum* var. *asperum* Podp., Verh. Zool. Bot. Ges. Wien 52: 655 (1902).

= *G. mixtum* Stransky, Sborn. Bălg. Acad. Nauk., kniga 16, klon Prirodo-Matem. 6: 134 (1921).

≡ *G. mollugo* subsp. *erectum* var. *mixtum* (Stransky) Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1050 (1925).

Stems 50–120 cm, often slender, branches long or short, mostly glabrous. Leaves 10–30 × 1.5–5 mm, oblanceolate, gradually narrowed towards the apex. Inflorescence wide pyramidal with long branches. Corolla 3.5–5 mm in diameter, whitish or greenish-white. 2*n* = 44, 44*.

Distribution and ecology

In lowlands, plains and mountains, in ravine forests and along mixed decidous forests, in mountain meadows, occasionally on screes and rocky terrains, from the sea level up to about 1900(2000) m a.s.l.

Flowering June to July.

G. album subsp. ***pycnotrichum*** (Heinr. Braun) Krendl, Österr. Bot. Z. 114: 539 (1967). **Lectotype**: Leopoldsberg, 10. Juli 1838, Neilreich 6531 (W!); **Syntype**: Neilreich 6530 (W!). – **Illustrations:** abb. 18 (Krendl 1987: 55); table X, fig. 1 (Ančev 1989: 59).

≡ *G. mollugo* var. *genuinum* f. *pycnotrichum* Heinr. Braun, Österr. Bot. Z. 42: 132 (1892).

≡ *G. pycnotrichum* (Heinr. Braun) Borbás ap. A. Kern., Sched., Fl. Exsicc. Austr.-Hung. 6, 70 (1893).

≡ *G. mollugo* subsp. *pycnotrichum* (Heinr. Braun) O. Schwarz, Mitt. Thüring. Bot. Ges. 1/1: 117 (1949).

= *G. mollugo* var. *pubescens* Schrad., Spicil. Fl. Lips. 16 (1794).

= *G. firmum* var. *genuinum* Hallácsy, Consp. Fl. Graec. 1: 712 (1901) p. p.

Stems up to (60)80–150 cm, robust, mostly pilose. Leaves 10–40 × 3–7 mm, oblong or broadly oblanceolate, abruptly narrowed towards the apex. Inflorescence wide pyramidal with long branches. Corolla 3–4 mm in diameter, whitish or greenish-white. 2*n* = 44, 44*.

Distribution and ecology

Frequent in plains and lowlands, mostly in E and S Bulgaria. Occurs in steppe shruby forests, in dune areas, in rockreefs, from the sea level up to 900(1000) m a.s.l. S and C Europe (Pannonian area).

Flowering May to July.

G. album subsp**. *prusense*** (C. Koch) Ehrend. & Krendl, Bot. J. Linn. Soc. 68: 270 (1974).

≡ *G. prusense* C. Koch, Linnaea 24: 466 (1851).

= *G. erectum* auct. p.p., non Huds (1762).

= *G. firmum* auct. p.p., non Tausch (1831).

Lectotype. Asia Minor, Litos aust. Pontus Euxini (Ehrendorfer & Schönbeck-Temesy, 1982: 791. LE, photo).

Stems up to 60(80) cm, glabrous or pubescent with short flowering branches. Leaves 10–25 × 2–4(5) mm, oblanceolate to lanceolate, gradually narrowed towards apex, usually coriaceus. Inflorescence oblong, narrow, dense. Corolla 3.5–4.5 mm in diameter, whitish. 2*n* = 44.

Distribution and ecology

In alpine grassland and pastures on gravelly, mostly limestone ground. Above the timberline, Mt Slavyanka, N Pirin Mts and Rila Mts, from (1700)1800 up to 2500 m a.s.l.

Flowering late June to early August.

Note. In Bulgaria (Black Sea Coast: Kranevo; Forebalkan; Balkan Range: Shipka Pass and Kaloferski Balkan; Mt Vitosha and Rhodopi Mts-*Western*) occurs *G.* ×*pomeranicum* Retz. (*G. album* × *G. verum* – 4*x*, Appendix 2). In Balkan Range (*Central*): above the timberline it grows together with the parental species and forms populations with numerous plants.

3. *G. lucidum* All., Mélangs Phil. Math. Soc. Roy. Turin 5: 57 (1773); Ehrend. & Krendl, Fl. Eur. 4: 25 (1976); Ančev, Fl. RP Bulg. 9: 66 (1989).

Type: „Hort. Reg. Taurinensis“ (ex descr.).

≡ *G. erectum* var. *lucidum* (All.) DC., Prodr. 4, 596 (1830).

≡ *G. mollgo* subsp. *lucidum* (All.) Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1049 (1925).

= *G. gerardi* Vill., Prosp. 19 (1779).

≡ *G. mollugo* subsp. *gerardi* (Vill.) Briq. in Schinz & Kell., Fl. Schw. ed. 1, 489 (1900).

= *G. mollugo* subsp. *tenuifolium* (All.) Schinz & Thell., Bull. Herb. Boiss. Ser. 2, 7: 502 (1907, ex descr.).

= *G. rigidum* Vill., Hist. Pl. Dauph. 2, 319 (1787).

≡ *G. erectum* var. *rigidum* (Vill.) Gren. & Godr., Fl. Fr. 223 (1850).

= *G. sylvestre* p. p. auct. Fl. Bulg., non Poll.

= *G. pumilum* auct. Stoj., Stef. & Kitan., Fl. Bulg. 4, 2: 1017 (1967), non Murr.

Stock with rhizome with rooting subterranean runners. Stems 25–70 cm, erect or ascending, glabrous or pilose (hairs 0.1–1.5 mm). Leaves in whorl of 5–10, 10–30 × 1–2(2.5) mm, linear-lanceolate, with hyaline apiculum, midrib narrow, margin somewhat incurved, scabrid with 2–3 rows of teeth, occasionally succulent. Inflorescence oblong or ovoid; partial inflorescences broadly conoid, ascending to spreading; pedicels 1–3 mm. Corolla 3–5 mm in diameter, white or yellowish-green. 2*n* = 44, 44*.

Distribution and ecology

Forebalkan, Balkan Range, Znepole Region, West Frontier Mts, Mt Vitosha Region, Mt Belasitsa, Mt Slavyanka, Pirin Mts, Rila Mts, W and C Rhodopi Mts (Chepelare, Pamporovo, Bachkovo, Assenovgrad), Thracian Lowland (Krichim, Plovdiv), Mt Strandzha (Gramatikovo, Brodilovo, Malko Tarnovo, Yasna Polyana). In deciduous and coniferous forests, along forest edges, in brook ravines, rockheaths and meadows; on limestone, sandstone, schist, gneiss, andesit, from 200 up to 1500 m. S and SC Europe.

Flowering from June to July.

Note. In localities where *G. lucidum* grows together with *G. album* subsp. *album,* occur plants with intermediate morphological characteristics, difficult to be determined and most probably of hybrid origin.

4–8. *G. asparagifolium* group

Stock woody, with or witout subterranean runners. Stems 35–80(120) cm, shortly hairy, more seldom glabrous. Leaves in whorls of 6–11, linear-lanceolate, linear to filiform, more or less blackening when dried; midrib prominent; margin more or less incurved and scabrid. Inflorscence long, wide and lax with long patent branches. Corolla usually pale-yellowish to greenish, slightly cup-shaped; lobes incurved, usually strongly apiculate. Anthers more or less darkening when dried. Fruit dark-brown to blackish.

4. *G. mirum* Rech. f., Bot. Jahrb. 69: 512 (1939); Ehrend. & Krendl, Fl. Eur. 4: 26 (1976); Ančev, Fl. RP Bulg. 9: 69 (1989).

Lectotype: Macedonia orientalis, District Drama, montes Boz Dagh, in fauce infra pagum granitis (Jurcik, *ca*. 300 m); substr. calc., 01.06.1934, K.H. & H. Rechinger 6339 W! **Isotypes**: LD! W! **Syntypes**: Leilagebirge bei Serrai, Föhrenwald, *ca.* 1400 m (10749); Boz-Dagh bei Drama, Schlucht unterhalb Granitis, *ca.* 500 m (6342); Granithügel bei Kavala (10111) (Krendl 1987: 111). **Illustrations**: Abb. 38 (Krendl 1987: 112), table XI, fig. 1 (Ančev 1989: 63).

Stock woody, without subterranean runners. Stems robust, (60)80–150 cm, strongly branched, densely villos at base, with hairs more than 1 mm long. Leaves in whorls of (6)8–11, 15–5 × 1–2 mm, linear to aciculate, slightly falcate, gradually narrowed, with 0.2–0.3 mm long hyaline apiculum, margin slightly incurved, with two to several rows of teeth. Inflorescence broadly ovoid; partial infloescences with very long, spreading branches; pedicels 0.5–2(3) mm. Corolla 2–2.5(3) mm in diameter, yellowish, lobes revolute, with 0.5–0.6 mm long apiculus; anthers 0.2–0.3 mm long, dark-brown. 2*n* = 22, 22*.

Note. *Galium mirum* differs from *G. macedonicum* and *G. rigidifolium* by its dense indumentum at the base of the stem (hairs 1–2 mm), short pedicels (0.5–3 mm) and small corolla (2–3 mm in diameter).

Distribution and ecology

SW Bulgaria. Mt Slavyanka, Pirin Mts (*Northern*), Rhodopi Mts (*Eastern* – Arda Valley near Kardzali), Thracian Lowland (Krichim). On stony slopes, rockheaths, sandstone, granite, seldom on marble, from 250 upwards to1000 m. SE part of the Balkan Peninsula: Greece (Drama, Kavala, east of Xanthi). A Balkan endemic.

Flowering from June to July.

5. ***G. macedonicum*** Krendl, Bot. Chron. (Patras) 6/7: 121 (1987); Ehrend. & Krendl, Fl. Eur. 4: 24 (1976); Ančev, Fl. RP Bulg. 9: 69 (1989)

Holotype: Jugoslawien, Mazedonien, Jakupica, oberhalb von Papradista, auf dem Weg zum Čeplec-Schutzhaus, *ca*. 1100–1200 m; Eichenmischwald-Rand, Silikat, 27.06.1977, Krendl 2290 (W! **Isotypes**: ATH, B, C, G! M, WU). **Illustrations**: abb. 44 (Krendl 1987: 123), table XI, fig. 2 (Ančev 1989: 63).

= *G. scabrifolium* auct. bulg., non (Boiss.) Hausskn.

Stock woody, with long subterranean runners and many flowering shoots. Stems 40–60(90) cm, erect, dense pilose (hairs 0.1–0.6 mm), asperate. Leaves in whorls of 6 (seldom 7– 9), 10–15(20) × 0.5–1 mm, linear to acicular, gradually narrowed to a long hyaline apiculum (0.5–1 mm), midrib broad, margin slightly incurved, very scabrid, with two to several rows of teeth. Inflorescence broadly ovoid, partial inflorescences with erect spreading branches (30–0 mm). Pedicels 1–4 mm. Corolla 2–3(4) mm in diameter, yellow, lobes incurved, with long (0.4–0.8 mm) apiculus. 2*n* = 22, 22*.

Distribution and ecology

In scattered localities in S and SW Bulgaria. Znepole Region, Mt Vitosha Region, Valley of River Struma (northward to Mt Konyavska), Mt Belasitsa, Mt Slavyanka, Pirin Mts, Rhodopi Mts (*Eastern*). On open slopes and rockheath, on limestone or marble, seldom on silicate ground, from 400 up to about 1200 m. Macedonia, NE Greece. A Balkan endemic.

Flowering from June to July.

6. ***G. rigidifolium*** Krendl, Bot. Chron. (Patras) 6/7: 124 (1987)

Holotype: Griechenland, Mazedonien, Veron Oros: zwischen Nimfeon und Perikopi, *ca*. 3–4 km NE Perikopi, S-Hang der Preskopana, *ca*. 1300–1400 m; Trockenrasen, Felstriften, Silikat, 10.07.1978, Krendl 3042 (W! **Isotypes**: UPA! WU!). **Illustrations**: abb. 45 (Krendl 1987: 126).

= *G. flavescens* auct. bulg., non Borbás, 1874.

= *G. scabrifolium* auct. bulg., non (Boiss.) Hausskn. 1893.

Plants darkening when dried, rootstock with long subterranean runners and many flowering shoots. Stems 60–80 cm, erect, dense pilose at base (hairs 0.1–0.7 mm), with prominet ridges. Leaves in whorls of 6–8(11), (10)15–25 × 0.5–1.5 mm, linear to aciculate, gradually narrowed into a long (0.2–1 mm) hyaline apiculum, midrib beneath broad, margin incurved, strongly scabrid, with two to several rows of teeth. Inflorescence broadly oval, densiflorous; partial inflorescences up to 80 mm long, mostly strongly ramificate; pedicels 1–3 mm. Corolla 3–4 mm in diameter, yellowish, lobes incurved, with long (0.4–0.6 mm) apiculus; anthers dark-brown. 2*n* = 44, 44*.

Note. 1. *Galium rigidifolium* is reported for Bulgaria for first time by Anchev (1999). In habit it is close to *G. flavescens* and known for Bulgarian flora by earlier authors under this name.

2. *Galium rigidifolium* is a tetraploid, morphologically closely related to the diploid *G. macedonicum*. It

differs from *G. macedonicum* by some longer leaves and longer corolla lobes.

Distribution and ecology

In scattered localities along the Black Sea Coast (*Northern*), Northeast Bulgaria, Forebalkan, Balkan Range, Znepole Region, Mt Vitosha Region, Valley of River Struma, Valley of River Mesta, Pirin Mts, Rila Mts, Rhodopi Mts, Thracian Lowland (Kurtovo). The occurence near Sliven (direction Balgarka) is doubtful. In pinetis, bush- and ravine forest, on rubble and rocks, in pastures, along road margins, on silicate and serpentine; from 350 upwards 2000 m. Serbia (Pirot), E Macedonia, NE Greece. A Balkan endemic.

Flowering from June to July.

7. *G. flavescens* Borbás ex Simonk., in shedis Kerner Fl. Exsicc. Austro-Hung. no. 958 (1883); Sched. Fl. Exsicc. Austro-Hung. 3: 106 (1884); Krendl, Vitek & Barina, Ann. Naturhist. Mus. Wien B, 110: 262 (2009). **Illustration**: table XII, fig. 4 (Ančev 1989: 67).

= *G. flavescens* Borbás, Akad. Közl. 11 (7): 266 (1874), nom. inval.; Hayek, Prodr. Fl. Penins. Balc. 2: 464 (1930); Ehrend. & Krendl, Fl. Eur. 4: 26 (1976); Ančev, Fl. RP Bulg. 9: 72 (1989).

≡ *G. verum* subsp. *flavescens* (Borbás) Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1051 (1925).

= *G. ochroleucum* Kit. in Schult., Österr. Fl. ed. 2, Pars 1: 305 (1814), nom.illeg., non *G. ochroleucum* Wolf apud Schweiger & Koerte (1811).

Lectotype: *G. ochroleucum* Kit. (Descripta in Diar. it. 1810). In rupibus ad Paulis, Sólymos (Herbar Kitaibel 2058 / Mus. Nat. Hung. Fasc. VII, No 127) (BP) (Krendl & al. 2009: 262).

= *G. asparagifolium* A. Kern., Österr. Bot. Z. 20: 327 (1870), nom. illeg., non Boiss. & Heldr. (1859: 91).

Rootstock with long subterranean runners and many flowering shoots. Stems (15)30–80 (100) cm, erect, strongly branched from the base, glabrous or pilose. Leaves in whorls of 6–8(10), 20–40 × 0.5–1 mm, narrow linear to aciculate, margin strongly incurved, sharply scabrid, gradually narrowed into a long (0.5–1 mm) hyaline apiculum, midrib more or less prominent. Inflorescence broad, ovoid, with numerous branches; partial inflorescences strongly ramificate. Pedicels 2–7 mm. Corolla (3)4–5 mm in diameter, pale-yellowish, with incurved strongly apiculate lobes. 2*n* = ?22, 44, 44*.

Distribution and ecology

In scattered localities along the Black Sea Coast, Northeast Bulgaria, Forebalkan, Balkan Range (*Eastern* & *Central*), Znepole region, Sofia Region, Mt Vitosha Region, Mt Slavyanka, Pirin Mts (Sinanitsa), Rila Mts, Rhodopi Mts (*Western* & *Central*), Thracian Lowland (south of Pazardzhik and Plovdiv), Mt Strandzha (east of Malko Tarnovo). In open terrains, on limestone and andesit, dry rockheaths and rubble, occasionally in ruderal habitats, from 300 to 1200 m a.s.l. Serbia (Vranje, Vršac), Kosovo, Montenegro (east of Kotor), Bosnia, C and E Romania.

Flowering from June to July.

8. *G. asparagifolium* Boiss. & Heldr. in Boiss., Diagn. Pl. Or. Nov. 3/6: 91 (1859); Krendl, Bot. Chron. (Patras) 6/7: 127 (1987); Ehrend. & Krendl, Fl. Eur. 4: 26 (1976).

Lectotype: in saxosis calcareis reg. inferior. m. Parnassi pr. Rachova de Gourna, alt. 2000–3000'. 15. Jul. 1857, No 645, leg. *Samaritani* & *Guicciardi* – G! (**Isotypes** C! FI! M! PRC! W!). **Illustration**: abb. 46 (Krendl 1987: 129).

≡ *G. aureum* var. *asparagifolium* (Boiss. & Heldr.) Boiss. Fl. Or. 3: 62 (1875).

≡ *G. firmum* var. *asparagifolium* (Boiss. & Heldr.) Hayek, Prodr. Fl. Penins. Balc. 2: 464 (1930).

= *G. rhodopeum* sensu Rech. f., in Denkschr. Akad. Wiss. Wien, Mat.-Nat. Kl. 105: 574 (1943), non Velen. (1894).

Plants darkening when dried. Rootstock with long subterranean runners and many flowering shoots. Stems 25–100 cm, virgate, fragile, glabrous or short pilose (hairs 0.1–0.7 mm), strongly branched. Leaves in whorls of 6(7)5–15(20) × 0.5–2 mm, linear to aciculate, gradually narrowed into a hyaline apiculum, margin incurved to the midrib, with 2–3 rows of antrorse teeth. Inflorescence long oval, strong, ramificate, partial inflorescence narrow conoid. Pedicels 2–3(4) mm. Corolla 2–4 mm in diameter, yellowish, lobes incurved, strongly apiculate. 2*n* = 22, 44, 44*.

Distribution and ecology

SW Bulgaria. Mt Slavyanka: Mt Stargach, on northeast limestone slopes southwest of Ilinden, 675 m), Pirin Mts (*Southern*). On open dry limestone substrates in the oak vegetation belt, in xerophilous plant communities dominated by oak–hornbeam forests, at 600–900 m. The Balkan Peninsula (Greece: Kastoria, Seres,

Pangeon, near Drama, Mt Athos, Lesbos and Samos islands), W Anatolia.

Flowering from mid-May to early-July.

Note. *Galium asparagifolium* was reported for Bulgaria for first time by Mitova & al. (2002).

9–11. *G. rhodopeum* group

Stock woody, with or witout subterranean runners. Stems (3)10–35(40) cm shortly hairy, more seldom glabrous. Leaves narrowly linear-lanceolate to linear, acicular to filiform, more or less blackening when dried, midrib prominent, margin usually strongly incurved and scabrid. Inflorscence long and narrow, with short branches. Corolla yellowish to greenish, seldom pure white, slightly cup-shaped; lobes incurved, usually strongly apiculate. Anthers more or less darkening when dry. Fruit dark brown to blackish.

9. *G. rhodopeum* Velen., Sitzungsber. Königl. Böhm. Ges. Wiss. Math.-Naturwiss Cl. 1893, 37: 32 (1894); Ehrend. & Krendl, Fl. Eur. 4: 26 (1976); Ančev, Fl. RP Bulg. 9: 73 (1989).

Type: In rupibus calcareis calidis supra Tekir ad radicem m. Rhodope detexi a. 1893. **Lectotype**. [Bulgaria]: In calcareis aridis supra Tekir, 1893, J. Velenovský, s.n., B! **Illustrations**: abb. 6 (Krendl 1987: 18); table XII, fig. 1 (Ančev 1989: 67).

Plants with branched rhizome with rooting subterranean runners. Stems 10–40 cm, the lower half pubescent, with small coarse hairs (0.1–0.2 mm), seldom glabrous, rigid and erect, fragile with prominent white ridges. Leaves in whorls of 6–7(8), 5–10(12) × 0.5–1 mm, linear to acicular, with 0.5–0.8 mm long hyaline apiculum, beneath with broad midrib, margin incurved, scabrid, with 3–5 rows of teeth. Inflorescence narrow pyramidal, with short, rigid, erect branches. Pedicels 2–6 mm. Corolla 3.5–4.5 mm in diameter, pale-yellowish, lobes mostly incurved, apiculate, with 0.4–0.6 mm long apiculum; anthers dark-brown. $2n$ = 22, 22* ?44*.

Note. The Macedonian populations (Jablanica, Popova Šapka) differ from the Greek and Bulgarian plants by stems with narrow ridges, +/– falcate leaves, narrow midrib; smaller corollas, and lobes with shorter apiculum.

Distribution and ecology

SW Bulgaria. Rhodopi Mts (*Western* & *Central*) (Peshtera, Asenovgrad, Chepelare–Hvoina), Thracian Lowland (Besaparski Ridove), frequent on open south-facing stony and grassy slopes in glades and patchy shrub communities of *Carpinus orientalis* and *Fraxinus ornus*, on shallow and eroded soils, on limestone, marble and dolomite, from 300 m to about 1450 m a.s.l. The Balkan Peninsula (R Macedonia: southeast of Titov Veles, south of Gradsko; NE Greece). A Balkan endemic.

Flowering from May to June.

10. *G. velenovskyi* Ančev, Dokl. Bulg. Acad. Nauk. 28 (11): 1534 (1975); Ančev, Fl. RP Bulg. 9: 74 (1989).

Holotype: In rupestribus apricis solo calcareo, Strămni rid, Rhodopae orientalis, 04.06. 1970, *M. Ančev* (SOM 70235a !). **Illustrations**: table XII, fig. 3 (Ančev 1989: 67).

Stock with branched rhizome with rooting subterranean runners. Stems few, 10–30 cm with prominent whitish edges, glabrous or lower half minutely hispid (hairs 0.1 mm). Leaves in whorls of 6(7)6–12(15) × 0.7–1 mm, linear to acicular, with 0.7–1 mm long hyaline apiculum, beneath with broad prominent midrib, margin scabrid, with 1–2 rows of teeth. Inflorescence narrow pyramidal, little ramificate, with short, rigid and erect branches. Pedicels 2–6 mm. Corolla 4–4.5(5) mm in diameter, white; lobes mostly incurved, apiculate. $2n$ = 44*.

Distribution and ecology

S Bulgaria. Rhodopi Mts (*Central* & *Eastern* – south of Kardzhali and Momchilgrad), Thracian Lowland (Sladun vill., Svilengrad district). On open rocky and gravelly slopes, in glades and shrub communities of *Quercus pubescens, Carpinus orientalis, Paliurus spina-christi, Colutea arborscens,* etc., on limestone substrate, from 250 up to about 600 m a.s.l. A local endemic.

Flowering from May to June.

11. *G. aegeum* (Stoj. & Kitan.) Ančev, Dokl. Bulg. Akad. Nauk. 28 (11): 1535 (1975); Ančev, Fl. RP Bulg. 9: 74 (1989).

≡ *G. firmum* subsp. *aegeum* Stoj. & Kitan., God. Sofiisk. Univ. Fiz.-Mat. Fak. 42/3: 71 (1946).

Lectotype: Ins. Tasos, in rupibus marmoreis jugo saxoso inter cacuminos Ipsarion et Kamenovrachos, *ca.* 1000–1100 m s. m., 14.07.1943, *N. Stojanov*, *B. Kitanov* (SOM 71171!) (Ančev 1975: 1535). **Illustrations**: Abb. 48 (Krendl 1987: 137); table XII, fig. 2 (Ančev 1989: 67).

= *G. rhodopeum* var. *nudatum* Rech. f., Bot. Jahrb. Syst. 69: 513 (1939).

= *G. rhodopeum* auct. Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1049 (1925), p.p. et auct. fl. Bulg., non Velen.

Plants blackening when dried. Rhizome thick, with short or long rooting subterranean runners. Stems (3)10–35(40) cm, ascending to erect, pubscent at the base (hairs 0.1–0.4 mm), seldom glabrous; basal vegetative shoots numerous. Leaves in whorls of 6(8), (3.5)4–10 × 0.7–1 mm, linear to acicular, falcate, mucronate, thick, midrib broad and prominent, margin scabrid, with 1–2 rows of teeth. Inflorescence narrowly conoid, sparcely branched; pedicels 2–3.5(4) mm. Corolla 3.5–4.5 mm in diameter, white or greenish-yellow, lobes incurved, apiculate, with 0.2–0.4 mm long apiculum. 2*n* = 44, 44*.

Note. 1. *Galium aegeum* differs from *G. rhodopeum* by darkening when dried, stem base with many short lateral shoots, falcate leaves, and 2*n* = 44.

2. *Galium rhodopeum* var. *nudatum* Rech. f. described from „Boz-Dagh bei Serrai, *ca.* 1800 m (10 899)" (Rechinger 1939: 513) corresponds to *G. aegeum*.

Distribution and ecology

SW Bulgaria. In the coniferous belt of Mt Slavyanka and the Pirin Mts (*Southern*) in open glades, on rocky and gravelly slopes, on shallow and eroded soils, on limestone substrate, from 800 up to 2000 m. Greece (Thasos, Bozdag, Pangeon). A Balkan endemic.

Flowering from May to June.

12–14. ***G. glaucum*** group

Plants glaucous-pruinose. Stock with or without subterranean runners. Stems glabrous or pilose. Leaves in whorls of 6–12, linear to acicular, gradually narrowed into hyaline apiculum; margin revolute, scabrid with several rows of theet. Inflorescence broadly ovoid to pyramidal, with long lower branches. Pedicels stout, not divaricate after anthesis. Corolla white, infundibuliform to cup-shaped; lobes acute, seldom shortly apiculate.

12. *G. octonarium* (Klokov) Soó, Acta Bot. Acad. Sci. Hung. 9(3-4): 427 (1963); Ehrend. & Krendl, Fl. Eur. 4: 27 (1976); Ančev, Fl. RP Bulg. 9: 76 (1989).

≡ *Asperula octonaria* Klokov, Bot. Mater. Gerb. Bot. Inst Komarova Akad. Nauk SSSR 18: 229 (1957).

Type: Described from environs of Taganrog (LE).

Plants glaucous-pruinose. Stock without subterranean runners. Stems (20)25–70(90) cm, erect to ascending, glabrous or pilose. Leaves in whorls of 6–12, (15)20–45 × 0.5–1.5(2) mm, linear to acicular, usually stiffly erect, gradually narrowed into a 0.1–0.3 mm long hyaline apiculum, margin scabrid with several rows of teeth, incurved to the midrib. Inflorescence broadly ovoid or conoid, with spreading branches. Pedicels 0.5–4 mm. Corolla 2–3 mm in diameter, cup-shaped, white. 2*n* = 22, 22*.

Distribution and ecology

Frequent along the Black Sea Coast to Mt Strandzha, scattered in Northeast Bulgaria, Danubian Plain, Forebalkan, Balkan Range, Znepole Region, and Thracian Lowland (Plovdiv, Dimitrovgrad, Haskovo). In xerophilous plant communities in dry meadows, in forest-steppe and related grassland, on limestone, seldom on sandstone or granite, from 160 up to 1100 m. SE Europe (E Romania, Euroepan Turkey,Ukraine, S Russia to the Ural (near Ufa), SW Asia.

Flowering from May to June.

G. octonarium (Klokov) Soó × ***G. rhodopeum*** Velen.

Stock with subterranean runners. Stem 25–40 cm, erect, shortly hairy at the base. Leaves in whorls of 6–7, 10–15 × 0.5–0.7 mm, linear with prominent midrib; margin revolute. Inflorescence narrow pyramidal; pedicels 1.5–2.5 mm. Corolla 2–3.5 mm in diameter, white, infundibuliform, lobes shortly apiculate.

Distribution. Thracian Lowland: in limestone glades on open slopes of the mountain foothills of Besaparski Ridove, above Ognyanovo vill.Occurs together with the parental species.

13. *G. glaucum* L., Sp. Pl. ed. 1, 107 (1753); Ehrend. & Krendl, Fl. Eur. 4: 27 (1976); Ančev, Fl. RP Bulg. 9: 77 (1989).

≡ *Asperula glauca* (L.) Besser, Enum. Pl. Volhyn. 7 (1822).

Type: Linn. Herb. 1, n. 129. 20 (BM-LINN).

Plants glaucous-pruinose. Stock with long subterranean runners. Stems 40– 100 cm, erect, usually rounded with four ridges, glabrous or pilose. Leaves in whorls of 8–9(12), 20–45 × 1–3(4) mm, linear to aciculate, seldom narrow-oblanceolate to oblanceolate, apex 0.2–0.3 mm long, mucronate, mostly spreading, midrib narrow, margin weakly scabrid, with 1–2 rows of teeth. Inflorescence conoid to broad oval; partial inflorescence conoid. Pedicels 0.5–3 mm. Corolla 3.5–4.5(6) mm in diameter, white, broadly cup-shaped; lobes with short apex; anthers 0.2–0.4 mm long, brown to dark brown. 2*n* = 44, 44*.

Distribution and ecology

NW Bulgaria. In scattered localities in the Danubin Plain (Pleven, Nikopol), Forebalkan (Shiroka Planina, the upland Veslets, the vicinity of Lukovit and Lovech), Sofia Region, Znepole Region, West Frontier Mts (Mt Vlahina), and Valley of River Struma, from 200 m up to 900 m. Along bushy forest margins, in dry meadows, on limestone, dolomite, seldom basalt. W, C and S Europe (from Belgium and France eastwards to Austria, Slovakia, Roumania and Russia, southwards to Portugal and Italy).

Flowering from May to June.

14. *G. volhynicum* Pobed., Novosti Sist. Vyssh. Rast. 7: 278 (1971); Ehrend. & Krendl, Fl. Eur. 4: 27 (1976); Ančev, Fl. RP Bulg. 9: 78 (1989).

Type: Ad Tyram in Podolia australis, Herbar Besser (**Holotype** LE!)

= *Asperula tyraica* Besser, Enum. Pl. Volhyn. ed. 1, 41-42 (1822).

≡ *Asperula glauca* subsp. *tyraica* (Besser) Hayek, Prodr. Fl. Penins. Balc. 2: 446 (1930).

= *A. glauca* var. *hirsuta* auct. Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1046 (1925) et auct. Fl. Bulg., non Wallr.

Plants darkening when dried. Stock with subterranean runners. Stems 20–100 cm, erect, rounded in the lower part, with four ridges, stout, usually densly pilose at the base, glabrous above. Leaves in whorls of 6–8, 20–40 × 0.5–1.5 mm, linear to acicular, margin scabrid, with 1–2(3) rows of teeth. Inflorescence ovoid to broadly conoid paniculate; partial inflorescences pyramidal. Pedicels 1–3 mm. Corolla 3–4 mm in diameter, cup-shaped, lobes +/– incurved. 2*n* = 44.

Distribution and ecology

In scattered localities along the Black Sea Coast, from the area of Balchik southwards to Mt Strandzha (Malko Tarnovo), Northeast Bulgaria (Shumen Plateau, Provadiya Plateau), Forebalkan (Lovech). On stony and gravelly terrains, on rocky slopes, in steppe regions along dry forests and bushes, usually on limestone substrates, from 150 m to 500 m. SE Europe (R Macedonia, Moldova, Romania, and the Ukraine).

Flowering May to June.

15–18. *G. sylvaticum* group

Young shoots green or glaucous and pruinose. Stock with or without runners. Stems terete to 4-angled, glabrous or hairy. Leaves elliptical to linear-lanceolate, lower surface paler-green than the upper, often bluish. Inflorescence broadly ovoid-pyramidate; pedicels usually capillary, not divaricate after anthesis. Corolla white, cup-shaped to rotate; tube shorter than acute to shortly apiculate lobes.

15. *G. pseudoaristatum* Schur, Enum. Pl. Transs. 282 (1866) (incl. *G. matteji* (Bald.) Hayek); Ehrend. & Krendl, Fl. Eur. 4: 27 (1976); Ančev, Fl. RP Bulg. 9: 80 (1989).

Type: Zwischen Gebüsch, auf kräuterreichen Abhängen am Zoodfluß bei Talmats mit *G. capillipes*; Alluvium. Jul. 1846.

≡ *G. sylvaticum* var. *pseudoaristatum* (Schur) Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1050 (1925).

≡ *G. sylvaticum* subsp. *pseudoaristatum* (Schur) Stoj. & Stef., op. c. ed. 2: 956 (1933); *G. turcicum* Velen., Fl. Bulg. 231 (1891) et Suppl. I: 140 (1898).

= *G. sylvaticum* var. *turcicum* (Velen.) Stoj. et Stef., op. c. 1050 (1925).

= *G. sylvaticum* subsp. *laconicum* auct. Stoj. & Stef., op. c. 955 (1933) et auct. Fl. Bulg., non Boiss & Heldr., p. p.

= *G. aristatum* auct. Bulg. p. p. min., non L.

= *G. aristatum* var. *scabrum* Griseb., Spicil. Fl. Rumel. 2: 157 (1844)

= *G. heuffelii* Borbás, Acad. Közl. 12: 88 (1874) et auct. Fl. Bulg.

= *G. papillosum*, Heuff., Flora No. 36: 563 (1853), non Lapeyr.

Root short, branched, stock without subterranean runners. Stem usually 70–100 cm, erect, 4-angled, glabrous or denesly pilose below. Leaves (25)30–60 × 2–4(6) mm, narrow to linear-lanceolate, often falcate, bright-green, margin scabrid with several rows of teeth. Inflorescence ovoid to broadly pyramidal, flowers crowded towards the end of the branches. Pedicels 0.5–3 mm. Corolla 2–3 mm in diameter, cup-shaped, lobes acute. 2*n* = 22, 22*.

Distribution and ecology

Across the country, in scattered localities in the hilly plains and on the south-facing mounatin slopes, frequent in xerophilous plant communities in the oak vegetation belt, on limestone and sandstone ground, from 150 m to 1300 m a.s.l. C and SE Europe (Slovakia, Albania, Greece, R Macedonia, Serbia, Romania,).

Flowering from June to July.

16. *G. paschale* Forssk., Fl. Aeg.-Arab. 203 (1775); Ančev, Fl. RP Bulg. 9: 82 (1989), table XIV, fig. 2.

Holotype: [Turkey A2 (E) Istanbul] ad Constantinopolem, VIII 1761 (Forsskål) (C – Forssk.!).

= *Asperula longifolia* Sm. in Sibth. & Sm., Prodr. Fl. Graec. 1: 87 (1806).
≡ *G. longifolium* (Sm.) Griseb., Spic. Fl. Rumel. 2: 157 (1844).
≡ *G. sylvaticum* var. *longifolium* (Sm.) Stoj. & Stef., Fl. Bulg. ed. 1, 2: 1050 (1925).
≡ *G. sylvaticum* subsp. *longifolium* (Sm.) Stoj.& Stef., op. c. ed. 2: 955 (1933).
= *G. bulgaricum* Velen., Fl. Bulg. 231 (1891). **Type**: Bulgaria, in collinis dumosis prope pagum Karnobat, J. Velenovský, 1891 (PRC, n.v.).
≡ *G. sylvaticum* var. *bulgaricum* (Velen.) Stoj. & Stef., op. c. ed. 1, 2: 1050 (1925).
≡ *G. sylvaticum* subsp. *bulgaricum* (Velen.) Stoj. & Stef., op. c. ed. 2: 955 (1933).

Plants green. Root short, branched, stock witout subterranean runners. Stem 80–100 cm, erect, glabrous, with +/– prominent angels. Leaves in whorls of 6–9(13), 30–60 × 2–6 mm; linear or narrow lanceolate, narrowed gradually to the apex, mucronate, dark-green above, pale bluish-green beneath, midrib narrow, margin with several rows of very small teeth. Pedicels 0.5–2 mm. Corolla 2–4 mm diameter, cup-shaped, lobes with short apiculus. 2*n* = 22, 22.

Distribution and ecology

At the Black Sea Coast, Northeast Bulgaria (Shumen Plateau, Provadiya Plateau, Balkan Range (*Eastern*), Mt Vitosha Region, Rila Mts, Rhodopi Mts (*Eastern* – Chal Planina), Thracian Lowland (Lyubimets, N of Peshtera, W of Krichim), Mt Strandzha. Mostly on slopes of the mountain foothills and in forest glades along the edges of *Ostrya–Quiercus* woodlands and in communities of *Fagus orientalis, F. sylvaticca, Quercus fraineto, Q. polycarpa, Acer monspessulanum, Fraxinus excelsior,* etc., usually on limestone, from the sea level up to 700(900) m. SE Europe (Greece: Nomos of Pella and Nomos of Evros, after Strid & Tan 2002; European Turkey); SW Asia (N Turkey, SW and C Anatolia)

Flowering from June to July.

17. *G. procurrens* Ehrend., Pl. Syst. Evol. 124: 1 (1975), fig. 1; Ehrend. & Krendl, Fl. Eur. 4: 28 (1976); Ančev, Fl. RP Bulg. 9: 84 (1989), table XIV, fig. 3.

Holotype. (Montenegro) Cattaro (= Kotor), Vermač, 2.VII.1905, J. Schneider. Det.: *F. Ehrendorfer* (W !).

Stock with long subterranean rooting runners. Stems 40–80(110) cm, stout, erect, rounded at the lower part, upwards with four weak ridges, usually glabrous; young shoots pruinose. Leaves in whorls of (6)8–10(11), 25–60 × (3)4–8(12) mm, linear-oblanceolate to elliptical, narrowing abruptly towards the acute apex; margin with 1–2 rows of small papilose teeth. Inflorescence ovoid pyramidate, rather loose; pedicels 0.7–2.5 mm. Corolla (2)2.2–3 mm in diameter, cup-shaped, lobes acute to shortly apiculate. Mericarps dark-brown to black, more or less pruinose. 2*n* = 22*.

Distribution and ecology

SW Bulgaria: Mt Vitosha Region (Mt Plana above river Vedena) and Mt Slavyanka (on the west slopes of Parilski Dol – Ambar Dere), from 650 m up to about 1400 m a.s.l. In bushy and shadowy grassy places along mixed deciduous forests of *Fagus orientalis, F. sylvatica, Carpinus betulus, Tilia tomentosa, T. platyphyllos,* and *Acer platanoides*. The Balkan Peninsula (Montenegro, N Albania). A Balkan endemic.

Flowering from mid-June to August.

Note. *Galium procurrens* is morphologically close to the hexaploid *G. intermedium*, from which it differs by narrower, oblong oblanceolate to elliptical leaves and smaler, cup-shaped corolla with non-apiculate lobes. After the first finding of *G. procurrens* in Mt Slavyanka (Ehrendorfer & Ančev 1975), we report now a new site in the plant communities of deciduous *Carpinus-Quercus* forest in Mt Plana (Mt Vitosha Region). The new finding of *G. procurrens* in Mt Plana extends the known distribution area of this Balkan endemic species from Mt Slavyanka northwards to the Mt Vitosha Region. It is likely that *G. procurrens,* a species listed in the *Red Data Book of R Bulgaria* as threatened by extinction, has a wider distribution in the mountains of SW Bulgaria.

18. *G. intermedium* Schult.**,** Obser. Bot. Oeniponti 22 (1809).

Neotype: In silvis montis Strebel ad fl. Raba ppe (prope) Mszana dolna, Galicia occidentalis (Krendl & Vitek 2008: 168, abb. 1).
= *G. schultesii* Vest, Flora (Regensb.) 4(6): 530 (1821); Ehrend. & Krendl, Fl. Eur. 4: 28 (1976); Ančev, Fl. RP Bulg. 9: 85 (1989).

Neotype: Kärnten, Deutschberg, W der westlichsten Straßenkehre der Gerlitzenstraße, steiler S-Hang, 13°36'17"E, 46°40'26"N, 27.07.2007, F. Krendl s.n. (W 2007-0017366, isotypus: K), abb. 2.
≡ *G. sylvaticum* var. *schultesii* (Vest) Stoj. et Stef., Fl. Bulg. ed. 1, 2: 1050 (1925).

≡ *G. sylvaticum* subsp. *schultesii* (Vest) Stoj. et Stef., op. c. ed. 2: 955 (1933); *G. sylvaticum* auct, Fl. Bulg. non L.

= *G. aristatum* auct. Fl. Bulg. p. max. p., non L.

≡ *G. sylvaticum* subsp. *aristatum* auct. Stoj. et Stef., op. c. 1050 (1925) et auct. Fl. Bulg., non. L.

Plants glaucous-pruinose. Rootstock with long subterranean runners. Stems 30–120 cm long, stout, erect, terete at the base with four weak ridges, otherwiese 4-angled, usually glabrous. Leaves 25–60 × (3)4–8(12) mm, broadly oblanceolate to elliptical, narrowing apruptly at the apex, margin with one or two rows of teeth. Inflorescence usually dense, broadly ovoid, strongly ramified.. Pedicels 4–7 mm long. Corolla (3)4.5 mm in diameter, mostly rotate; lobes distinctly apiculate. $2n = 66, 66^*$.

Distribution and ecology

Forebalkan, Balkan Range, Sofia Region, Znepole Region, West Frontier Mts (Mt Osogovska), Mt Vitosha Region, Rila Mts, Mt Sredna Gora. Frequent in mixed deciduous forests, on ravine woodland slopes in the mountains and mountain foothills, mostly on granite and sandstone ground, with *Fagus sylvatica, Quercus deleschampi, Carpinus orientalis,* etc., along forest margins, bushes, rocky slopes, from 800 m to 1700 m. C and SE Europe.

Flowering fromJune to July.

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Appendix 1. List of examined herbarium specimens

G. aegeum

Bulgaria. **Mt Slavyanka** (Ali-Botush): 1650 m, 10.07.1934, *A. Drenovski* as *G. rhodopeum* (SOM); peak Gotsev, limestone terrain, 16.07.1957, *V. Velchev* & *al.* as *G. asperum* Schreb. (SOM); Ambar Dere above Paril, calcareous rocky habitats, 10.07.1934, *A. Drenovski* as *G. rhodopeum* (SOM); Ambar Dere, 28.09.1969, *M. Anchev* A3175 (SOM); 26.07.1971, *M. Anchev* 71691a (SOM); Ambar Dere, limestone rocky slopes, 27.05.1976, *N. Andreev* (SOM); 25.06.1979, *M. Anchev* (SOM); Parilski Dol (Ambar Dere), 29.06.1980, *B. Kuzmanov* & *M. Anchev* (SOM); 17.08.1987, *I. Pashaliev* (SOM); 1400 m, 04.08.1994, *M. Anchev* (SOM); Mt Stargach, rocky places, 29.07.1977, *M. Anchev* (SOM); **Pirin Mts**: near Lovcha, 23°19'E, 41°29'N, 15.6.1995, *M. Anchev* (SOM); gravelly habitats on peak Sveshtnik, 23°34'E, 41°33'N, 19.09.1969; 05.07.19709, *M. Anchev* (SOM).

Greece. Nomos Dramas, Falakron, *ca.* 1200–1500 m, Felstriften, Felsen, Marmor, 29.06.1980, *W. Burri* & *F. Krendl* (SOM).

G. album subsp. *album*

Black Sea Coast: 5 km NE of Nesebar, near Elenite Resort, Kozlushko Dere, 27°48'32"E, 42°42'36"N, 31.05.1999, *Gussev* & *Rutherford* 30-4-391 (W); S of the Dyuni Resort, 27°43'15"E, 42°21'1"N, 10 m, 24.05.1999, *Gussev* & *Rutherford* 16-4-137 (W); NE of Burgas, Slanchev Briyag, 27°30'E, 42°33'N, 18.05.1962, *Ehrendorfer* 62-1/8-3 (W); **Northeast Bulgaria**: Deli-Orman, circa urbem Dobrich, 02.06.1902, *B. Davidoff* (SOM); **Balkan Range**: north of Sliven, at Dik Tepe, 500–750 m, 06.07.1970, *Krendl* (W); Vitinya, 750 m, 02.07.1995, *Anchev* (SOM); 15 km W-SW of Dalgopol, N of Dobromir, Chudnite Skali, 27°17'23"E, 42°58'1"N, 100 m, 01.06.1999, *Gussev*, *Rutherford* 33-4-305 (W); **Rila Mts**: Kurt Dere, 23°30'E, 41°50'N, 1050 m, 15.08.1912, *B. Davidoff* (SOM); **Valley of River Struma**: south of Rila town, 27.09.2003, *D. Stoyanov* (SOM); **Thracian Lowland**: ad pag. Dervent, 26°44'E, 42°0'N, 20.07.1914, *Urumov* (SOM); east of Dimitrovgrad, 400 m, 14.06.1980, *Malicky* (W); **Mt Strandzha**: along the road Burgas–Sredets, 20 km off Burgas, 11. 06.1998, *Uzunov* & *Vitek* (SOM, W); NW of Malko Tarnovo, along the river near Brashlyan, 27°25'6"E, 42°2'44"N, 250 m, 21.05.1999, *Gussev* & *Rutherford* 2-4-19 (W); Malko Tarnovo, northwestern edge of the town, 350 m, 10. 06. 1998, *Uzunov*, *Gussev* & *Vitek* (W); along the road from Sredets to Bolyarovo, 300 m, 11. 06. 1998, *Uzunov* & *Vitek* (W).

G. album subsp. ***pycnotrichum***

Black Sea Coast: *ca.* 1 km S of the border to Romania, 03.06.1998, *Uzunov*, *Gussev* & *Vitek* (W); S of Shabla, along road from Gorun to Tyulenovo, 100 m, 04.06.1998, *Uzunov*, *Gussev* & *Vitek* (W); NE of Nesebar, Kozlushka river valley N of Elenite Resort, 27°48'39"E, 42°42'54"N, 40–80 m, 07.06.1998, *Uzunov*, *Gussev* & *Vitek* 98-477 (W); Cape Emine, 10 km E–NE of Nesebar, 27°53'53"E, 42°42'14"N, 50 m, 30.05.1999, *Gussev* & *Rutherford*, (W); 15 km W–SW of Varna, S of Beloslav, Provadiya Plateau, 27°41'50"E, 43°10'16"N, 150 m, 02.06.1999, *Gussev* & *Rutherford* 34-4-409 (W); Veli-Faka (Popgrigorovo), 17.07.1905, *B. Davidoff* (SOM!); Ad urbem Kavarna, 28°20'E, 43°26'N, 15.07.1902, *B. Davidoff* (SOM); Dubrudzha, ad Gebédze, 27°42'E, 43°12'N, 06.06.1904, *B. Davidoff* (SOM); *ca.* Varna, Gebédze–Aladin, 27°46'E, 43°12'N, 06.06.1904, *B. Davidoff* (SOM); circa Varna, ad Pontum, 27°54'E, 43°12'N, 02.07.1904, *B. Davidoff* (SOM); *ca.* 6 km S–SE of Obzor, 06.06.1998, *Uzunov*, *Gussev* & *Vitek* (W); NW of Nesebar, 5 km W of Vlas, Kalinata loc., 27°41'30"E, 42°42'54"N, 29.05.1999, Gussev, & Rutherford 25,1-4-372 (W); E–NE of Nesebar, Cape Emine , 6.6.1998, *Uzunov*, *Gussev*, *Vitek* 98-394 (W); **Northeast Bulgaria**: Shumenska Trapeza, 26°56'E, 43°16'N, 06.06.1894, *B. Davidoff* (SOM); near Tarnovo, ad stadionem, *Urumov* 1896 (W); Kaspichan, 27°9'E, 43°18'N, 20.08.1905, B. *Davidoff* (SOM); **Balkan Range**: Mt Kamchiyska, Balban Dere, 05.06.1998, *Uzunov*, *Gussev* & *Vitek* (W); 15 km W–SW Dalgopol, N of Dobromir, 27°17'23"E, 42°58'1"N, 100 m, 01.06.1999, *Gussev* & *Rutherford* 33-4-307 (W); **Rhodopi Mts** (*Eastern*): Stramni Rid south of Momchilgrad, 25°25'E, 41°42'N, 04.06.1970, *M. Anchev* 70236a (SOM); **Thracia orientalis [Turkey],** Bulair, 1913, *Urumov* (SOM).

G. asparagifolium

Mt Slavyanka (Montis Ali Botuš): *Skřivánek* (PRC); Mt Stargach, rocky calcareus slopes south of Ilinden, 15.06.1995, *M. Anchev* (SOM); mountain slopes above village Ilinden, Ca, 67-–680 m, 21.06.2008, *M. Anchev* & *F. Krendl* (SOM, W).

G. flavescens

Northeast Bulgaria: Madara, in gravelly places, 27°6'E, 43°16'N, 19.08.1970, *M. Anchev* (SOM); **Forebalkan**: Tarnovo, 1896, *I. Urumov* (W); Mt Malka Aitoska, 29. 06.1972, *M. Anchev* (SOM); **Znepole Region**: Mt Konyavska, above vill. Konyavo, 22°47'E, 42°19'N, 03.07.1974, *M. Anchev* (SOM); **Mt Vitosha Region**: Kopitoto, 23°16'E, 42°37'N, 1300 m, 12.07.1971, *M. Anchev* (SOM); Mt Vitosha, l. d. Kopitoto, 1400 m, 08.07.1951, *Efremov* & *B. Achtarov* (W); Mt Plana, Visokodolski Rid, 23°25'E, 42°29'N, 1050 m, 16.06.1970, *B. Davidoff* (SOM); Mt Lozenska, S of Pancharevo, along the road to Samokov, 02.70.2006, *F. Krendl* (W); Mt Lozenska, near Kokalyanski Monastery, 23°25'24"E, 42°33'34"N, *ca.* 680 m, 02.07.2006, *F. Krendl* (W); Lyulin, above the railway, on an open rocky slope, 23°44'E, 42°38'N, 15.06.1971, *M. Anchev* (SOM); **Mt Slavyanka**: Parilski Dol, 23°41'E, 41°26'N, 29.06.1980, *B. Kuzmanov* (SOM); **Pirin Mts**: along oak forest above Drakolovo, at the foots of Grantscharska Rock, 800 m, 22.07.1982, *S. Kozhuharov* (SOM); **Rila Mts:** Zelena Rila, ad riv. Cherna Mesta supra pagum Yakoruda, 01.07.1915, *B. Davidoff* (SOM); on screes along the road, Sapareva Banya–Panichishte, 23°17'E, 42°19'N, 16.07.1970, *M. Anchev* (SOM); **Rhodopi Mts**: Chernatitsa, near Rodopski Partisani, 700 m, 27.06.1973, *M. Anchev* (SOM); **Thracian Lowland**: Bunartschik bei Philipopol (Plovdiv), 05.1890, *Pichler* (W); Ovchi Halmove, in grassy and stony places, 30.06.1977 (SOM).

G. glaucum

Danubian Plain: the valley of river Studena near vill. Studena, Pleven district, 13.05.2007, *S. Stoyanov* (SOM); Jasen vill., Pleven district, 26.06.1924, *I. Urumov* (SOM); in graminosis ad Lukovit, 1924, *I. Urumov* (SOM); in collinis siccis prope Lovech, 1889. *I. Urumov* (SOM); **Sofia Region**: Gradets, Sofia district, in grassy places, on limestone ground, *V. Velchev*, 27.06.1956 (SOM).

G. intermedium (*G. schultesii*)

Forebalkan: S of Balgarski Isvor, Lovech district, 18.07.1971, *M. Anchev* (SOM); **Balkan Range**: prope urbem Karlovo, 24°48'E, 42°39'N, 1894, *I. Urumov* (SOM!); Prope urbem Kalofer, 24°58'E, 42°37'N, 1896, *I. Urumov* (SOM!); Near Gabrovo, 450 m, 25°19'E, 42°54'N, 07.07.1907, *B. Davidoff* (SOM!); Arman Kaja, 26.07.1902, *I. Neiceff* (SOM!); Troyan, Smesite, S Cherni Osam, along beech forest, 25°30'E, 42°52'N, 14.08.1970, *M. Anchev* (SO !); Kuru Dere, 11.08.1969, *M. Anchev* (SOM!); Troyanski Balkan, 1899, *I. Urumov* (SOM!); **Znepole Region**: Mt Rui, prope Tran, 25°38'E, 43°5'N, 1903, *I. Urumov* (SOM!); Mt Rudina, supra l. d. Borovski Dol prope pagum Treklyano, 22°35'E, 42°33'N, 1100 m,

31.07.1939, *B. Achtarov* (SOM!); Tsarvendol, Krushkata loc., Kyustendil district, 23.07.1969, *M. Anchev* (SOM!); Tzarvendol, 03.09.1970, *M. Anchev* (SOM!); Mt Paramunska, above vill. Paramun, 09.07.2008, *S. Stoyanov* (SOM). **Mt Vitosha Region**: Bosnek, 23°10'E, 42°29'N, *B. Achtarov* (SOM!); deciduous forests aboveVladaya, 23°12'E, 42°38'N, 28.06.1970, *M. Anchev* (SOM!); Mt Vitosha, *I. Urumov*, 1924 (SOM!); Near Boyana waterfall, 23°15'E, 42°48'N, 10.06.193 , *B. Achtarov* (SOM!); ad radicem Mt Vitosha, 23°16'E, 42°33'N, 1904, *M. Anchev* (SOM!); Dragalevtsi, 23°19'E, 42°38'N, 1200 m, 25.08.1933, *B. Achtarov* (SOM!); above Knyazhevo, 1300 m, 30.08.1970, *M. Anchev* (SOM!); SE of Sofia, Pancharevo Water Reservoire, 19.05.2002, *A. Polatschek* (W); **Rila Mts**: Tsarska Rila ad riv. Malka Bistritsa, 1200 m, 03.06.1909, *B. Davidoff* (SOM!); Markudzhik, 2000 m, 07.08.1909, *B. Davidoff* (SOM!); Cherna Rila, 30.07.1911, *B. Davidoff* (SOM!); on a scree on the steep bank of river Bistritsa, above Borovets, 23°34'E, 42°20'N, 12.10.1970, *N. Vichodcevski* (SOM!); Mt. Cerna Rila: Beliya Uley supra coenobium, 1700 m, 30.07.1916, *B. Davidoff* (SOM!); Mt Malka Rila loc., 1200 m, 05.07.1911, *B. Davidoff* (SOM!); Mt Topla Rila, supra riv. Dupnishka Bistritsa, 1200 m, 29.07.1912, *B. Davidoff* (SOM!); Tsarska Rila, 1400 m, 06.09.1909, *B. Davidoff* (SOM!); Mt. Tsarska Rila, Malka Bistritsa, 1100 m, 23.07.1969, *M. Anchev* (SOM!); Mt Tsarska Rila, Sokolets ad riv. Malka Bistritsa, 23°11'E, 42°3'N, 1400 m, 23.07.1910, *B. Davidoff* (SOM!); Mt Tsarska Rila, 1250 m, 23.07.1910, *B. Davidoff* (SOM!); Tsarska Rila, ad riv. Lukovitsa, 1100 m, 14.06.1909, *B. Davidoff* (SOM!); Mt Malka Rila, peak Shismanov, 1100 m, 14.07.1910, *B. Davidoff* (SOM!); Mt. Malka Rila, peak Shismanov, 1100 m, 10.07.1910, *B. Davidoff* (SOM!); near Tran, 18.05.2002, *A. Polatschek* (W); Rila Mts, in Monte Mussala, 1300 m, 19.08. 1907, *Schneider* & *Bergmann* (W); **Mt Sredna Gora**: 30.07.1911, *B. Davidoff* (SOM!); Manastirski Hills, northern slopes, Gradischteto, 30.05.1967, *I. Ganchev* (SOM).

G. lovcense

Black Sea Coast:. Varna, 04.08.1886, *Bornmüller* (WU); Yailata at Kamen Briyag, 28°33'E, 43°27'N, 09.08.1998, *A. Petrova* (SOM); Kavarna, 16.05.1905, B. *Davidoff* (SOM; 15 km WSW of Varna, S of Beloslav, Provadiya Plateau, 27°41'50"E, 43°10'16"N, 150 m, 02.06.1999, *Gussev* & *Rutherford* 34-4-413 (W); mouth of river Kamchia, 06.06.1904, *A. Javashov* as *G. verum* (SOM);

Northeast Bulgaria: near vill. Tabachka, Ruse district, 25°2'E, 43°47'N, 16.07.1971, *M. Anchev* 71647a (SOM); valley of river Lom near Ruse, 12.07.1930, *Ronniger* (W); Shumen, 1902, *A. Javashov* (WU); Madara – Kaspichan, 07.06.1902, *A. Javashov* as *G. saxatile* (SOM); Gulitsa, 1902, *A. Javashov* (WU); ad urbem Lukovit, 24°10'E, 43°13'N, 1924, *I. Urumov* (SOM); near Kozludzha (Suvorovo), 27°36'E, 43°20'N, 22.07.1901, *B. Davidoff* (SOM); supra urbem Provadiya, 27°27'E, 43°11'N, 24.05.1903, *B. Davidoff* (SOM); **Forebalkan:** Vrashka Chuka, 19.06.1972, *S. Kozhuharov* (SOM); Bash Kulesi, south of Lovech, 1895, *I. Urumov* as *G. erectum* (WU); near Lovech, 1897, *I. Urumov* (WU); Bash Kulesi above Lovech, June 1971, *M. Anchev* (W); proper Lovech, 1899, *I. Urumov* (SOM); near Tarnovo, 1895, 1896, 1899, *I. Urumov* as *G. aureum* (SOM, WU); supra Tarnovo, 25°38'E, 43°5'N, 1210 m, 24.06.1933, *B. Achtarov* (SOM); Gabrovo, 0.1900, *I. Neichev* (SOM); above vill. Zdravkovets, Gabrovo district, 22.06.2008, *A. Petrova* (SOM); on limestone rocky slopes, Derventa loc. east of Tarnovo, 12.08.1970, *M. Anchev* (SOM); near Gabrovo, 1898, *I. Urumov* (WU); **Balkan Range:** Balkan Range, 20.07.1900, *I. Neichev* (SOM); Kuru Dere above Gabarevo, 09.08.1969, *M. Anchev*, (SOM); Kozya Stena, 24°37'E, 42°49'N, 03.09.1995, *T. Meshinev* (SOM); S slopes of Kumanitsa hill, on limestone, 1770 m, 06.07.1996, *I. Apostolova* & *T. Meshinev* as *G. heldreichii* (SOM); Tvarditsa, 25°54'E, 42°42'N, 05.07.1969, *S. Kozhuharov* (SOM); near Karlovo, 1910, *I. Urumov* (SOM); 20.07.1900, *I. Neichev* (SOM); Mt Rishka, calcareus rocky places of Golyamia Oritlza, 850 m, 27.06.2002, *D. Stojanov* (SOM); Troyanski Balkan, 22.07.1898, *I. Urumov* (WU); C Stara Planina, Dobrila, 1896, *I. Urumov* (WU); E , prope Sliven, nördl. vom Barmuck, 16.07.1907, *Schneider* (W); 15 km WSW Dalgopol, N of Dobromir, Chudnite Skali loc., 27°17'23"E, 42°58'1"N, 100 m, *Gussev* & *Rutherford* 33-4-278 (W); **Znepole Region**: Mt Konyavska, north of Polska Skakavitsa, loc. Pazarliya, Ca, 03.06.1992, *M. Anchev* (SOM); Mt Konyavska, above vill. Konyavo, 22°47'E, 42°19'N, 03.70.1974, *M. Anchev* (SOM); Golo Bardo, on the south slopes along the road to Kula, 11.07.1969, *M. Anchev* (SOM); Berende Izvor, 23.07.2005, *K. Vassilev* (SOM); **Mt Belasitsa**: along edges of chestnut forest south of Petrich, 900 m, 12.07.1969, *M. Anchev* (SOM); **Mt Slavyanka**: above Goleshevo, 23°35'E. 41°46'N, 28.06.1980, *B. Kuzmanov* & *M. Anchev* as *G. heldreichii* subsp. *heldreichii* (SOM); Ambar Dere above vill. Paril, limestone, 23°39'E, 41°25'N, 27.06.1976, *M.*

Anchev (SOM); peak Gotsev, in mountain rocky grassland, 23°38'E, 41°23'N, 2200 m, 26.08.1992, *I. Pashaliev* (SOM); on the east slope of peak Tsarev, 01.07.1997, *M. Anchev* (SOM); **Pirin Mts**: along river Sandanska Bistritsa near Popina Laka, 23°26'E, 41°42'N, 15.07.1969, *M. Anchev* (SOM); **Rhodopi Mts**: limestone terrains near vill. Mogilitsa, Smolyan district, 24°39'E, 41°30'N, 03.08.2003, *A. Petrova* (SOM); Dobrostan Massif, rocky slopes above the Marziganitsa–Bachkovo trail, 24°55'E, 41°55'N, 29.06.1991, *A. Petrova* (SOM); Bachkovo, 07.1914, *V. Střibrný* as *G. aureum* (SOM); Dobrostan Massif, Kuru Dere, 24°50'E, 41°54'N, 07.1996, *A. Petrova* (SOM); E Rhodopi Mts, Stramni Rid, S of Momchilgrad, 10.06.1971, *M. Anchev* (SOM); **Thracian Lowland:** Haskovo district, 106 km E Plovdiv, 250 m, 14.06.1962, *F. Ehrendorfer* (WU).

G. lucidum

Balkan Range: C Balkan, 07.1903, *I. Neichev* (SOM); Stapalata, 1920, *I. Neichev* (SOM); rocky places above Karlovo, 24°48'E, 42° 39'N, 08.1970, *M. Anchev* (SOM); **Mt Vitosha Region**: l. d. Kopitoto, 1400 m, 08.07.1951, *Efremov* & *B. Achtarov* (W); **Znepole Region**: ad Belovo (Zemen) prope Kyustendil, 22°46'E, 42°29'N, 1908, *I. Urumov* (SOM); **Mt Slavyanka**: south of Paril, Ambar Dere, 23°39'E, 41°2'N, 1300 m, 29.07.1988, *I. Paschaliev* (SOM); grassland above the timberline, *ca.* 2000 m, 23°39'E, 41°26'N, 29.07.1977, *M. Anchev* (SOM); **Pirin Mts**: Kamenitisa, Pogledets, 23°26'E, 41°42'N, 1980 m, 05.07.1981, *N. Andreev* (SOM); Banski Suhodol, 22.07.1980, *B. Kuzmanov* (SOM); alpine grasslands, Kazana, 20.07.1980, *B. Kuzmanov* (SOM); Orelova Skala supra pagum Pirin, 2000 m, 23°35'E, 41°34'N, 25.07.1938, *B. Achtarov* (SOM); Mt Baba, supra urb. Nevrokop (Gotse Delchev), 23°22'E, 48°8" N, 1850 m, *B. Achtarov* (SOM); Near Orelek, 2000 m, 23°36'E, 41°35'N, 28.07.1970, *M. Anchev* (SOM); ad Orelek supra Nevrokop, 23°35'E, 41°34'N, 2000 m, 21.07.1950, *B. Achtarov* (SOM); stony grassy places along the trail to Orelek, 19.07.1977, *N. Andreev* (SOM); Pirin, Kazana, 24.07.1980, 2000 m, *B. Kuzmanov* (SOM); Sandanska Bistritsa, near turisthaus Begovitsa, 23°24'32"E, 41°40'45"N, 1415 m, 09.07.2007, *F. Krendl* 44883 (W); S. Pirin Mts, between Ilinden and Paril, 23°36'34"E, 41°51'54"N, 746 m, 06.07.2007, *F. Krendl* 44861 (W); **Rila Mts**: NE of Urdini Ezera, 700–1580 m, 22.07.1976, *Vitek* (W); Mt Tsarska Rila, 1450 m, 23.07.1920, *B. Davidoff* (SOM); Mt Bela Rila, sub Mala Cherkva, 1100 m, 12.06.1911, *B. Davidoff* (SOM); **Rhodopi Mts**: Prespa bei Bela Cerkwa, 21.07.1930, *Ronniger* (W); vill. Kara Chumak, along the road of Karierata, 18.08.1971, *Petrova* (SOM); supra Bachkovski Monastery, 350–400 m, 12.06.1973, *W. Greuter* 11165 (W); ad Asenova Krepost, inter Asenovgrad et Bachkovo, 350 m, 12.06.1973, *W. Greuter* (W); Krichim, 24°26'E, 42°4'N, 350 m, 13.07.1970, *F. Krendl* (W); Beglika, 07.1976, *B. Kuzmanov* (SOM); **Mt Strandzha:** Malko Tarnovo, northern edge of city, 350 m, 10.06.1998, *Uzunov*, *Gussev* & *Vitek* (W); S of Gramatikovo, near the bridge of river Veleka, 64 m, 20.05.2000, *A. Polatschek* (W).

G. macedonicum

Valley of River Struma: open slopes north of Kresna, 250 m, 02.07.1992, *M. Anchev* (SOM); **Mt Belasitsa**: stony places in wood of *Castanea sativa*, 12.07.1969 (SOM); **Pirin Mts**: 2 km above vill. Vlahy, 22.07.1970, *M. Anchev* (SOM); Popina Laka, 1300–1350 m (BP); roadsides near Razlog, 06.06.1971, *M. Anchev* (SOM).

G. mirum

Pirin Mts: along the road G. Delchev-Papaz Chair, 1250 m, *A. Petrova* & *M. Anchev* (SOM); Gradevo, 06.06.1971, *M. Anchev* (SOM); **Rhodopi Mts:** Terasata loc., southwest of Kardzhali, 25°23'E, 41°38'N, 13.06.1953, *N. Stojanov* & *B. Kitanov* as *G. angustifolium* Leers. (SOM); Stramni Rid, south of Momchilgrad, 25.08.1971, *M. Anchev* (SOM); **Thracian Lowland**: Peshtera, *V. Stribrný* (PRC); Besaparski Ridove, south of Sinitevo, 311 m, 04.07.2007, *M. Anchev* & *F. Krendl* (SOM); Basaparski Hills near Ognyanovo, in bushes of *Cotinus coggygria* and *Paliurus spina-christi,* 11.06.1992, *M. Anchev* (SOM); Besaparski Ridove above Ognyanovo, 09.06.2004, *M. Anchev* & *V. Goranova* (SOM).

G. octonarium

Black Sea Coast: Kavarna, valley between the town and the port, 14.07.1975, *Manitz* (JE); 5 km southwest of Kavarna, Balchishka Tuzla loc., 28°15'54"E, 43°24'42"N, 50 m, 03.06.1999, *Gussev* & *Rutherford* 36-4-445 (W); Cape Kaliakra, 28°27'37"E, 43°22'33"N, 120 m, 05.06.1999, *Gussev* & *Rutherford* 42-4-474 (W); *ca.* Varna, 27.05.1927, *B. Davidoff* (SOM); ad pagum Emirler (Povelyanovo), 1885, *I. Urumov* (SOM); **Northeast Bulgaria:** prope Razgrad, 07.1885, J. *Velenovský* (PR); Razgrad district, prope pag. Mirovo, 18.06.1948, *N. Stojanov* (SOM); *ca.* 2 km nor-

teast of Byala, 160 m, 02.06.1998, *Uzunov*, *Gussev* & *Vitek* 98-87 (LI); **Danubian Plain**: ad urbem Pleven, 1924, *I. Urumov* (B); **Forebalkan**: between Brestnitsa and Toros, near river Vit, south slopes, 24°15'1"E, 43°3'36"N, *ca.* 200 m, 05.70.2006, *F. Krendl* 44407 (W); Lovech, 1892, *I. Urumov* (BP); prope Lovech, 1882, *I. Urumov* (SOM); bei Lovech, Stratesh, 1893, *I. Urumov* (W); south of Lovech, Lipaka, 10.07.1970, *M. Anchev* (SOM); Sevlievo, 05.1901, *I. Neichev* (SOM);); Prope Tarnovo, 12.05.1896, *I. Urumov* (WU); Tarnovo, 1896, *I. Urumov* (SOM); **Balkan Range**: Troyansky Balkan, 1895, *I. Urumov* (WU); near Gabrovo, 1892, *I. Urumov* (WU); Sliven, under the saddle of the road to Balgarka, 800–1100 m, 06.07.1970, *F. Krendl* 39639 (W); **Znepole Region**: in the environs of Dragoman, 16 kms east of the Bulgarian-Serbian frontier, 18.05.1962, *F. Ehrendorfer* 62-1/99-2 (W); **Thracian Lowland**: hills near vill. Brestovitsa, 19.6.1969, *A. Petrova* (SOM); Besaparski Ridove, 408 m, 14.07.1970, *F. Krendl* 39640 (W); Besaparski Ridove near Ognyanovo, 28.05.1970, *M. Anchev* (SOM); ad Sadovo, 18.06.1890, *V. Střibrný* (PR); near Papasly (Поповица), 06.1890, *Keck* & *Pichler* (WU, G); ad Papasly, 1890, *J. Velenovský* (PRC); Plovdiv, town hill, 07.07.1970, *F. Krendl* 33932 (W); 1–2 km south of Dimitrovgrad, 29.06.1972, *F. Krendl* 39637 (W); ad Haskovo, 06.1906, *L. Adamovič* (W, WU).

G. paschale

Black Sea Coast: 5 km NE of Nesebar, east of Vlas, Kozlushko Dere loc., 27°48'32"E, 42°42'36"N, 20 m, 31.05.1999, *Gussev* & *Rutherford* 30-4-390 (W); *ca.* 1–2 km S Primorsko, --20 m, 01.07.1970, *F. Krendl* 10066a (W); Batovata, 06.07.1900, *B. Davidoff* (SOM); **Northeast Bulgaria**: Shumenska Trapeza, 26°5'E, 43°16'N, 21.06.1894, *B. Davidoff* (SOM); Shumen, 05.08.1901, *A. Javashov* (SOM); Near Dobrich, 17.07.1900, *B. Davidoff* (SOM); **Balkan Range**: Mt Kamciyska, Gulitsa, 26°59'E, 42°54'N, 07.08.1900, *B. Davidoff* (SOM); Mt Eminska, in shadowy woody places, 11.06.1973, *M. Anchev* (SOM); Mt Eminska, Banya, 350 m, 11.06.1973, *Reuter* 11125 (W); **Rila Mts**: Waldregion ober Čam-Korija [Borovets], 23°24'E, 42°5'N, 26.07.1930, *Ronniger* (W); **Thracian Lowland**: 43 km SE Sofia, on the main road to Plovdiv, 600 m, 14.06.1962, *F. Ehrendorfer* (W); **Mt Strandzha**: in oak forest of the Uzun–Bodzak Reserve, 27°47'E, 42°0'N, 05.08.1974, *M. Anchev* (SOM); Uzun–Bodzak Reserve, river Rezovska, open rocky terrain, 06.1998, *Bancheva* & *Gussev* (SOM); in beech forest east of Kosti, 27°48'E, 42°4'N, 26.06.1972, *M. Anchev* (SOM); NW of M. Tarnovo, near Brashlyan, 27°25'6"E, 42°2'44"N, 250 m, *Gussev* & *Rutherford* 2-4-2 (W).

G. ×pomeranicum

Black Sea Coast: Kranevo, 27°39'E, 44°0'N, 09.07.1987, *M. Anchev* (SOM); **Balkan Range**: Kaloferski Balkan, 25°0'E, 42°43'N, 1700 m, 08.08.1911, *A. Drenovski* (SOM); Sliven, under the saddle of the road to Balgarka, 800–1100 m, 26°19'E, 42°43'N, 06.07.1970, *F. Krendl* 39639 (W); Stara Planina 07.1903, *I. Neichev* (SOM); **Mt Vitosha Region:** near the road Bistritca–Pancharevo, 06.07.1973, *Markova* & *Katsareva* (W); **Rhodopi Mts:** Peshtera–Batak, near the crossroad to Fotinovo, 24°14'E, 41°59'N, 11.07.1970, *F. Krendl* (W). Mt Perelik, 24°36'E, 41°36'N, 1900 m, 29.70.1997, *Bergmeister* & *al.* (W).

G. procurrens

Mt Vitosha Region: Mt Plana, on the eastern slopes above river Vedena in the vicinity of Kokalyanski Monastery, 23°25'25"E, 42°33'34"N, *ca.* 680 m, mixed deciduous forest, silicate, 02.07.2006, *M. Anchev* & *F. Krendl*, A0064 & K 44401 (SOM, W); **Mt Slavyanka**: Ambar Dere, above vill. Paril, 28.09.1973, *M. Anchev* A3194 (SOM).

G. pseudoaristatum

Black Sea Coast: 5 km SW of Kavarna, Balchishka Tuzla loc., 28°15'54"E, 43°24'42"N, 60 m, 03.06.1999, *Gussev* & *Rutherford*, 36-4-437 (W); *ca*. 6.5 km, SW of Sinemorets, 09.06.1998, *Uzunov*, *Gussev* & *Vitek* 98-655 (W); **Balkan Range**: 15 km WSW Dalgopol, SE of Dobromir, near river Balaban Dere, 27°16'21"E, 42°56'33"N, 100 m, 01.06.1999, *Gussev* & *Rutherford* 32-4-323 (W); **Mt Strandzha**: NW of Burgas, Zhaltata Prast loc. near Kondolovo, 27°13'33"E, 42°36'59"N, 250 m, 22.05.1999, *Gussev* & *Rutherford*, 7-4-69 (W); *ca.* 2 km south of Kondolovo, 300 m, 10.06.1998, *Uzunov*, *Gussev* & *Vitek* 98-836 (SOM, W)

G. rhodopeum

Rhodopi Mts: ad Stanimaka (Assenovgrad), L. *Adamović* (WU); limestone slope between Yugovo and Laki, 03.07.2004 (SOM); **Thracian Lowland**: In collinis ad Tekira (Trivoditzi), *V. Střibrný* 9518 (B, BP, GB, GZU, M, PRC, W, WU); in calcareis aridis supra Tekira (Trivoditzi), *J. Velenovský* (B, G, GB); In rupestribus submontanis mt. Rhodope, Adamovič (G, M, W, WU);

Besaparski Ridove above Ognyanovo, 24.08.1971, 11.06.1992, *M. Anchev* (SOM); Besaparski Ridove, Bababair, 1907, *I. Urumov* (SOM); Besaparski Ridove, Glavinishki Rid, 30.05.1991, *I. Apostolova* (SOM); Besaparski Ridove, *ca*. 30 km S of Plovdiv, 15.06.1970, *O. Polunin* 10480 (LTR); ad Pazardzhik, *V.ýStřbrný* 1987 (BP, FI, G, W); in submontanis ad Alikochovo (Kapitan Dimitrievo), 09.06.1895, *V. Střibrný* (W).

G. rigidifolium

Black Sea Coast: Balchik, Solnitsata, 30.07.1907, *A. Javashov* as *G. ochroleucum* (SOM); Kaliakra, 25.07.1999, A. *Petrova* & *M. Anchev* (SOM); *Rusalka*, 27.07.1999, *A. Petrova* & *M. Anchev* (SOM); **Northeast Bulgaria**: Provadiyska Trapeza, 27°27'E, 43°10'N, 27.06.1903, *B. Davidoff* as *G. ochroleucum* (SOM); Kalajži–Dere (Tvarditsa), 10.07.1900, *B. Davidoff* as *G. ochroleucum* (SOM); Nevsha, 06.06.1902, *B. Davidoff* as *G. aureum* (SOM); **Forebalkan**: Tarnovo, 1896, *I. Urumov* (SOM); **Balkan Range**: Imitliysky Prohod, 30.07.1902, *I. Neichev* & *B. Davidoff* as *G. lucidum* (SOM); Mala Planina, Katinski Piramidi, 04.07.2005, *V. Vutov* & *D. Dimitrov* (SOM); Prope Karlovo, 24°48'E, 42°39'N, 1898, *I. Urumov* as *G. ochroleucum* (SOM); **Znepole Region**: Dolno Selo, 01.07.1913, *B. Davidoff* as *G. lucidum* (SOM); **Mt Vitosha Region:,** Mt Lyulin, Gradishteto, 24.06.1951, *I. Ganhev* as *G. mollugo* subsp. *lucidum* (SOM); Mt Lyulin, above the railway, 28.06.1919, *B. Achtarov* (SOM); in graminosis petrosis apricis l.d. Kopitoto, 1400 m, 08.07.1951, *N. Efremov* & *B. Achtarov* as *G. lucidum* (SOM); Mt Plana, Prodanovski Rid, 23°27'E, 42°26'N, 1100 m, 25.06.1909, *B. Davidov* as *G. ochroleucum* (SOM); **Valley of River Struma**: Pastuh vill. south of Nevestino, 500 m, 20.05.2005, *A. Polatschek* (W); Kresnenko Hanche, 23°11'E, 41°47'N, 350 m, 20.05.2005, *A. Polatschek* (W); Prope Gorna Džumaja (Blagoevgrad), 500 m, 15.10.1929, *Fenensko* (SOM); **Valley of River Mesta**: above the right river bank, in stony places along the road to G. Delchev, 23°44'E, 41°35'N, 30.06.2005, *D. Dimitrov* (SOM); **Rila Mts**: Topla Rila, Chiflika sub coenobium, 950 m, 02.08.1911, *B. Davidoff* as *G. ochroleucum* (SOM); **Rhodopi Mts:** Yundola, 23°52'E, 42°4'N, 1912, *I. Urumov* (SOM); W of riverKanina, Osikovo, 23°36'40"E, 41°33'14"N, 940 m, 07.07.2007, *F. Krendl* (W); Bachkovo, 08.1914, *V. Střibrný* as *G. ochroleucum* (SOM); Kuru Dere above Asenovgrad, 30.06.1991, *A. Petrova* & *M. Anchev* (SOM); ad Lazene, 1912, *I. Urumov* as *G. erectum* (SOM); **Thracian Lowland**: pr. Kurtovo, 23°52'E, 42°2'N, 1898, *I. Urumov* (SOM).

G. velenovskyi

Rhodopi Mts: in limestone places on the west slope of the Zhelezni Vrata hill near Kardzhali, 25°23'E, 44°39'N, 600 m, 13.06.1953, *N. Stojanov* & *B. Kitanov* (SOM); near Studen Kladenets, 25°37'E, 41°37'N, 27.05.2001, *A. Petrova* (SOM); on rocks near the road Studen Kladenets–Krumovgrad, 25°41'E, 41°34'N, 25.05.2002, *A. Petrova* (SOM); south of Momchilgrad, Stramni Rid, 04.06.1970, *M. Anchev* (SOM); inter Plovdiv et Stanimaka (Assenovgrad), 1916, *I. Urumov* (SOM).

G. volhynicum

Black Sea Coast: Rusalka Seaside Resort, 28°30'E, 43°25N, 27.06.1999, *A. Petrova* & *M. Anchev* (SOM); the Kaliakra Reserve, 28°30'E, 43°25'N, 15.06.1999, *A. Petrova* & *M. Anchev* (SOM); the White Coast E. of Balchik, Cape Imeto, 50–70 m, *Uzunov*, *Gussev* & *Vitek* 98-185 (W); Kavarna, 13.07.1931, *Häýrén* (H); bezirk Varna: *ca.* 20 km W Varna on the street to Shumen, 17.08.1968, *Merxmüller* & *Zollitsch* 24586 (M); **Northeast Bulgaria:** Provadiyska Trapeza, 27°27'E, 43°10'N, 27.06.1903, *B. Davidoff* (SOM); **Forebalkan**: near Tarnovo, 1896, *I. Urumov* (WU); Lovech, 1892, *I. Urumov* (BP).

Appendix 2. List of karyologically examined taxa, chromosome numbers and origin of the material

***G. aegeum* – 2*n* = 44**

Mt Slavyanka: Ambar Dere, 23°48'E, 41°27'N, 19.09.1970, *M. Anchev* (SOM)

Pirin Mts (*Southern*): north of Nova Lovcha vill., stony slopes with scattered trees of *Pinus nigra*, 23°46'40"E, 41°29'20"N, 659 m, 06.07.2007, *M. Anchev* & *F. Krendl* (Krendl 44865, SOM, W).

***Galium album* subsp. *album* – 2*n* = 44**

Forebalkan: south of Malak Varshets, Lovech district (Anchev 1982).

Balkan Range: north of Karnare, on south slopes of Troyanski Balkan, 24°37'32"E, 42°44'8"N, *ca.* 1050 m, 06.07.2006 (K 44415); east of Sliven, near the road to peak Balgarka, mountain meadow in oak forest, 06.07.1970 (K 1664$^+$, 1666$^+$); east of Sliven, south of peak Balgarka, ravine woods of *Fagus sylvatica*, 06.07.1970, (K 1966a) *ca.* 950–1100 m; east of Sliven, at the southern foot of the Barmuka Hill, *Quercus pubescens* with *Pinus* stand, sandstone, 06.07.1970 (K 1663).

Znepole Region: Kamenishka Skakavitsa, Kyustendil district (Anchev 1982).

Pirin Mts: near peak Orelek, 23°29'E, 41°41'N, 2000 m, dry meadows, 30.06.1997, *A. Polatschek* (K 32992); above Popski Preslap pass, 23°43'1"E, 41°25'49"N, 1564 m, margins of forest road, limestone rocks, 01.07.2007, *M. Anchev* & *F. Krendl* (K 44867); south of Orelek, 23°36'40"E, 41°33'14"N, 1702 m, limestone rocky slopes, meadow, 07.07.2007, *M. Anchev* & *F. Krendl* (K 44870); south of Orelek, 23°36'43"E, 41°33'49"N, 1984 m, rockheath meadow, limestone, 07.07.2007, *M. Anchev* & *F. Krendl* (K 44872).

Rila Mts: Rila Monastery, in forest outskirts, 15.07.1970 (K 1667); south of Samokov, Beli Iskar, *ca.* 1200 m, gravelly and rocky slopes, gneiss, 02.07.1997, *A. Polatschek* (K 32993).

Mt Sredna Gora (*Western*): Mt Lozenska, Trudovaka loc., 23°24'46"E, 42°33'22"N, 650 m, mixed deciduous forest, Si, 02.07.2006, *M. Anchev* & *F. Krendl* (K 44403).

Mt Strandzha: 1–2 km SE of Yasna Polyana vill.*, 27°37'E, 42°17'N, 300 m, 03.07.1970 (K 1662).

***G. album* subsp. *pycnotrichum* – 2*n* = 44**

Black Sea Coast: NE of Burgas, Slanchev Bryag, 10.07.1970 (K 4699).

Forebalkan: Draganovo vill., Veliko Tarnovo district (Anchev 1982).

Balkan Range: Karnare, Troyan Divide. 24°37'22"E, 42°44'8"N, 1050 m, sparse deciduous forest, 07.07.2006, *M. Anchev* & *F. Krendl* (K 44415); east of Sliven, south foot of the Barmuka Hill, 06.07.1970 (K 45328).

Znepole Region: Strezimirovtsi vill., SE of Trun, 900 m, Ca, 18.05.2002, *A. Polatschek* (K 39039).

Rhodopi Mts: Ognyanovo vill., Gotse Delchev district (Anchev 1982); north of Peshtera, near the cross-road to Fotino, 11.07.1970 (K 1659$^+$); two km west of Krichim, deciduous forest, limestone, 13.07.1970 (K 1658$^+$); Bachkovo, 1–2 km S of the Monastery; bushy margin, 10.07.1970 (K 1655); Bachkovo, mixed wood near to the charnel-house, 10.07.1970 (K 1656$^+$, 1657$^+$); south of Momchilgrad, Stramni Rid, 300 m (Anchev 1982).

Thracian Lowland: 13 km west of Harmanli, 200 m, *F. Ehrendorfer* (K 35766).

***G. asparagifolium* – 2*n* = 44**

Mt Slavyanka: Mt Stargach, rocky slopes south of Ilinden vill., 15.06.1995, *M. Anchev* (Mitova & al. 2002 (SOM); south of Ilinden vill., Ca, 670–680 m, 21.06.2008, *M. Anchev* & *F. Krendl* (SOM, W).

***G. flavescens* – 2*n* = 22**

Balkan Range: north of Karnare, Troyanski Pass, 900 m, 25.06.1997, *Polatschek* & *Anchev* (K 32990).

Mt Vitosha Region: south of Pancharevo, the Dyavolskiya Most loc., 23°25'24"E, 42°33'37"N, 650 m, forest outskirts, rocks, Si, 02.70.2006, *M. Anchev* & *F. Krendl* (K 44400$^+$).

2*n* = 44

Northeast Bulgaria: Madara vill., above the Madara Horseman, 08.1970, *M. Anchev* (SOM 70443);

Pirin Mts: in the vicinities of Sinanitsa Forestry Station, 05.08.1970, *M. Anchev* (SOM 70409a).

***G. glaucum* – 2*n* = 44**

Forebalkan: south of Dolna Verenitsa vill., limestone grassy slopes (Anchev 1982); the hill Veslets, north of Gorna Kremena vill., dolomite, 16.05.2002, *A. Polatshek* & *M. Anchev* (K 39034$^+$).

***G. intermedium* – 2*n* = 66**

Sofia Region: south of Pancharevo Water Reservoir, Si, 19.05.2002, *A. Polatschek* & *M. Anchev* (K 9031).

Znepole Region: Tsarven Dol, Kyustendil district, 950 m (Anchev 1982 sub *G. schultesii*); Tsarven Dol, Kyustendil district, 22°42'E, 42°17'N, , *M. Anchev* & *F. Krendl* (SOM A00863, W).

Mt Vitosha Region: above Knyazhevo, July 1970, *M. Anchev* (SOM A70621).

***G. lovcense* – 2*n* = 22**

Northeast Bulgaria: Shumen Plateau, south of Madara vill., limestone slope, *M. Anchev* (SOM 70447); vill. Tabachka, Ruse district (Anchev 1982 sub *G. heldreichii* subsp. *protopycnotrichum*).

Forebalkan: W–NW of Veliko Tarnovo, Emen Gorge of river Negovanka, limestone rocks, 250 m, 23.06.1997, *A. Polatschek* & *M. Anchev* (K 32997$^+$); Bash Kulesi, south of Lovech, limestone gravelly and rocky ridge, *M. Anchev*, 15.08.1970 (SOM, W).

Balkan Range: Sinite Kamani above Sliven, open rocky slopes, 27.07.1999, *M. Anchev* (SOM A993); Troyansky Balkan, west of Troyan Pass, Kozyata Stena, 24°34'3"E, 42°47'28"N, 1200 m, Ca, 06.07.2006, *M. Anchev* & *F. Krendl* (K 44411); Kuru Dere above Gabarevo vill., 09.08.1969 (Anchev 1982 sub *G. heldreichii* subsp. *protopycnotrichum*).

Pirin Mts: peak Sveshtnik, 1900 m (Anchev 1982 sub *G. heldreichii* subsp. *protopycnotrichum*).

Rhodopi Mts: south of Asenovgrad, Kuru Dere, 24°52'E, 41°58'N, 12.05.2002, *A. Polatschek* (K 9042); Along Vacha River near Krichim, 07.05.1971, F. Krendl (K 11944 as *G. protopycnotrichum*).

***G. lucidum* – 2*n* = 44**

Balkan Range: above Karlovo (Anchev 1982).

Mt Vitosha Region: above Zheleznitsa vill., stony slope of the valley river Selskata, 23°21'23"E, 42°32'26"N, 1100 m, 01.07.2006, *M. Anchev* & *F. Krendl* (K 44396$^+$); 23°20'37"E, 42°32'12"N, 1130 m, 01.07.2006 (K 44398$^+$).

Rila Mts: Rila Monastery, 15.07.1970 (K 1667).

Rhodopi Mts: south of Chepelare, 09.07.1970 (K 1650); north of Pamporovo, 700–1580 m, gneiss, 09.07.1970 (K 1649$^+$).

Mt Strandzha: *ca.* 1–2 km S of Yasna Polyana vill., 03.07.1970 (K 1662); near Malko Turnovo, 200 m, 14.06.1980, *Malicky* (K 4718); Gramatikovo vill., near to the bridge of river Veleka, 64 m, sandstone ground, 20.05.2000, *A. Polatschek* (K 36547$^+$).

***G. macedonicum* – 2*n* = 22**

Mt Vitosha Region: south of Pancharevo, bushy rock slopes with *Lactuca perennis*, silcate, 19.05.2002, *A. Polatschek* (K 39043).

Znepole Region: Mt Zemenska, 22°45'E, 42°28'N, 500 m, *M. Anchev*; gravelly places near the railway station Polska Skakavitsa, Ca, 22°40'E, 42°25'N.

Mt Slavyanka: north of Paril vill., ruderal roadsides, 18.05.2005, *A. Polatschek* (K 41811$^+$).

Pirin Mts: near Vlahi vill., 900 m, *M. Anchev* (SOM A373); Rozhenski Monastery, bushy slopes at the foot of the sandstone pyramids, 20.05.2005, *A. Polatschek* (K 41808).

***G. mirum* – 2*n* = 22**

Mt Slavyanka: Paril vill., meadow margin, sandstone, *A. Polatschek* (K 41808$^+$).

Pirin Mts: Rozhenski Monastery, bushy slopes at the foot of the sandstone pyramids, 20.05.2005, *A. Polatschek* & *M. Anchev* (K 41806).

Rhodopi Mts: Terassata loc., south of Karadzhali, limestone ground, 03.06.1970, *M. Anchev* (SOM).

Thracian Lowland*: ca.* 1 km west of Krichim, 250–300 m, Si, 13.07.1970 (K1646, 1647); *ca.* 2 km west of Krichim, 250 m, deciduous forests, bushy margins, silicate, 13.07.1970 (K 2009); SE Pazardzhik, N slope, *ca.* 400 m, marble (K 1648, 2010, 2011, 2012);

***G. octonarium* – 2*n* = 22**

Forebalkan: E-NE of Veliko Tarnovo, limestone gravelly glades above the St Troitsa Monastery, 320 m, brushwood of *Carpinus orientalis, Tilia tomentosa, Staphyllea pinnata, Cotinus coggigria, Syringia vulgaris,* 22.06.1997, *A. Polatschek* & *M. Anchev* (K 32991).

Balkan Range: east of Sliven, at souther foot of the Barmuka Hill, ravine wood of *Quercus pubescens* and *Pinus* stands, rockheath, rubble, sandstone, 06.07.1970 (K 5296$^+$).

Thracian Lowland: SE of Popovitsa, dry glades with *Quercus pubescens, Astragalus onobrychis,Filipendula vulgaris, Orchis purpurea*, limestone ground, 12.05.2002, *A. Polatschek* (K 39022$^+$); SE of Pazardzhik, 300–408 m; *Quercus*

pubescebs-bush, rockheath, limestone, 14.07.1970 (K 5295); 2-3 km SW of Dimitrovgrad, thin *Quercus cerris* wood, limestone rocks, 07.07.1970 (K 6609+); Besaparski Ridove, *M. Anchev* (SOM A4131) (Anchev 1982).

***G. paschale* – 2*n* = 22**

Black Sea Coast: 1–2 km south of Primorsko, mixed oak woods, rocks, 03.07.1970 (K 10076+).

Balkan Range: NE of Sliven, ravine woods south of peak Balgarka, 800–1100 m, 06.07.1970 (K 10068, K 10130).

Mt Vitosha Region: above Knyazhevo, mixed deciduous forest, 11.10.1970, *M. Anchev* (SOM 70537a).

Rodopi Mts: Mt Chal, glades in oak-hornbeam forest (Ančev 1982).

Thracian Lowland: north of Peshtera, forest outskirts, Si, 11.07.1970 (K 10069); west of Krichim, bushy forest outskirts, Si, 13.07.1970 (K 10070+).

Mt Strandzha: south of Yasna Polyana vill., 03.07.1970 (K10071, K 10067+); 4–5 km south of Primorsko, mixed oak woods, rocks, 01.07.1970 (K 10066+); Vurgarski Dol near Kosti vill. (Anchev 1982, sub *G. bulgaricum*).

***G.* ×*pomeranicum* – 2*n* = 44**

Forebalkan: Panega river valley, north of Petrevene vill., 24°9'12"E, 43°11'8"N, 05.07.2006 (K 44404).

Balkan Range: at the southern foot of Mt Shipchenska, near Skobelevo, 06.07.2006 (K 44416); near the peak Stoletov, 25°19'28"E, 42°44'47"N, *ca.* 1300 m, rocky glades, Ca, 07.07.2006 (K 44418).

Mt Strandzha: 1–2 km south of Yasna Polyana vill., 27°37'E, 42°17'N, Si, 03.07.1970 (K 162+).

G. procurrens

Mt Vitosha Region: Mt Plana, on the slopes above river Vedena, 23°25'25"E, 42°33'34"N, *ca.* 680 m, mixed deciduous forest, Si, 02.07.2006 (SOM A 00864; K 44401 W).

Mt Slavyanka: Gotse Delchev district, Parilski Dol (Ambar Dere), above Paril vill., 28.09.1973, *M. Anchev* (SOM A3194) (Ehrendorfer & Ančev 1975).

***G. pseudoaristatum* – 2*n* = 22**

Mt Sredna Gora: *ca.* 43 km SE of Sofia, near the highway to Plovdiv, 600 m, 18.05.1968, *Habeler* (W).

Mt Vitosha Region: Forest outskirts above Knyazhevo (Anchev 1982).

Mt Strandzha: SW of Tsarevo (Michurin), Kosti, oak-hornbeam wood, Si, 20.05.2000, *A. Polatschek* & *M. Anchev* (K 36553+).

***G. rhodopeum* – 2*n* = 22**

Rhodopi Mts: 5 km north of Shiroka Laka, 800 m, 22.06.1980, *Malicky* (K 4717+).

Thracian Lowland: SE of Pazardzhik, Besaparski Ridove, open limestone slopes, 500 m, *F. Krendl* (K 1645); Besaparski Ridove, SW of Tri Voditsi vill., Pazardzhik district (Ančev 1971).

***G. rigidifolium* – 2*n* = 44**

Balkan Range: NE of Sliven, Dik Tepe, 500–750 m, 06.07.1970 (K 651); Sliven, the road to Balgarka, 800–1100 m; brook ravine wood, rockheath, rubble, silicate, 06.07.1970 (K 1652).

Valley of River Struma: Kresna Gorge near Kresnenko Hanche, Si, 20.05.2005, *M. Anchev* & *A. Polatschek* (K 41809).

Valley of River Mesta: near Konovsko, SW of Cherna Mesta, 23°45'53"E, 42°2'20"N, 983 m; anthropogenic habitats in *Robinia pseudacacia* stand, Ca, 05.07.2007, *M. Anchev* & *F. Krendl* (K 44856).

Pirin Mts: *ca.* 2 km above Dobrotino, west of Gotse Delchev, 23°43'16"E, 41°25'49"N, 1057 m, road margins with *Pinus nigra*, 07.07.2007, *M. Anchev* & *F. Krendl* (K 44866).

Rila Mts: Forest road to Treshtenik, above Yakoruda, 23°40'26"E, 42°3'22"N, 1317 m; road margin, the slopes near *Pinus sylvestris*-wood, screes, 05.07.2007, *M. Anchev* & *F. Krendl* (K 44858, SOM, W).

Rhodopi Mts: west of river Kanina, south of Osikovo, 23°36'40"E, 41°33'14"N, 05.07.2007, *M. Anchev* & *F. Krendl* (SOM).

***G. velenovskyi* – 2*n* = 44**

Rhodopi Mts: Stramni Rid, south of Momchilgrad, rocky slopes, Ca, 25°29'E, 41°29'N, 25.08.1971, *M. Anchev* (SOM 71705a).

***G. volhynicum*– 2*n* = 44**

Black Sea Coast: east of Balchik, Tuzlata loc., steep limestone rocky slopes, 23.05.2000, *A. Polatschek* & *M. Anchev* (K 36554+).

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