THE GENERA GRIMMIA AND COSCINODON (GRIMMIACEAE, MUSCI) IN HUNGARY

P. ERZBERGER

Belziger Str. 37, D-10823 Berlin, Germany; erzberger@erzfisch.de

All available specimens of Grimmia and Coscinodon collected in Hungary and kept in BP together with the collections of the author (B) were revised, in total more than 1,400 specimens. The following 20 species were found to occur in Hungary: Coscinodon cribrosus, Grimmia anodon, G. crinita, G. decipiens, G. dissimulata, G. elatior, G. funalis, G. hartmanii, G. laevigata, G. lisae, G. longirostris, G. montana, G. muehlenbeckii, G. orbicularis, G. ovalis, G. plagiopodia, G. pulvinata, G. teretinervis, G. tergestina, G. trichophylla. Descriptions, illustrations, distribution maps and a key are provided. Re-identification of specimens during revision is analysed with respect to the frequency of errors. The incidence of sporophytes and of mixed stands and mixed gatherings is given and evaluated. Some ecological, bryogeographical and conservational issues are briefly discussed.

Key words: bryophytes, Coscinodon, distribution maps, Grimmia, habitat requirements, illustrated key

INTRODUCTION

In Central Europe, the family Grimmiaeae is represented by the following four genera: Coscinodon, Schistidium, Grimmia (including Dryptodon and Hydrogrimmia) and Racomitrium (LIMPRICH'T 1889, LOESKE 1930, HILL et al. 2006), not considering attempts to split some of these genera (OCHYRA et al. 2003), which have not received general acceptance (HILL et al. 2006). In the past, many taxa of this family have not been well understood and often confused, and a need for their better recognition has long been felt. Recent progress in the taxonomy of these groups now makes it possible to analyse the Hungarian collections of Grimmiaeae and to establish the occurrence and distribution of taxa in Hungary. Schistidium has recently been the object of a comprehensive study (ERZBERGER and SCHRÖDER 2008); Coscinodon and Grimmia are dealt with in the present work, and Racomitrium is presently under revision.
According to the checklist of Hungarian bryophytes (ERZBERGER and PAPP 2004) fifteen species of *Grimmia* were known to occur in Hungary. For the preparation of the checklist, some critical specimens in BP, EGR and SZO had been revised, but not all specimens of the genus collected in Hungary. *Coscinodon cribrosus* had to be excluded from the bryoflora of Hungary (ERZBERGER and PAPP 2004). In the meantime, however, *C. cribrosus* and three more species of *Grimmia* (*G. elatior*, *G. decipiens*, *G. lisae*) have been shown to occur in Hungary, in part by revision of specimens inserted in *Schistidium* (ERZBERGER 2009, ERZBERGER and MAIER 2008a, b, ERZBERGER et al. 2008). *G. dissimulata*, a species only recently described (MAIER 2002a), proved to be rather frequent in parts of Hungary (Erzberger and Papp, unpublished field work). Recently, B. Papp discovered *Grimmia crinita* new to Hungary (PAPP 2009).

It was thought that the revision of all *Grimmia* and *Coscinodon* specimens collected in Hungary and housed in BP and of the herbarium of the author (B) would contribute to providing an answer to the following two questions.

Which taxa occur in Hungary?
What is their distribution within the country?

MATERIAL AND METHODS

All specimens labelled *Grimmia* collected in Hungary and preserved in the bryophyte collection of the Natural History Museum in Budapest (BP – more than 1,200 specimens) were revised by the author. A considerable number of critical specimens were also seen by Eva Maier, Geneva. In addition, a large part of the Hungarian collections of the author (215 specimens), housed in the Botanical Museum Berlin-Dahlem (B) were also revised by E. Maier. Where specimen data are quoted, revision by E. Maier has been denoted by “rev./det./conf. E.M.”. Apart from the names of the *Grimmia* species found in the specimen convolutes, the occurrence of sporophytes and of bryophyte companions was also noted. With the evaluation of mixed gatherings, a total set of 1,572 localised data was obtained. Frequency of species is estimated by the number of different growth sites as noted on the specimen labels.

Distribution maps were prepared on the basis of the Central European mapping scheme (NIKLFIELD 1971). Open circles represent collections before 1980, closed circles after that year.

Nomenclature of the bryophytes follows ERZBERGER and PAPP (2004), ERZBERGER and SCHRODER (2008) for *Schistidium* and HILL et al. (2006) for some other taxa.
Selected taxonomic characters

Central strand

A group of small, thin-walled cells in the centre of the stem that differs from the surrounding tissue, visible in transverse section (Fig. 25H). All species treated here except G. hartmanii (Fig. 15L) possess a central strand.

Hair-point

The length of the hair-point is a variable character in most species; all species treated here usually possess hair-points, but in G. hartmanii, G. trichophylla, and in the male plants of G. funalis, muticous leaves (without hair-point) occur. In Coscinodon cribrosus, G. anodon, G. crinita, G. decipiens, G. longirostris, G. montana, G. orbicularis, G. ovalis, G. plagiopodia, G. teretinervis, and G. tergestina, the lower leaves are usually muticous.

Similarly to the hair-point in the genus Schistidium, two types of different structure can be distinguished (BLOM 1996, ERZBERGER and SCHRÖDER 2008): In type A the cell lumen of the cells composing the hair-point is clearly visible, in type B cell lumina are very narrow and hardly visible. Of Hungarian species, only G. hartmanii has a type A hair-point (Fig. 15J), all other taxa have type B hair-points (e.g. Fig. 39C).

The hair-point can be smooth or bluntly to strongly denticulate. The denticulation of the hair-point is particularly conspicuous in G. decipiens, G. laevigata, G. montana, G. muehlenbeckii (Fig. 25C), G. ovalis, G. plagiopodia, and G. teretinervis. A nearly smooth hair-point occurs in C. cribrosus, G. funalis, G. longirostris, G. orbicularis, and G. tergestina.

Leaf shape

Leaf shape may differ between normal stem leaves and perichaetial leaves (those surrounding archegonia and later the sporophyte). If not stated otherwise, the descriptions refer to stem leaves, not perichaetial leaves.

In most species, leaves are ovate to lanceolate, but the perichaetial leaves of G. crinita are spatulate, i.e. they are widest below the broadly inserted hair-point (Fig. 5B).

G. funalis has asymmetric leaves, i.e. the costa reaches the apex close to one of the margins, not in the middle, due to curvature of the costa (Fig. 13B); all other species treated here have ± symmetric leaves (not considering, e.g. curvature of leaf margin, which often differs between sides; see below).

In C. cribrosus, G. decipiens, G. dissimulata, G. elatior, G. hartmanii, G. lisae, G. longirostris, G. montana, G. muehlenbeckii, G. ovalis, G. teretinervis, and G. trichophylla, the leaves are gradually narrowed towards the ± acuminate apex from usually far below the middle of the lamina, but in G. anodon, G. laevigata, G. orbicularis, G. plagiopodia, G. pulvinata, and G. tergestina, the apex is not acuminate, but broadly acute to obtuse, and overall leaf shape is more ovate, with the greatest width at or shortly above the middle.

The leaves of G. montana (Fig. 23B*) and G. ovalis (Fig. 29B*) have a pronounced shoulder, i.e. a rather abrupt transition from the wide basal to the narrower upper part of

* Studia bot. hung. 40, 2009
the leaf. In other species, the transition can be more gradual, but it is usually correlated with a change in cell shape from the more elongated basal cells to more isodiametric mid leaf cells (Fig. 21E).

Leaf orientation

In most species, leaves are ± appressed to the stem in the dry state. When moistened, they usually first move away from the stem to a squarrose position, but mostly do not remain like that, ending up in an erecto-patent orientation with the tips directed upwards; younger leaves usually move less and end up in a more erect position than the patent older leaves. *G. lisae* is characterised by strongly recurved to squarrose leaves in the moist state (Fig. 19B). In *G. ovalis*, moist leaves can spread nearly horizontally above the sheathing part (Fig. 29A). In *G. crinita* (Fig. 5A) and *G. laevigata* (Fig. 17A), on the other hand, leaves hardly change their position upon moistening.

Transverse sections of leaves

Transverse sections are useful to detect several important characters: The perichaetial leaves of *G. crinita* (Fig. 5H) and the leaves of *G. laevigata* (Fig. 17E), *G. ovalis* (Fig. 29F), and *G. tergestina* (Fig. 37F) are semicircular in section; many species have leaves with a ± pronounced keel (*G. anodon, G. decipiens, G. dissimulata, G. elatior, G. funalis, G. hartmanii, G. lisae, G. longirostris, G. montana, G. muehlenbeckii, G. orbicularis, G. pulvinata, G. trichophylla*); the plicae (folds) of *C. cribrosus* become obvious in transverse section, as do the important characters of stratosity of the lamina and the margins. A soft "standing fold" (Fig. 21H**) can be observed on one side of the costa at the base of the leaf in *G. longirostris*, and less conspicuously, in *G. elatior* and *G. decipiens*.

Lamina stratosity

The lamina can be unistratose, i.e. it consists of a single layer of cells, or be partly or nearly totally composed of more than one cell layer.

The leaves of *G. elatior, G. laevigata, G. longirostris, G. montana, G. ovalis*, and *G. tergestina* are, in the upper part, completely bistratose (and sometimes consist of even more than two layers), whereas *G. crinita, G. dissimulata, G. lisae, G. muehlenbeckii, G. orbicularis, G. plagiopodia, G. pulvinata*, and *G. trichophylla* usually have an unistratose lamina, except at the margin, which can be bistratose in few cell rows, and rarely also at (extreme) apex. In the remaining species, the lamina is unistratose to bistratose to a variable extent, usually more bistratose towards the apex; often bistratose striae reach down into the basal unistratose part of the leaf.

Leaf margin

The leaf margin can either be unistratose or pluristratose (usually bistratose) in one or several rows. Since most species have the unistratose margin in the basal part of the leaf, this character is best observed in the upper part of the leaf. A margin composed of
more than one cell layer will normally appear to be thicker than the adjacent unistratose lamina (not in *G. orbicularis* – Fig. 27G – and *G. anodon* – Fig. 3G). In species with a bistratose lamina, the margin is also usually bistratose, but in *G. laevigata*, the margin is usually unistratose (in 1 to several rows) in the lower part of the bistratose lamina (Fig. 17D); this can sometimes be also observed in leaves of *G. ovalis* and *G. teretinervis*. *G. crinita* has a completely unistratose margin (Fig. 5J), and in *G. orbicularis*, the margin is usually unistratose on one side of the leaf and bistratose in one row on the other side, but in this species bistratosey does not normally cause the margin to be thicker than the lamina (Fig. 27G).

The margin can be plane (*G. anodon*, *G. crinita*, *G. plagiopodia*, *G. teretinervis*) to erect (*G. laevigata*, *G. ovalis*, *G. tergestina*), erect to incurved (*C. cribrosus*, *G. montana*), recurved (at mid leaf in *G. orbicularis*) to revolute (*G. decipiens* – Figs 7F, G, *G. funalis* – Figs 13H, I). The curvature of the margin usually changes from apex to base (e.g. in *G. pulvinata* from plane in the apical part to recurved on one or both sides in the leaf base – Figs 33E, F), and it can also differ between sides: *G. dissimulata*, *G. elatior*, *G. hartmanii*, *G. lisae*, *G. longirostris*, *G. muehlenbeckii*, *G. trichophylla* usually have leaves with a plane margin on one side and a recurved margin on the other side (in the basal part of the leaf – e.g. Figs 39G, H).

Lamina cells

Data on size in the descriptions refer to mid leaf cells, if not stated otherwise.

In *G. hartmanii*, *G. lisae*, *G. longirostris*, *G. muehlenbeckii*, joint thickenings can occur (seen in transverse section as protruding papilla-like thickenings of the cell walls, as in *Dicranoweisia crispula*).

**Apical cells:** The lamina cells usually show a tendency to become smaller and more isodiametric towards the leaf apex. An exception is formed by the apical lamina cells of *G. decipiens*, which are in part longer than wide and ± sinuose (Fig. 7E).

**Basal cells:** Leaves should be individually detached from the stem with care in order to include the basal portion of the leaf, which has a relevant cell pattern. Cells immediately beside the costa (*paracostal* cells) tend to be more elongate than *marginal* basal cells, but the extent of short or long, incrassate or thin-walled cells, with smooth or pitted cell walls is a very important, though somewhat variable character. Elongate basal paracostal cells with particularly thin transverse walls are found in *G. decipiens* (Figs 7C, D), *G. longirostris* (Figs 21C–F), and less conspicuously in *G. elatior*, *G. funalis*, *G. muehlenbeckii*, *G. orbicularis*, and *G. ovalis*. Incrassate transverse walls and transversely elongate basal cells are found in *G. laevigata* (Fig. 17C).

Predominantly short basal cells occur in *Coscinodon cribrosus*, *G. crinita*, *G. laevigata*, *G. montana*, *G. plagiopodia*, *G. pulvinata*, and *G. teretinervis* (e.g. Fig. 35C).

Costa

Transverse sections of the costa are essential to reveal costal architecture: occurrence, number and arrangement of guide cells, hydroids, stereids, ventral (= adaxial) and dorsal (= abaxial) cell layers.
Guide cells are usually conspicuously larger than the surrounding cells (but less so in *G. tergestina*, *G. elatior*, and the upper part of the leaves of *G. laevigata*); in the species treated here they are positioned on the adaxial side of the costa (e.g. Fig. 7I). In *G. elatior* (Fig. 11G) and *G. trichophylla* (Fig. 39H), two layers of guide cells can be observed. The external (= adaxial) cell walls of the guide cells are often more strongly incrassate than the other walls, e.g. in *G. crinita*, *G. decipiens*, *G. dissimulata*, *G. funalis*, *G. hartmanii*, *G. laevigata*, *G. lisae*, *G. longirostris*, *G. muehlenbeckii*, *G. ovalis* (Fig. 29D), *G. plagiopodia*, and *G. trichophylla*.

Incassate external cell walls of the abaxial cell layer of the costa are found in *G. dissimulata* (Figs 9I–K).

Hydroids are small, thin-walled cells on the dorsal side of the guide cells (e.g. Fig. 3G).

Stereids have strongly incassate cell walls resulting in an almost complete reduction of the cell lumen (e.g. Fig. 11G).

The costa can be recessed in a groove on the adaxial side of the leaf (in *Coscinodon cribrosus* – Fig. 1D**, *G. montana* – Fig. 23E*, somewhat less so in *G. elatior* – Fig. 11H) or not; it can be scarcely prominent on the dorsal side (in *G. laevigata* – Figs 17D, E, and in the upper part of leaves in *G. ovalis* – Figs 29D–F, *G. longirostris* – Figs 21G, H, and *G. tergestina* – Figs 37E, F) or strongly prominent (e.g. in *G. montana* – Figs 23E, F); in *G. muehlenbeckii* the abaxial side of the costa is rectangular in section and shows ± well-developed wings (ridges – Figs 25E–G).

In *G. anodon*, *G. crinita*, *G. orbicularis*, and, to a lesser extent, in *G. montana* and *G. pulvinata*, the costa is attenuate towards the leaf base, becoming narrower and flatter than above (e.g. Fig. 27G), whereas in *G. decipiens* (Fig. 7G) and *G. laevigata* (Figs 17B, D) the costa becomes wider towards the base.

Calyptra

The calyptra is usually mitrate, but cucullate in *G. crinita*, *G. montana* (Fig. 23A), *G. orbicularis*, and *G. ovalis*, and widely campanulate and strongly plicate in *Coscinodon cribrosus* (Fig. 1A). However, the calyptra is usually lost soon, therefore this character cannot always be observed.

Gemmas

Gemmas occur in two different forms: *G. hartmanii* has multicellular globular-cubic gemmae (100–144 μm: NYHOLM 1998; to 250 μm: SMITH 2004) ± sessile at leaf apices (Fig. 15A), whereas several other species produce few-celled globose gemmae (usually < 60 μm: CORRENS 1899) on branched stalks at the abaxial side of costa or lamina at leaf base (*G. dissimulata*, *G. lisae*, *G. muehlenbeckii*, *G. trichophylla*).

Sporophytes

Not all taxa treated here produce sporophytes (capsules) in Hungary (cf. Table 2), however, when sporophytes are available, their characters are very useful in identifying...
plants, because they are in general less influenced by habitat conditions than gametophytic characters (Maier 2002b).

Seta

According to the length of the seta in relation to the theca (the body of the capsule), two groups of species can be distinguished: Coscinodon cribrosus (Fig. 1A), G. anodon (Fig. 3A), G. crinita (Fig. 5A), G. plagiopodia (Fig. 31A), G. tergestina (Fig. 37A) with immersed to emergent capsules, and the other species with elongate setae and exserted capsules.

In most species, the shape of the seta in the moist state (arcuate or straight) is a constant character, but it is variable in some species (e.g. G. tergestina, Maier 2002b). G. anodon, G. crinita, G. decipiens, G. dissimulata, G. elatior, G. funalis, G. lisae, G. muehlenbeckii, G. orbicularis, G. plagiopodia, G. pulvinata, G. trichophylla have an arcuate seta, and Coscinodon cribrosus (Fig. 1A), G. laevigata (Fig. 17A), G. longirostris (Fig. 21A), G. montana (Fig. 23A), and G. ovalis (Fig. 29A) have a straight seta.

Capsule

Apart from the characters used here to differentiate between the species occurring in Hungary, important morphological and anatomical features can be studied in the capsule, e.g. annulus, exothecial cells, occurrence, number and size of stomata, insertion of the peristome, etc.

Peristome

Most species have a well-developed peristome, but in G. anodon the peristome is completely lacking (and in Schistidium flaccidum, which has sometimes been confused with Grimmia species, it is usually rudimentary).

The peristome teeth are usually cleft at the apex or ± perforated (cribrose), particularly so in Coscinodon cribrosus.

Operculum

Most species have a rostrate operculum, but G. anodon (Fig. 3A), G. crinita (Fig. 5A), G. orbicularis (Fig. 27A) and G. plagiopodia (Fig. 31A) have a flat or mamillate operculum.

RESULTS AND DISCUSSION

According to the present revision, the following species of Coscinodon and Grimmia are found in Hungary:

Coscinodon cribrosus (Hedw.) Spruce
Grimmia anodon Bruch et Schimp.
**Grimmia crinita** Brid.
**Grimmia decipiens** (Schultz) Lindb.
**Grimmia dissimulata** E. Maier
**Grimmia elatior** Bruch ex Bals.-Criv. et De Not.
**Grimmia fonalis** (Schwägr.) Bruch et Schimp.
**Grimmia hartmanii** Schimp.
**Grimmia laevigata** (Brid.) Brid.
**Grimmia lisae** De Not.
**Grimmia longirostris** Hook.
**Grimmia montana** Bruch et Schimp.
**Grimmia muehlenbeckii** Schimp.
**Grimmia orbicularis** Bruch ex Wilson
**Grimmia ovalis** (Hedw.) Lindb.
**Grimmia plagiopodia** Hedw.
**Grimmia pulvinata** (Hedw.) Sm.
**Grimmia teretinervis** Limpr.
**Grimmia tergestina** Tomm. ex Bruch et Schimp.
**Grimmia trichophylla** Grev.

**Descriptions, selected diagnostic features**

The descriptions are mainly based on MAIER and GEISSLER (1995) and MAIER (1999, 2002a, b), and to a smaller extent on LIMPRICHT (1889), SMITH (2004) and my own observations. The illustrations are the work of E. Maier and taken from MAIER and GEISSLER (1995) and MAIER (2002a, b). Information on habitat, associated bryophytes, and vertical distribution refers to Hungarian material as noted on specimen labels or found in the convolutes.

**Coscinodon cribrosus** (Hedw.) Spruce
(Figs 1, 2)

Dense blackish cushions, up to 1 cm high. Central strand of few cells. Hair-point nearly smooth to bluntly denticulate, flattened at base, sometimes decurrent. Lower leaves smaller, muticus or with shorter hair-point. Leaves ovate-lanceolate to narrowly ovate-lanceolate, keeled, longitudinally plicate from near apex to base, leaf apex broad, margin ± incurved. Lamina usually bistratose in upper part, but sometimes with unistratose cell rows, in lower part with bistratose striae and bistratose to pluristratose plicae (Fig. 1D*) sometimes similar to “additional costae” (“pseudocostae”) at leaf base. Lamina cells smooth, not sinuose, 8–10 μm wide at mid leaf, upper quadrate, lower shortly rectangular, ± hyaline. Costa recessed in a deep adaxial groove (Fig. 1D**) reaching far down to leaf base, dorsally prominent and sometimes ± angulate, 70 μm wide. Gemmae unknown.
**Fig. 1.** *Coscinodon cribrosus*. A = moist plant with sporophyte; B = leaves; C = basal leaf cells showing costa and “pseudocosta”; D–G = transverse sections of leaves; * plicae; ** groove. Scale bar: A – 2 mm; B – 1 mm; E – 400 μm; C, D, F, G – 100 μm. (from Herzogia 11)
Sporophytes not infrequent (but not observed in Hungarian material). Calyptra large, campanulate, plicate, covering 2/3 to 3/4 of the theca. Operculum rostrate. Seta short, to 1 mm long, straight, capsule emergent. Peristome teeth papillose, ± strongly cribrose.

**Habitat and distribution** (1 growth site): At present known from a single site in Hungary, where the species grows in crevices of vertical basalt rock; in Europe a boreo-temperate species.

- **Associated bryophytes**: None.
- **Vertical distribution**: 500 m.

**Specimen examined**: Medves Mts: 7985/2 County of Nógrád, on the south face of the basalt rock "Nagy-kő" near Bárna, east of Salgótarján, in crevices of the vertical basalt rock, N 48° 05' 35.7", E 19° 57' 07.5", 500 m, 24.03.2008, leg. P. Erzberger (B Erzberger 12830) (ERZBERGER 2009).

![Map of Hungary](image)

**Fig. 2. Distribution of Coscinodon cribrosus**

**Literature**: Since the alleged existence of *Coscinodon cribrosus* in Hungary was, before 2008, based on a single misnamed specimen of *G. muehlenbeckii* (BP 71290), all the statements about the distribution and ecology of *C. cribrosus* in BOROS (1968) and ORBÁN and VAJDA (1983) are erroneous and must be deleted.
Grimmia anodon Bruch et Schimp.
(Figs 3, 4)

Plants in small dark green cushions, rarely desintegrating, to 1.5 cm high. Central strand developed. Hair-point bluntly denticulate, broadly inserted at leaf apex, lacking or short on lower leaves. Leaves enlarged in comal tuft, ovate, upper leaves ovate to lanceolate, concave, keeled in upper part, margin plane, bistratose. Lamina unistratose with bistratose striae. Lamina cells rounded quadrate, incrassate, only slightly sinuose, 8–10 (–12) μm wide, in transverse section often higher (up to 20 μm) than wide (Fig. 3G). Basal cells quadrate to (short) rectangular nearly throughout, paracostal cells elongate-rectangular with ± smooth walls, some marginal cell rows with incrassate transverse walls. Costa in transverse section with hydroids, without stereids or substereids, enlarged towards leaf apex (best seen on dorsal side). Gemmae unknown.

Sporophytes frequent; seta arcuate, to 0.3 mm long, shorter than the immersed theca; capsule subglobose, gibbous at base, wide-mouthed when dry and empty; operculum flat, mamillate; calyptra mitrate; stomata conspicuously large; peristome completely lacking.

When sporophytes are present, this species is easily identified in the field. Old emptied wide-mouthed capsules tend to be somewhat compressed in the cushion and are easily overlooked.

Habitat: On dry, exposed limestone and dolomite, often in south exposition, more rarely partly shaded.
Associated bryophytes: Grimmia dissimulata, G. tergestina, Schistidium brunnescens subsp. brunnescens.

Vertical distribution: 220–900 m.
Distribution (31 growth sites): In Hungary with most growth sites in the Transdanubian part, only few localities in the northern mountain range (Bük, Cserhát). In Europe with a preference for lowland as well as alpine regions (LOESKE 1930), in the Himalaya even at 6,000 m (MAIER 2002b).

Fig. 3. Grimmia anodon. A = moist plant with sporophyte; B, C = leaves (C = muticous); D = basal leaf cells; E = cells near costa in upper part of leaf; F, G = transverse section of leaves. Scale bar: A – 2 mm; B, C – 1 mm; F – 400 μm; D, E, G – 100 μm. (from Herzogia 11)
Apart from the localities represented in the map and documented by specimens, there are literature reports of some more localities, e.g. Pilis Mts: “ober Kesztőlc, Kétágúhegy” (GYÖRFFY 1920), but the following must appear doubtful: Visegrád Mts: Kis-Csikóvár ober Pomáz auf Andesitfelsen, 310–320 m, “massenhaft in schönen Exemplaren” 09.06.1921, leg. I. Gyorffy (GYÖRFFY 1920, SZEPESFALVI 1941). No voucher specimen for this record could be found in BP; the locality is the well-known growth site of *Schistidium flaccidum* (ERZBERGER and SCHRÖDER 2008), and the substrate (andesite) makes a misidentification very likely. This is further corroborated by the fact that the oldest specimen of *S. flaccidum* from this site in BP (160932, Bauer exs. no. 1609) was collected by Gyorffy at the very same day (09.06.1921) as the “*G. anodon*” reported in GYÖRFFY (1920). According to LOESKE (1930), *Schistidium pulvinatum* (Hoffm.) Brid. (synonym of *S. flaccidum*) includes *G. anodon*; this may explain some of the confusion. Both species seem to be strictly confined to their specific substrate: *S. flaccidum* to siliceous and *G. anodon* to calcareous rocks. Reports in the literature of *G. anodon* and *S. flaccidum* growing in association (MAIER and GEISSLER 1995, LOESKE 1930) do not prove the contrary, since the substrate might be locally calcareous slate or a mixture of calcareous and siliceous rock. (LOESKE 1930 quotes a similar example of *G. anodon* growing on the calcareous bits of eruptive breccia, in close association with *Coscinodon cribrosus* on the siliceous parts: p. 72).

**Fig. 4. Distribution of Grimmia anodon**

**Literature:** Apart from the localities represented in the map and documented by specimens, there are literature reports of some more localities, e.g. Pilis Mts: “ober Kesztőlc, Kétágúhegy” (GYÖRFFY 1920), but the following must appear doubtful: Visegrád Mts: Kis-Csikóvár ober Pomáz auf Andesitfelsen, 310–320 m, “massenhaft in schönen Exemplaren” 09.06.1921, leg. I. Györffy (GYÖRFFY 1920, SZEPESFALVI 1941). No voucher specimen for this record could be found in BP; the locality is the well-known growth site of *Schistidium flaccidum* (ERZBERGER and SCHRÖDER 2008), and the substrate (andesite) makes a misidentification very likely. This is further corroborated by the fact that the oldest specimen of *S. flaccidum* from this site in BP (160932, Bauer exs. no. 1609) was collected by Gyorffy at the very same day (09.06.1921) as the “*G. anodon*” reported in GYÖRFFY (1920). According to LOESKE (1930), *Schistidium pulvinatum* (Hoffm.) Brid. (synonym of *S. flaccidum*) includes *G. anodon*; this may explain some of the confusion. Both species seem to be strictly confined to their specific substrate: *S. flaccidum* to siliceous and *G. anodon* to calcareous rocks. Reports in the literature of *G. anodon* and *S. flaccidum* growing in association (MAIER and GEISSLER 1995, LOESKE 1930) do not prove the contrary, since the substrate might be locally calcareous slate or a mixture of calcareous and siliceous rock. (LOESKE 1930 quotes a similar example of *G. anodon* growing on the calcareous bits of eruptive breccia, in close association with *Coscinodon cribrosus* on the siliceous parts: p. 72).
Fig. 5. Grimmia crinita. A = moist plant with sporophyte; B = perichaetial leaf; C = upper leaves; D = hair-point, cells at apex; E = lower leaf; F = cells in upper part of leaf; G = basal leaf cells; H = transverse sections of perichaetial leaf; I, J = transverse sections of stem leaves. Scale bar: A – 3.33 mm; B, C, E – 1 mm; H, I – 400 μm; D, F, G, J – 100 μm. (from Candollea 57)
**Grimmia crinita** Brid.  
**(Figs 5, 6)**

Plants growing in grey hoary flat patches up to 0.6 (–1) cm high, usually on vertical walls. Central strand well-developed. Hair-point usually long, faintly denticulate, nearly smooth, at its basis transition to often hyaline apical part of leaf with cells with distinct colourless cell lumina. Leaves at base of stem scale-like, oblong, obtuse, muticus, small (Fig. 5E), enlarged in comal tuft, up to 1.5 mm long, imbricate, markedly narrowed at insertion, spathulate, widest above mid leaf and below the plane apex, concave, obtusely keeled. Leaf margin plane, unistratose. Lamina unistratose, lamina cells 10–12 μm, quadrate to rectangular in mid leaf, incrassate, sinus above, towards base rectangular, wider, basal paracostal cells elongate-rectangular, broad, towards margin shorter. Costa attenuate towards leaf base, vanishing below apex in lower leaves, excurrent to hair-point in upper leaves, with 2 (–4) guide cells and a group of hydroids partly transformed to substereids. Gemmae unknown.

Sporophytes common, seta arcuate, 0.6 mm long, as long as capsule, capsule immersed, ovoid, slightly ventricose at base, faintly ribbed, operculum flat conical (0.4 mm high), mamillate, calyptra small, cucullate, peristome teeth perforated or cleft, densely papillose.

The characteristic spathulate leaf shape and the grey hoary, flat patches make *G. crinita* an easily identified plant.

**Habitat and distribution** (1 growth site): On vertical limestone wall in a quarry, ca 2 km from the lake Fertő (Neusiedler See), in north exposition, but sunlit during part of the day.

**Associated bryophytes:** None.

**Vertical distribution:** 165 m.
**Grimmia decipiens** (Schultz) Lindb.
(Figs 7, 8)

Plants growing in green to brownish-green, lax, readily desintegrating tufts or cushions, 1–2.5 (–4) cm high. Central strand well defined. Hair-point usually long, strongly denticulate and often decurrent. Lower leaves muticous, at stem apex larger, narrowly lanceolate, acuminate, keeled, margin recurved, on one side revolute from mid leaf to base. Lamina unistratose with bistratose margin to irregularly bistratose. Lamina cells (7–)9–10 μm, rectangular, sinuose, below leaf apex elongate and quadrate cells mixed; basal cells near costa elongate, incrassate, nodulose with thin transverse walls, towards margin several rows of wider, shortly rectangular cells. Costa very wide at leaf insertion (often > 100 μm), with 6 guide cells at leaf base, 2 in upper part. Gemmae unknown.

Sporophytes not seen in Hungarian plants, seta arcuate, up to 3 mm long, capsule ellipsoid, ribbed, operculum longly rostrate, calyptra mitrate, peristome teeth papillose, split in 2 or 3 filiform segments.

**Habitat and distribution** (2 growth sites): At present, known from two sites, one in Visegrád Mts, where the species was found growing on andesite rock, and one in Balaton uplands, on basaltic rocks. The plants in the latter locality seem to belong to a vital population that is probably able to establish new colonies, since it persisted in this place in spite of mining activity from 1955 to the present, and was also found on scree (waste from mining).

**Associated bryophytes**: None.

**Vertical distribution**: 250–600 m.


**Literature**: SZEPESFALVI (1941) reports the species already from the site in the Pilis Mts (“Vadálló kövek (Keserűs) ober Dömös, ca 600 m, leg. Szepesfalvi”) where Boros collected (and misnamed) it in 1946 (see above, BP 111875). In BOROS (1968), Szepesfalvi’s report is quoted with a question mark; Latzel is quoted as the author of reports of the species in the Balaton uplands, also thought doubtful. ORBÁN and VAJDA (1983) omit the species.
Fig. 7, Grimmia decipiens. A = moist plant with sporophyte; B = leaves; C, D = basal leaf cells, E = leaf cells at apex; F, G, H = transverse sections of leaves; I = transverse section of costa (‘guide cells’); J = transverse section of leaf apex at hair-point insertion. Scale bar: A – 4 mm; B – 1 mm; F – 400 μm; C–E, G, H, J – 100 μm; I – 80 μm. (from Herzogia 11)
E. Maier (Figs 9, 10)

Plants growing in compact grey cushions up to 3 cm high. Central strand well-developed and clearly defined. Hair-point weakly denticulate (Fig. 9C), sometimes lacking. Leaves short at stem base and up to 2.5 mm long in comal tuft, from ovate base lanceolate, acuminate, keeled, margin recurved on usually one side only from base to upper lamina. Lamina unistratose or unistratose with bistratose spots, margin bistratose in 1 or 2 rows. Lamina cells 10–12 μm, in leaf base few rows of rectangular paracostal cells, other basal cells broad, short-rectangular, of nearly the same length, walls thickened, ± nodulose, occasionally smooth, at margin some rows of nearly isodiametric, smooth cells, in transitional zone cells short-rectangular, walls sinuose, cells becoming more isodiametric and rounded and less sinuose towards upper part of lamina. Costa at insertion, leaf base and lower part of lamina with 4 guide cells, in upper and apical part 2 markedly enlarged guide cells, with hydroids and substereid cells in lower part of leaf; exterior walls of dorsal cells markedly incrassate. Gemmae occasionally developed on abaxial side of lower lamina (frequency observed in Hungarian plants).

Sporophytes not observed in Hungarian material. Operculum conical, with long, straight rostrum. Calyptra mitrate. Seta arcuate, up to 5 mm. Peristome teeth lanceolate, split in 2 branches in upper part, papillose.

In the field, the cushions of this species superficially resemble those of *G. pulvinata* or *G. orbicularis*, but inspection of the leaf apex with a hand lens reveals the acuminate tips of *G. dissimulata*.

_Grimmia dissimulata_ E. Maier  
(Figs 9, 10)

Fig. 8. Distribution of _Grimmia decipiens_

_Studia bot. hung. 40, 2009_
Fig. 9. Grimmia dissimulata. A = moist plant with sporophyte; B = leaves; C = hair-point, leaf cells at apex; D = cells in transitional zone; E, F = basal leaf cells; G–J = transverse sections of leaves; K = transverse section of costa. Scale bar: A – 3.33 mm; B – 1 mm; G – 400 μm; C–F, H–J – 100 μm; K – 80 μm. (from Candollea 56(2))
Habitat: Predominantly on limestone and dolomite rocks, more rarely on (usually base-rich) siliceous rocks (eruptive rocks, e.g. basalt); often in dry and exposed situations in open calcareous grasslands, more rarely in shaded places, rarely on irrigated stones.

Associated bryophytes: Grimmia anodon, G. ovalis, G. pulvinata, G. tergestina, Tortula muralis.

Vertical distribution: 150–600 m.

Distribution (40 growth sites): In Hungary, few localities in the Northern mountain range, but many in the Transdanubian region, especially the sub-Mediterranean parts of it (around Lake Balaton and in the southernmost mountains: Villány). In Europe, a southern species of sub-Mediterranean affinities (Maier 2002a).

Fig. 10. Distribution of Grimmia dissimulata


Studyia bot. hung. 40, 2009
Bruch ex Bals.-Criv. et De Not. (Figs 11, 12)

Plants growing in dark green to brownish lax tufts, easily desintegrating into ± stiff, wiry single plants up to 8 cm long. Central strand developed in comal tuft, lacking in lower stem part and branches. Hair-point of variable length, nearly smooth to bluntly denticulate. Leaves at stem tip only slightly larger than lower leaves, up to 4 mm long and 0.75 mm wide, from oblong to ovate decurrent base narrowly lanceolate, acuminate, keeled above, leaf margin plane to slightly recurved on one side and revolute on the other side from above mid leaf far down to leaf base, bistratose (to 5-stratose) in several rows. Lamina bistratose in upper part of leaf, sometimes 3- to 4-stratose, with scattered hemispherical papillae (Figs 11D, G) on cell walls of lamina and costa, rarely completely smooth. Lamina cells (8–) 9–10 μm, in mid leaf quadrate to short rectangular, incrassate, sinuose, basal cells elongate, with strongly incrassate, nodulose longitudinal walls, thin transverse walls except at margin, cells towards margin shorter. Costa prominent on abaxial side, ± angulate; on adaxial side recessed in ± deep groove, in transverse section costa cells hardly differentiated except larger guide cells, which are arranged in 1–2 rows, hydroids lacking; in leaf base an additional cell layer can be found on one side of the costa (subcostal cells – Fig. 11G). Gemmae unknown.

Sporophytes not frequent in Hungary, seta arcuate, 2–3 mm long, capsule ovoid, ribbed, calyptra mitrate, operculum rostrate, peristome teeth weakly papillose, perforated or deeply split in 2 or 3 fine branches.

Well-grown plants of this species can be recognised in the field by their size (more robust than any other Grimmia species in Hungary). Under the microscope the papillose lamina can usually be observed.
Fig. 11. *Grimmia elatior*. A = moist plant with sporophyte; B = leaf; C = perichaetial leaf; D = upper leaf cells (showing papillae), E = basal leaf cells; F–H = transverse sections of leaves. Scale bar: A – 3.33 mm; B, C – 1 mm; F – 400 μm; D, E, G, H – 100 μm. (from Candollea 57)
Habitat: On sandstone, basalt and andesite rocks and boulders.

Associated bryophytes: Brachythecium velutinum, Frullania tamarisci, Grimmia laevigata, G. ovalis, Hedwigia ciliata var. ciliata, H. ciliata var. leucophaea.

Vertical distribution: 200–600 m.

Distribution (6 growth sites): In Hungary known at isolated localities mostly in the Transdanubian part. In Europe a boreal montane to alpine species. The Hungarian growth sites are remarkable for their low altitude.


Studia bot. hung. 40, 2009
Fig. 13. Grimmia funalis. A = moist plant with sporophyte; B = leaves; C–E = basal leaf cells (showing variation in cell pattern); F = young shoot and its leaves; G–I = transverse sections of leaves. Scale bar: A – 2 mm; B, F – 1 mm; G – 400 μm; C–E, H, I – 100 μm. (from Herzogia 11)
**Grimmia funalis** (Schwägr.) Bruch et Schimp.
(Figs 13, 14)

Plants growing in dense glaucous to yellowish-green tufts, readily desintegrating, up to 5 cm high; young shoots bearing imbricate small, muticous, boat-shaped leaves with incurved apices (Fig. 13F) often present in interior of tuft and on the reverse side of the cushion. Central strand of few, thin-walled cells, surrounding tissue thick-walled, orange coloured. Hair-point nearly smooth to bluntly denticulate, of varying length, sometimes longer than leaf, nearly completely lacking in male plants. Leaves loosely appressed to stem, twisted and arranged in ± regular spiral rows when dry, giving shoots a string-like appearance, erecto-patent when moist, larger in comal tuft, up to 1.5 mm long, slightly secund, ovate-lanceolate, keeled above, asymmetric, the costa reaches the apex close to one of the margins, not in the middle, due to curvature of the costa. Leaf margin plane, on one side recurved to revolute from widest part of leaf to leaf base, bistratose in 1–2 rows. Lamina unistratose below, bistratose above, sometimes irregularly so. Lamina cells rounded quadrate to shortly rectangular, 7–9 μm, ± incrassate, sinuose; paracostal basal cells elongate, with slightly to strongly nodulose longitudinal walls, towards margin 1 to 2 rows of quadrate to short rectangular cells, some basal cell rows often orange tinged. Costa stout above, attenuate towards leaf base, with two guide cells. Gemmae unknown.

Sporophytes rare, not seen in Hungarian material. Seta arcuate, up to 1.6 mm long, capsule small, with 8 weak ribs, operculum conical, calyptra mitrate, peristome short, papillose, teeth perforated or split at apex.

The rope-like appearance (*funalis*: related to rope) of dry tufts, due to the asymmetric leaves, is very characteristic, as are the young shoots often hidden in the tuft and on the reverse side of the cushion.

**Fig. 14.** Distribution of *Grimmia funalis*
Habitat and distribution (1 growth site): On andesite rocks in northern exposition, known from a single site in the Mátra Mts.

Associated bryophytes: Frullania tamarisci, Grimmia ovalis.

Vertical distribution: 730 m.

Selected specimens examined: Mátra Mts: 8186/1 Comit. Heves. In rupibus andesit. sept. montis Disznó-kő, prope Parád, 730 m, 25.03.1951, leg. Á. Boros, BP 112798 (numerous duplicates, e.g. Crypt. exsiccat. Vindobonens. 3958; first collected in 1931 and confirmed by Loeske); Heves County, Disznó-kő, andesite rocks N 47° 52' 43.5", E 20° 02' 26.0", 730 m, 09.06.2007, leg. B. Papp, BP 174842 (in mixed stand with G. ovalis).

Grimmia hartmanii Schimp.
(= Dryptodon hartmanii (Schimp.) Limpr.)
(Figs 15, 16)

Plants growing in light to dark green, lax, extended patches. Plants up to 10 cm long. Central strand lacking (Fig. 15L). Hair-point bluntly denticulate, composed of cells with visible lumen (Fig. 15J), conspicuous to small or lacking, leaf apex often with cells deformed after production of gemmae (Fig. 15K). Leaves loosely appressed to stem and slightly flexuose when dry, slightly secund at stem apex when moist, to 3 mm long, from weakly decurrent, ovate base narrowly lanceolate, acuminate, keeled above. Leaf margin plane, recurved from mid leaf to base, revolute on one side, bistratose in 1 or more rows. Lamina unistratose with few bistratose cell rows to rarely bistratose. Lamina cells rounded quadrate to shortly rectangular, (6–) 8–9 (–10) μm, incrassate, with pitted walls, basal cells predominantly rounded quadrate to shortly rectangular, with smooth or hardly nodulose walls, few paracostal cells more elongate. Costa angulate above, below with stereids on dorsal side of guide cells. Multicellular globular gemmae, 100–250 μm, often present on apices of young leaves at stem tips (Fig. 15A).

Sporophytes very rare in Central Europe, but known from Southeast Europe, e.g. Montenegro (PAPP and ERZBERGER, unpublished). Seta arcuate, 3–4 mm long, operculum conical rostrate, calyptra cuculate-mitrato-rectangular, peristome papillose only at apex or throughout: var. montenegrina Breidler et Szysz. (LIMPRICHT 1889).

When gemmae are present, this plant is easily identified. Sometimes gemmae (or at least some leaves with apices damaged by gemma formation) may be found at the end of the previous year’s growth. Gemma production and the colour of gemmae (green to brown or scarlet red) vary in a seasonal way.

Habitat: Shaded siliceous rocks (most often andesite, but also porphyric and diabasic and other volcanic rocks, e.g. basalt), often in forests or near streams.

Studia bot. hung. 40, 2009
Grimmia hartmanii. A = moist plant with gemmae; B = leaves; C, D = basal leaf cells; E–I = transverse section of leaves; J = hair points and cells at apex; K = leaf apex with cells deformed by gemma production; L = transverse section of stem (showing absence of central strand). Scale bar: A – 4 mm; B – 1 mm; I – 400 μm; C–H, J–L – 100 μm. (from Herzogia 11)
**Associated bryophytes:** *Barbilophozia barbata, Brachydontium trichodes, Brachythecium populeum, Bryum moravicum, Dicranum fulveum, D. scoparium, Frullania tamarisci, Grimmia muehlenbeckii, G. ovalis, G. trichophylla, Hedwigia ciliata var. ciliata, Hypnum cupressiforme, Isothecium alopecuroides, Lejeunea cavifolia, Lophocolea minor, Metzgeria furcata, Orthotrichum sp., Paraleucobryum longifolium, Plagiochila porelloides, Pohlia cruda, Pseudoleskea incurvata, Pseudoleskeella nervosa, Pterigynandrum filiforme, Racomitrium aciculare, R. aquaticum, Rhizomnium punctatum, Rhytidiadelphus triquetrus, Schistidium apocarpum, S. lancifolium, Thuidium sp.*

**Vertical distribution:** 250–1,010 m.

**Distribution** (123 growth sites): In Hungary, widespread in nearly all regions with suitable siliceous bedrock, particularly in the northern mountain range, less frequent in the Transdanubian region. In Europe a boreal montane species.

**Selected specimens examined:** *Zemplén Mts: 7594/3* Borsod-Abaúj-Zemplén County, Bagoly-bérc peak at Háromhuta, shaded andesite rocks, N 48° 24′ 50.0″, E 21° 23′ 38.6″, 690 m, 26.05.2007, leg. B. Papp, BP 174926; *Bükk Mts: 7988/2* Comit. Borsod. In rupibus diabas. sept. silvat. montis Nagy István erőse, prope Nagyvisnyó, 900 m, 29.09.1950, leg. Á. Boros, BP 113142; *Mátra Mts: 8084/4* Heves County, Bárány-kő rocks in the valley of Csörgő stream at Mátraszentimre, andesite rocks, N 47° 54′ 35.3″, E 19° 49′ 05.8″, 490 m, 01.07.2007, leg. B. Papp, BP 175084; *Karancs–Medves Mts: 7885/3* Comit. Nógrád. In rupibus basalticis montis Nagy-Salgó, prope pag. Salgótarján, 13.06.1951, leg. L. Vajda, BP 6145; *Cserhát hills: 8082/3* County of Nógrád, Szanda, on andesite boulder in Carpinetum W of castle hill, 23.04.2000, leg. P. Erzberger (B Erzberger 6120); *Bőrzsöny Mts: 8079/1* Comit. Nógrád. In rupibus andesiticiis silvat. vallis rivi Kemence-patak sub monte Csóványos, prope Diósjénő, 500–600 m, 10.04.1955, leg. Á. Boros, BP 113091;

*Studia bot. hung.* 40, 2009
Plants growing in blackish-grey, readily desintegrating tufts or extended patches up to 1.5 cm high. Small-leaved young shoots present in interior of tufts. Central strand well-developed. Hair-point strongly denticulate, flat at insertion and decurrent, to longer than lamina in comal tufts, giving shoot tips an appearance like a paint brush. Leaves appressed to stem when dry, little altered when moist (Fig. 17A), lower leaves scale-like, small and nearly muticous, but with at least a sharp hyaline end cell, upper leaves enlarged in comal tuft, 1.2–1.8 mm, rarely up to 3 mm long, imbricate, from broadly ovate, half-sheathing, slightly decurrent base lingulate to broad lanceolate with rounded to acute apex, concave, semicircular in section. Leaf margin plane, bistratose above, usually unistratose in one to several rows in bistratose parts of lamina (Fig. 17D). Lamina bistratose from apex to nearly base. Lamina cells rounded-quadrat, 6–9 (–10) μm, incrassate, esinuose; basal cells, except some rows of rectangular paracostal cells, predominantly transversely rectangular, incrassate, transverse walls thicker than longitudinal walls. Costa broad at base, poorly defined above, not to hardly prominent on abaxial side, with 2 guide cells with incrassate external (= adaxial) walls in shallow groove from apex to near base, in leaf base and at insertion more guide cells and in addition hydroids and substereids. Gemmae unknown.

Sporophytes not infrequent, seta straight, 1–3 mm long, capsules emergent, ovoid to ellipsoid, smooth, operculum conical rostrate, calyptra mitrate, covering upper part of capsule, peristome papillose, usually perforated or cleft.

Usually easily recognised in the field due to the paint-brush-like appearance of shoot tips and the characteristic leaf shape with broad apex, but *G. plagiopodia* and *G. tergestina* are superficially similar in this respect. *G. plagiopodia* normally bears immersed sporophytes, and *G. tergestina* grows in smaller, lower cushions on calcareous, not siliceous rocks.

**Habitat:** On dry siliceous rock (andesite, trachite, basalt, sandstone, glaukonite, gabbro, conglomerate, rhiolite, ingimbrite, granite), but also (rarely: Cserhát Mts) on dolomite.
Fig. 17. Grimmia laevigata. A = moist plant with sporophyte; B = leaves; C = basal leaf cells; D, E = transverse sections of leaves. Scale bar: A – 2 mm; B – 1 mm; E – 400 μm; C, D – 100 μm. (from Herzogia 11)

**Vertical distribution:** 88–950 m.

**Distribution** (94 growth sites): In Hungary widespread in the regions with siliceous bedrock, but with a preference for the Transdanubian basaltic regions, fewer sites in the northern mountain range. In Europe a southern plant with a need for warm climate.

![Fig. 18. Distribution of Grimmia laevigata](image)

hill, N 47° 40' 22.4", E 19° 00' 52.6", 350 m, 31.05.2004, leg. B. Papp, BP 171470; **Pilis Mts:** 8379/4 Comit. Pest. In rupibus arenaceis montis "Vendel-hegy", prope pag. Pilisborosjenő, 270 m, 23.05.1948, leg. Á. Boros, BP 111505; **Buda Mts:** 8579/2 Comit. Pest. In rupibus silicato-dolomiticiis “Sorrento” montium Csíki-hegyek, prope Budáörs, 250 m, 14.10.1946, leg. Á. Boros, BP 111507; **Gerecse Mts:** 8278/3 County of Esztergom, Nagy Gete hill near Tokod, on sandstone boulder above the village, N 47° 42’ 45.3", E 18° 40’ 07.4", 220 m, 20.03.2008, leg. P. Erzberger (B Erzberger 12772); **Vence Mts:** 8777/2 Comit. Pest. In rupibus graniticis montis Zsidó-hegy, prope pagum Pázmánd, 200 m, 29.05.1940, leg. Á. Boros, BP 111518; **Bakony Mts:** 9069/4 Comit. Zala. In rupibus basalt. montis Farkas-hegy, prope Sümeprága, 350 m, 20.09.1953, leg. Á. Boros, BP 111474; **Balaton uplands:** 9270/2 Comit. Veszpré. In rupibus basalticis montis Badacsony, prope pag. Badacsony, 29.04.1956, leg. L. Vajda, BP 49005; **Keszthely Mts:** 9069/4 Comit. Veszpré. In rupibus basalticis montis Tátiaka, supra Hidegkút, 03.05. 1954, leg. L. Vajda BP 27232; **Közeg Mts:** 8664/4 F. cr. cottus castriferrensis Bozsok, in saxis Kalaposkö dictis, 604 m, 29.10.1930, leg. A. Visnya, BP 111478, det. Latzel; **Mecsek Mts:** 9974/2 Comit. Pest. “Babás szerkövek” a Jakab-hegy déli oldalán. Homokkőn. Silikat trocken sonnig, 400 m, 24.07.1932, leg. A. Visnya, det. Latzel, BP 111473.

**Literature:** The substrate of the plants growing in the Buda Mts: Csíki-hegyek (“In rupibus silicato-dolomiticiis Sorrento montium Csíki-hegyek”, see specimen above) is described in more detail by **SZEPESFALVI** (1941): “Bemerkenswert ist ihr Vorkommen in unserem Kalk-Dolomitgebiete, in den Csíki-hegyek, wo sie an den Felsblöcken einer eingesprengten Hornsteinader auftaucht”.

**Grimmia lisa** De Not.
(Figs 19, 20)

Plants growing in greenish black, mostly desintegrating cushions, up to 3.5 cm high. Central strand well defined. Hair-point bluntly denticulate, of variable length, sometimes lacking. Leaves 1.8–2.7 mm, loosely arranged around stem, erecto-patent to spreading or squarrose when moist (Fig. 19B), from ovate base lanceolate, tapering to acute apex, keeled above. Leaf margin at one side recurved from insertion up to mid leaf, occasionally slightly so at other side, plane in upper part, unistratose below, bistratose (rarely 3-stratose) above in several rows. Lamina unistratose, in upper part irregularly to completely bistratose. Lamina cells 8–10 μm, in mid leaf isodiametric, above rounded, below sinuose, sometimes with joint thickenings (resembling papillae above the cell walls in transverse section), basal cells rectangular to elongate-rectangular, with smooth or slightly nodulose walls, but near margin isodiametric to rectangular, smooth. Costa rounded on abaxial side, at insertion and leaf base 6 (–8) guide cells, reduced to 4 and 2 guide cells, respectively, towards apex, with substereids throughout, but usually without hydroids. Gemmae sometimes formed on abaxial side of leaf base (also observed in one Hungarian specimen from Mt Tátika).
Fig. 19. Grimmia lisae. A = moist plant with sporophyte; B = part of moist plant showing squarrose leaves; C = leaves; D = hair-point; E = basal leaf cells; F = cells in transitional zone; G, H = transverse sections of leaves. Scale bar: A, B – 2 mm; C – 1 mm; G – 400 μm; D–F, H – 100 μm. (A, C–H from Candollea 56(2); B from Herzogia 11)
Sporophytes not observed in Hungarian plants, seta arcuate, nearly straight when dry, to 4.8 mm, capsule ellipsoid, weakly ribbed, operculum conical rostrate, calyptra mitrate, covering upper 1/4 of capsule, peristome teeth (outside) smooth in lower third, papillose on inner side and above, usually split in 2 branches in upper half.

Well-developed, typical plants are characteristic due to their long squarrose leaves, but some Hungarian plants are depauperate.

**Habitat and distribution** (5 growth sites): On andesit, basalt and diabasic rock; the occurrence of this Mediterranean-oceanic species in Hungary is remarkable. The growth site at Szarvaskő (Bükk Mts) is also famous for other sub-Mediterranean species: *Fabronia pusilla* and *Frullania inflata*.

**Associated bryophytes:** *Grimmia ovalis*.

**Vertical distribution:** 250–650 m.

![Distribution of Grimmia lisae](image)

**Specimens examined:** **Bükk Mts:** 8087/2 Comit. Heves. In rupibus diabasicis, prope Szarvaskő, 250–300 m, 15.10.1950, leg. Á. Boros, BP 111944 sub *G. commutata*, rev. E. M.; **Börzsöny Mts:** 8079/1 Comit. Hont. In rupibus andesiticis or. montis Hollókő, prope Perócsény, 650 m, 20.05.1962, leg. Á. Boros, BP 111917 together with *G. ovalis*, rev. E. M.; Comit. Nógrád. In rupibus andesiticis vallis rivi Kemencepatak, prope Diósjenő, montes Börzsöny, 10.04.1955, leg. L. Vajda, BP 46335 sub *G. apocarpa*, rev. E. M. (ERZBERGER and MAIER 2008b); **Balaton uplands:** 9170/4 Comit. Zala. In rupibus basalt. sept. montis Szentgyörgy-hegy prope Tapolca, 300–400 m, 01.05.1955, leg. Á. Boros, BP 111845 sub *G. commutata*, rev. E. M.; **Keszthely Mts:** 9069/4 County of Veszprémed. Zalaszántó, Tátika, on basalt rock at the base of the steep rock wall below the summit, with gemmae, 30.07.2000, leg. P. Erzberger (B Erzberger 6280) sub *G. cf. pulvinata*, rev. E. M.

*Studia bot. hung.* 40, 2009
**Grimmia longirostris** Hook.

(= *G. affinis* Hornsch., *G. ovalis* auct. non (Hedw.) Lindb.,
*G. ovata* F. Weber et D. Mohr sensu Limpricht)

(Figs 21, 22)

Plants growing in olive to blackish, dense, coherent cushions, up to 2.5 cm high, with small-leaved young shoots in the interior. Central strand well-developed. Hair-point almost smooth, reaching to 1/3 (–1) of lamina, lower leaves muticous. Leaves enlarged in comal tuft, 2.5–3 mm long, narrowly lanceolate, tapering to acuminate apex, keeled in upper third, transition between leaf base and lamina hardly developed, near insertion with a soft standing fold on one side of the costa (Fig. 21H**). Leaf margin plane above, in many leaves recurved on one side below, bistratose (in apical part sometimes 3- to 4-stratose) except at leaf base. Lamina unistratose to bistratose in upper part of leaf. Lamina cells in mid leaf 8–10 (–12) μm, rounded-quadratice, incrassate, sinuose, basal cells near costa elongate-rectangular, with thick, nodulose longitudinal and thin, often oblique transverse walls, cells towards margin short rectangular to quadrate, smooth, transverse walls thickened, some marginal cell rows hyaline. Costa semilunar in transverse section, ± obscure in narrowly keeled part of leaf, on abaxial side ± prominent, rounded, towards base unevenly so and somewhat angulate, with 6–4 guide cells below and 2 guide cells above, substereids, and sometimes hydroids are present below. Gemmae unknown.

Sporophytes frequent, seta straight, (1–) 2–3 (–5) mm long, capsule cylindrical, obloid to ovoid-ellipsoid, constricted at mouth, operculum conical, bluntly rostrate, beak straight or slightly oblique, calyptra mitraceous, covering 1/3 of urn, peristome teeth narrow, only slightly perforated and split to mid size, densely papillose except at base.

Superficially resembling *G. ovalis* in leaf shape and especially the rounded abaxial appearance of the costa near apex, but careful examination will show the difference: in *G. longirostris* leaves are keeled, not semicircular in transverse section. See also the note under *G. ovalis*.

**Habitat**: On andesite rock.

**Associated bryophytes**: Andreaea rupestris, Grimmia muehlenbeckii, *G. ovalis*, *Hedwigia ciliata* var. leucophaea.

**Vertical distribution**: 480–750 m.

**Distribution** (7 growth sites): In Hungary, few localities in the Northern mountain range (Zemplén and Mátra); in Europe a widespread somewhat continental boreo-temperate species.

**Selected specimens examined**: Zemplén Mts: 7494/2 Comit. Abaúj-Torna. In rupibus andesit. occ. Kövesces-hegy ad montem Nagy-Milic, prope Füzér, 600 m, 03.10.1953, leg. Á. Boros, BP 111936 sub *G. commutata* together with *G. muehlenbeckii*, rev. E. M.; Mátra Mts: 8185/2 Comit. Heves. In rupibus andesit. or. supra vallem Csatorna-völgy montis Remete-bérc, prope Mátrafüred, 750 m, 06.05.1951, leg. Á. Boros, BP 111953 sub *G. commutata* together with *G. ovalis*, *G. muehlenbeckii*, rev. E. M.
Fig. 21. Grimmia longirostris. A = moist plants with sporophytes, showing different leaf orientation and capsule shape; B = leaves; C = basal leaf cells; D = paracostal basal leaf cells with nodulose walls; E, F = cells near costa above leaf base, G, H = transverse section of leaves (*keel, **standing fold). Scale bar: A – 3 mm (left plant); 4.8 mm (right plant); B – 1 mm; G – 400 μm; C–F, H – 100 μm. (from Herzogia 11)
For the names in use for this plant by Hungarian bryologists see ERZBERGER and PAPP (2004). MATOUSCHEK (1903) published *G. ovata* (Hedw.) Lindb. from the Pilis Mts (Fehérhegy, leg. Á. de Degen), but the specimen (BP 36943) was correctly revised (by B. Papp) to *G. laevigata*. Apart from the confirmed occurrences in the Zemplén Mts and Mátra Mts, BOROS (1968) and ORBÁN and VAJDA (1983) erroneously report the plants from basaltic rocks in the Medves Mts, but the specimens represent *G. muehlenbeckii* (BP 6051 and 112291). Therefore the alleged occurrence of *G. longirostris* on basaltic rocks in Hungary is erroneous.

**Grimmia longirostris** Bruch et Schimp.

(Figs 23, 24)

Plants growing in dark green to greyish, dense, compact cushions up to 1–2 cm high, strongly attached to the substrate. Central strand developed, consisting of few cells. Hair-point usually long, bluntly to strongly denticulate, lacking in small lower leaves. Leaves enlarged in comal tuft, 1.8–2.5 mm, from decurrent ovate to ovate-lanceolate base abruptly lanceolate to linear lanceolate with a pronounced shoulder (Fig. 23B*), tapering to acuminate apex, keeled above, transverse section of upper part (Fig. 23E) shaped like a pair of tongs. Leaf margin plane to incurved from shoulder to apex, bistratose to occasionally 3- to 4-stratose. Lamina bistratose above, unistratose below, in young or depauperate plants sometimes unistratose in upper part of leaf near costa. Lamina cells 7–10 μm, isodiametric, lumina rounded, hardly sinuose, incrassate, in transverse section higher than wide, external walls smooth, not protruding. Basal cells esinuose, predominantly short rectangular, paracostal cells rectangular, at margin several rows of quadrate to short rectangular cells with strongly incrassate transverse walls; a series of transversely oblong cells with small lumen can be found at the margin above the shoulder.
Fig. 23. *Grimmia montana*. A = moist plant with sporophyte; B = leaves (*shoulder*); C = basal leaf cells; D = marginal cells above shoulder, E–G = transverse sections of leaves (E* groove*). Scale bar: A – 3 mm; B – 1 mm; G – 400 μm; C–F – 100 μm. (A, C–G from Candollea 57; B from Herzogia 11)
Costa recessed in deep groove (Fig. 23E*), obscure in apex, below strongly prominent on abaxial side, rounded to angulate, very slightly to not attenuate towards insertion, with 2 guide cells throughout except at insertion, where 4 guide cells are found; a central median group of hydroids, observed in basal part, is gradually transformed to substereids above, vanishing in apical part. Gemmæ unknown.

Sporophytes not frequent, not observed in Hungarian specimens; capsule emergent to exserted, ovoid, stomata lacking, seta straight, 2–4 mm long, operculum conical, rostrate, beak straight or oblique, blunt; calyptra cucullate, large, longly rostrate, covering 2/3 of urn, peristome teeth papillose, irregularly cleft or perforated.

Habitat and distribution (1 growth site): On dry sandstone rocks in southern exposition, known from a single site in the Mecsek Mts; in Europe a montane species with suboceanic tendencies.

Associated bryophytes: Grimmia laevigata.

Vertical distribution: 500–550 m.

Fig. 24. Distribution of Grimmia montana


Literature: All distributional data on G. montana in Boros (1968) and “G. donniana” in Orbán and Vajda (1983) are erroneous except the occurrence in the Mecsek Mts.

Studia bot. hung. 40, 2009
Fig. 25. Grimmia muehlenbeckii. A = moist plant with sporophyte; B = leaves; C = hair-point; D = basal leaf cells; E–G = transverse sections of leaves; H = transverse section of stem (showing central strand). Scale bar: A – 3 mm; B – 1 mm; G – 400 μm; C–F, H – 100 μm. (from Herzogia 11)
Grimmia muehlenbeckii Schimp.
G. trichophylla var. muehlenbeckii (Schimp.) Husn.
(Figs 25, 26)

Plants growing in dark to blackish green dense to lax patches up to 1–2 cm high. Central strand developed. Hair-point strongly denticulate (Fig. 25C). Leaves from broadly ovate base elongate lanceolate, acuminate, without shoulder, keeled above. Leaf margin plane, on one side recurved to revolute from above mid leaf to base, bistratose in several cell rows. Lamina above unistratose with bistratose patches to sometimes bistratose. Lamina cells (7–) 9 μm, incrassate, sinuose, rounded above, joint thickenings are sometimes observed. Basal cells near costa wide rectangular with nodulose longitudinal walls, near margin a wide band of short rectangular to quadrate cells with incrassate transverse walls. Costa not to slightly attenuate at leaf base, angulate to winged by longitudinal ridges on abaxial side (Figs 25 F, G), guide cells 4 below, 2 above. Gemmae sometimes found on abaxial side of costa and lamina at leaf base.

Sporophytes not infrequent, capsule ovoid (urn 1.2 × 0.75 mm), weakly ribbed, seta arcuate, 2–3 mm long, operculum shortly to longly rostrate, calyptra mitrate, peristome teeth cleft at apex only, papillose.

The characteristic shape of the costa (angulate to winged, with prominent ridges on the abaxial side) can be observed at magnifications 20–40 × on dry specimens in situ.

Habitat: On andesite and other siliceous rocks (e.g. basalt, radiolarite), particularly in shaded places, but very rarely also on dolomite (Vértes Mts).


Vertical distribution: 230–900 m.

Fig. 26. Distribution of Grimmia muehlenbeckii
Distribution (83 growth sites): In Hungary widespread in the siliceous mountains of the Northern range, much rarer in the Transdanubian part. In Europe a temperate-montane species.


Reports in BOROS (1968) of the taxon in Tihany and Köszeg Mts must be considered doubtful, since no vouchers were found. In ORBÁN and VAJDA (1983) this taxon is considered rarer than *G. trichophylla*, but this revision shows the contrary.

Literature: Reports in BOROS (1968) of the taxon in Tihany and Köszeg Mts must be considered doubtful, since no vouchers were found. In ORBÁN and VAJDA (1983) this taxon is considered rarer than *G. trichophylla*, but this revision shows the contrary.

Studia bot. hung. 40, 2009
Fig. 27. Grimmia orbicularis. A = moist plant with sporophyte; B = leaves; C = basal leaf cells; D = upper leaf cells near costa; E = basal paracostal leaf cells with smooth walls; F, G = transverse sections of leaves. Scale bar: A – 3 mm; B – 1 mm; F – 400 μm; C–E, G – 100 μm.
(from Herzogia 11)
Grimmia orbicularis Bruch ex Wilson
(Figs 27, 28)

Plants growing in yellowish to olive green, hoary, often large, bulging compact cushions 1–2 (–4) cm high, strongly attached to the substrate. Central strand developed. Hair-point nearly smooth, slightly widened at base. Leaves 1–1.5 mm, not enlarged in comal tuft, but small and mucous at stem base, from ovate leaf base lanceolate to elongate-lanceolate, widest at mid leaf, ± abruptly narrowed to obtuse apex, keeled above. Leaf margin plane, recurved at mid leaf usually on both sides, unistratose or sometimes bistratose in a single row on one side near apex, in transverse section bistratose part not thicker than unistratose margin (Fig. 27G). Lamina completely unistratose. Lamina cells 9–12 μm, incrassate, sinuose, rounded quadrat above, quadrat to short rectangular below mid leaf, basal cells narrowly rectangular to elongate from costa to near margin, with thick longitudinal and thin transverse walls, some rows at margin rectangular to quadrat with transverse walls thicker than longitudinal walls. Costa attenuate towards leaf base, with 2 guide cells (4 at insertion) and hydroids (vanishing in apical part), prominent on abaxial side. Gemmae unknown.

Sporophytes frequent, capsule horizontal or pendent, subglobose to ovoid, weakly ribbed, stomata large, seta arcuate, 2–3 mm long, operculum convex, mamillate, not rostrate (Fig. 27A), calyptra cucullate, covering 1/2 of urn, peristome teeth cleft in upper 2/3, finely papillose.

The cushions of G. orbicularis resemble those of G. pulvinata, but are often larger and more bulging. When sporophytes with operculate capsules are present, the mamillate operculum will easily distinguish G. orbicularis from G. pulvinata with rostrate operculum in the field; sterile plants can be identified by the basal cells elongate in G. orbicularis, short in G. pulvinata, and the margin predominantly unistratose in the former and bistratose in at least 2 rows and thickened in the latter species.

Habitat: On limestone and, more often, on dolomite, rarely on sandstone.


Vertical distribution: 150–500 m.

Distribution (33 growth sites): In Hungary almost exclusively in the Transdanubian part (apart from a single record each in the Cserhát Mts and Naszály); in Europe a sub-Mediterranean species with a need for a warm climate.

112856; **Gerecse Mts:** 8477/2 Komárom-Esztergom County, Kecske-kő at Gyermely, limestone grassland, N 47° 35' 53.1", E 18° 36' 54.7", 220 m, 11.04.2007, leg. B. Papp, BP 174742; **Vértes Mts:** 8676/3 Comit. Fejér. In rupibus dolomit. montis Bucka et Kőlik-hegy, prope Csákberény, 250 m, 29.03.1936, leg. Á. Boros, BP 112831; **Bakony Mts:** 8775/3 Comit. Fejér. In rupibus dolomit. merid. montis Baglyas-hegy, prope Csőr, 200–300 m, 06.04.1951, leg. Á. Boros, BP 112836; **Balaton uplands 9073/1** Comit. Zala. In dolomiticis montis Tamás-hegy, prope Balatonfüred, 200–300 m, 02.04.1926, leg. Á. Boros, BP 112823; 9171/3 Comit. Zala. In rupibus arenac. "Kőhát" ad Salföld, 150 m, 12.05.1956, leg. Á. Boros, BP 110812 sub *G. apocarpa* together with *G. trichophylla*, rev. E. M.; **Villány Mts:** 0176/1 Comit. Baranya. In rupibus calc. merid. montis Harsány-hegy, prope Nagyharsány, 300–400 m, 27.04.1962, leg. Á. Boros, BP 112824.

**Fig. 28.** Distribution of *Grimmia orbicularis*

**Literature**: The occurrence of this species in the Gerecse Mts “Berg Kőpíté bei Komorn (Skofitz)” is already reported in LIMPRICH (1889: p. 760).

**Grimmia ovalis** (Hedw.) Lindb.

*G. commutata* Huebner [nom. illeg.]

(Figs 29, 30)

Plants growing in dark green to blackish, hoary, lax, easily desintegrating tufts up to 2–4 cm high. Central strand well-developed. Hair-point denticulate, sometimes only few hyaline cells. Leaves scale-like and muticous at stem base, enlarged in comal tuft, up to 3.5 mm long, sheathing part appressed to stem, laminal part loosely or slightly flexuose when dry, erecto-patent when moist, from broad ovate ± sheathing base lanceolate tapering to acuminate apex, shoulder well-developed at transition from base to narrower part of lamina (Fig. 29B*); in section semicircular, at apex tubular.
Fig. 29. Grimmia ovalis. A = moist plants, one with sporophyte, showing different leaf orientation; B = leaves (‘shoulder’); C = basal leaf cells; D–F = transverse sections of leaves.
Scale bar: A – 4 mm; B – 1 mm; F – 400 μm; C–E – 100 μm (from Herzogia 11)

Studia bot. hung. 40, 2009
Leaf margin plane, slightly inflexed above, unistratose below, bistratose above, but sometimes a single unistratose cell row at bistratose laminal part. Lamina bistratose in upper part, sometimes 3- to 4-stratose, with bistratose striae towards unistratose base. Lamina cells 6–8 (–9) μm, irregularly quadrate, incrassate, slightly sinuose, basal paracostal cells elongate rectangular with slightly nodulose longitudinal walls, near margin short rectangular to transversely rectangular with incrassate transverse walls. Costa indistinct at apex, slightly prominent at abaxial side below, with 4 guide cells and usually also a group of hydroids visible in wider part of lamina, external (adaxial) walls of guide cells strongly incrassate. Gemmae unknown.

Sporophytes frequent, capsule ovoid, constricted at orifice, seta straight, 3–4 mm long, operculum rostrate, beak oblique, blunt, calyptra cucullate, covering 1/2 of urn, peristome teeth cleft to 1/2 length from apex, papilllose.

This species is easily identified by its leaf shape and the bistratose lamina semicircular in section. A superficial resemblance to *G. longirostris* necessitates a careful observation: leaves of that species lack a shoulder and are keeled, i.e. in transverse section the left and right parts of the lamina enclose an angle of ± 90°, and the costa is more prominent on the abaxial side. (It is normally not necessary to make sections, but these features can be observed at magnifications 20–40× on dry specimens in situ).

**Habitat:** On preferably dry siliceous rocks (andesite, diabas, basalt, trachyte, sandstone, conglomerate, ingimbrite), rarely on calcareous rocks and dolomite (Pilis Mts, Vértes Mts), mostly in open situations, but also in forests.


**Vertical distribution:** 83–900 m.

**Distribution** (108 growth sites): In Hungary widespread in the siliceous mountains of the Northern range as well as in the Transdanubian part, ± absent from calcareous regions; in Europe a boreo-montane species.


**Fig. 30. Distribution of Grimmia ovalis**

*Studia bot. hung.* 40, 2009
**Grimmia plagiopodia** Hedw.

(Figs 31, 32)

Plants growing in dull, greyish green, dense low patches usually only 0.5–0.8 cm high. Central strand developed. Hair-point bluntly denticulate, broadly inserted. Leaves imbricate, ovate to ovate lanceolate, concave; lower leaves smaller, muticous. Leaf margin plane to weakly recurved, mostly unistratose to occasionally bistratose in 1 to few cell rows. Lamina usually completely unistratose, but sometimes bistratose at apex or with bistratose striae further down. Lamina cells 9–12 μm, incrassate, irregularly rounded quadrarate to oval, slightly sinuose, towards leaf base larger, basal cells quadrarate to short rectangular throughout, only slightly enlarged near costa. Costa vanishing below apex, slightly prominent on abaxial side, with 2 guide cells and a group of hydroids, adaxial wall of guide cells incrassate. Gemmae unknown.

Sporophytes commonly present, capsules immersed in perichaetium, subglobose, gibbous at base, seta arcuate, very short (0.4 mm), operculum conical, mamillate to shortly rostrate, calyptra mitrate, peristome teeth irregularly cleft and perforated, finely papillose in apical part, ± smooth below (MÄIER 1999, NYHOLM 1998).

In the field, the patches of *G. plagiopodia* can be recognised because they appear as if combed, *i.e.* the hair-points oriented ± in the same direction. Superficially similar species have either a bistratose lamina (*G. tergestina, G. laevigata*) or lack a developed peristome (*G. anodon, Schistidium flaccidum*).

**Habitat and distribution** (3 growth sites): On andesite and other siliceous rocks (*e.g.* gabbro) in the Zemplén and Visegrád Mts; a rare species without a closed area anywhere, with remarkably stable and in one case (Visegrád: Fellegvár) rich populations in Hungary.

**Associated bryophytes:** *Grimmia pulvinata, Schistidium brunnescens* subsp. *brunnescens*.

**Vertical distribution:** 250–350 m.
Fig. 31. Grimmia plagiopodia. A = moist plant with sporophyte; B = leaves; C = basal leaf cells; D, E = transverse sections of leaves. Scale bar: A – 2 mm; B – 1 mm; E – 400 μm; C, D – 100 μm. (from Herzogia 11)
Selected specimens examined: Zemplén Mts: 7693/3 Comit. Abaúj-Torna. In rupibus andesit. ruinae Boldogkő, prope Boldogkővár alja, 268 m, 26.05.1952, leg. Á. Boros, BP 86710; Borsod-Abáuj-Zemplén County, castle hill of Boldogkőváralja, andesite rocks, N 48° 20.731', E 21° 13.926', 250 m, 03.04.2004, leg. B. Papp, BP 171489; Visegrád Mts: 8279/2 Visegrádi Fellegvár andesit szikláin, 320 m, 09.05.1922, leg. “et detexit” I. Győrffy, det. as G. plagiopodia var. avernica, BP 86555; Pest County, Visegrád, on the north-western and western facing andesite rock wall of the castle, N 47° 47' 36.5", E 18° 58' 48.2", 330 m, 30.05.2004, leg. B. Papp, BP 171454; 8380/1 Comit. Pest. In monte Kö-hegy, ad Pomáz, 29.06.1916, leg. Á. de Degen, det. I. Győrffy as var. avernica, BP 86566; Pest County, Kö-hegy hill, Pomáz, on andesite open grassland and rock walls on the southern part of the hill, N 47° 40' 22.4", E 19° 00' 52.6", 350 m, 31.05.2004, leg. B. Papp, BP 171468.

Literature: Apart from the localities for which voucher specimens are found in BP, some other sites are reported: Budapest, Aquincum, on old Roman walls, leg. G. Csösz, com. M. Péterfi (PÉTERFI 1906), but later Győrffy and Szepesfalvi could not find the moss at this site (SZEPESFALVI 1941); since the Roman walls are made of limestone, it is hardly conceivable, where this species could have found a suitable substrate. Börzsöny Mts: ober Nagymaros im “Tempelgraben”, 220 m, auf Andesitbreccia-Felsen, 06.06.1921, leg. Győrffy (GYŐRFFY 1920, SZEPESFALVI 1941, BOROS 1968). These reports must be qualified as doubtful until specimens are located. The specimens from Mátra Mts, Disznó-kő (BP 5608 and 111013; BOROS 1968) have been revised to Schistidium confertum, and the specimens from Balaton uplands: Tihany (BP 424528, 58002, 111007, 111009, 111010; Csúcs-hegy at Tihany, “Basalttufffelsen”, BOROS 1968) have been revised to Schistidium brunnescens subsp. brunnescens (ERZBERGER and SCHRÖDER 2008).
Fig. 33. Grimmia pulvinata. A = moist plant with sporophyte; B = leaves; C = basal leaf cells; D = upper leaf cells; E, F = transverse sections of leaves. Scale bar: A = 3 mm; B = 1 mm; F = 400 μm; C–E = 100 μm. (from Herzogia 11)
**Grimmia pulvinata** (Hedw.) Sm.

*G. pulvinata* var. *africana* (Hedw.) Hook. f. et Wilson

(Figs 33, 34)

Plants growing in grey-green, rounded, dense, compact cushions up to 3 cm high, strongly attached to the substrate. Central strand developed. Hair-point denticulate, muticous leaves can occur. Leaves loosely appressed to the stem and slightly flexuose when dry, erecto-patent when moist, becoming gradually longer towards stem apex, up to 2.5 mm long, ovate-lanceolate to elongate-lanceolate, of nearly constant width from above insertion to above mid leaf, shortly tapering or abruptly narrowed to obtuse apex, keeled above. Leaf margin plane above, recurved below on one or both sides, bistratose in 1 to several rows, bistratose margin thicker than adjacent unistratose lamina (Fig. 33E). Lamina unistratose, rarely bistratose in apical part (Fig. 33E). Lamina cells (7–) 8–10 (–11) μm, ± incrassate, slightly sinuose, rounded quadrate and transversely oblong above, becoming longer and slightly larger towards base, basal paracostal cells slightly elongate-rectangular, towards margin short rectangular to quadrate with incrassate transverse walls. Costa not to slightly attenuate towards leaf base, prominent on abaxial side, with 2 guide cells (4 at insertion) and a group of hydroids that can be transformed to stereids in plants from harsh habitats. Gemmae unknown.

Sporophytes commonly present, capsule obloid, pendent, with 8–10 pronounced ribs, seta arcuate, 2–4.5 mm long, operculum (conical to) longly rostrate, beak of variable length, calyptra obliquely mitrate, peristome teeth cleft at tips and papillose.

Usually easily recognised by leaf shape (obtuse apex) and abundance of rostrate-lidded capsules with seta cygneous except when old and dry. For the difference to *G. orbicularis* see the note under the latter species. The operculum exhibits a beak of variable length, and short-beaked morphs (“var. africana” – included in the synonymy of *G. pulvinata*) may be confused with *G. orbicularis*.

**Habitat:** On nearly all kinds of natural rock (siliceous rock, e.g. granite, sandstone, radiolarite, phyllite, volcanic rock like andesite, amphibolite, trachyte, geysirite, basalt, calcareous rock, e.g. limestone, dolomit) and man-made stone constructions, walls of ruins, cemeteries, vineyards, on roof tiles, brick and concrete, but also (rarely) on the bark of trees (e.g. *Fagus sylvatica*, *Populus nigra*), on wood of a fence, on rotting wood, on soil (loam), on loess walls; in all kinds of situations, dry, shaded, exposed to east, west, south, north, in forest, in open places.


*Studia bot. hung.* 40, 2009
Vertical distribution: 82–750 m.

Distribution (239 growth sites): In Hungary in nearly all regions, siliceous as well as (more frequent) calcareous mountain areas, in lowland regions on man-made constructions or tree bark; in Europe a southern temperate species.

**Fig. 34.** Distribution of *Grimmia pulvinata*

Fót, 21.05.1901, leg. Á. de Degen, BP 36599; **Börzsöny Mts**: 8079/1 Comit. Hont. In rupibus andesiticis or. montis Hollókő, prope Perócsény, 650 m, 20.05.1962, leg. Á. Boros, BP 112464; **Visegrád Mts**: 8380/1 Pest County, Pilis Mts, Kis-Cskóvár hill at Pomáz, south-western slope, rocky grassland on andesite rocks, 15.08.2000, leg. B. Papp, BP 175302; **Naszály**: 8180/2 Com. Pest: Vácz: a Katalin psz. fölötti elhagyott bánya szikláin, 300 m, 01.06.1917, leg. Á. Boros, BP 112458; **Pilis Mts**: 8278/4 Comit. Esztergom. In rupibus calcar. merid. montis Öreg-szírt, prope Keszthely, 400–500 m, 29.09.1946, leg. Á. Boros, BP 112484; **Buda Mts**: 8579/2 Comit. Pest. In argillothesis vallis Farkas-völgy ad Budam, 25.03.1904, leg. Á. de Degen, BP 36597, det. Matouschek; **Gerecse Mts**: 8477/2 Comit. Komárom. In rupibus dolomit. montis Bagoly-hegy, prope pag. Gyermely, 250 m, 22.05.1941, leg. Á. Boros, BP 112547; **Vértes Mts**: 8675/2 Comit. Fejér. In rupibus dolomit. sept. montis Vár-hegy, prope pag. Csákás, 350–400 m, 20.08.1948, leg. Á. Boros, BP 112538; **Velence Mts**: 8777/2 Comit. Fejér. In rupibus granit. ad Nadap, 180 m, 25.05.1933, leg. Á. Boros, BP 112534; **Bakony Mts**: 9069/2 Comit. Veszprém (olim Zala). In rupibus calcar. montis Vár-hegy ad Sümeg, 250 m, 30.05.1968, leg. Á. Boros, BP 112409; **Balaton uplands**: 9171/2 Comit. Veszprém (olim Zala). In rupibus arenac. Felsőkőhát, prope Kővágóörs, 150 m, 29.05.1968, leg. Á. Boros, BP 112400; **Keszthely Mts**: 9270/1 County Veszprém. On exposed calcareous rock Szamár-kő in valley Kigyós-völgy at Balatongyörök, 200 m, 18.10.1969, leg. B. Papp, BP 166765; **Sopron**: 8265/3 Bécsi-domb, 27.02.1953, leg. Turók, BP 112446, det. Boros; **Vas region**: 9064/2 Praenoricum: Rábasik, in lapid. pontis supra rivul. Vöröspatak, pr. pag. Csákánydoroszló, 17.06.1954, leg. T. Pócs and Gelencsér, BP 58487; **Zala**: 9568/1 Nagykanizsa köztemető, 11.12.1947, leg. Károlyi, BP 112454; **Belső Somogy region**: 9768/2 Comit. Somogy. In muris ad Újváros, prope Csurgó, 150 m, 28.09.1936, leg. Á. Boros, BP 112438; **Mecsek Mts**: 9875/2 Mánfa, téglakerítésen, 21.08.1931, leg. Á. Visnya, BP 112422; **Villány Mts**: 0176/1 Praenoricum, Sopianicum, Transdanubia: mons Nagyhrsány, ad saxa calcarea form. jurassicae super. Xerophyton photophilum, 160–180 m, 22.09.1936, leg. I. Győrffy, BP 72447; **Little Hungarian Plain**: 8371/2 Győr, az Ágyugyár kerítésének betonfalán, 25.09.1941, leg. S. Polgár, BP 170346; **Hanság region**: 8069/3 Comit. Moson. In muris viae ferreae ad fluv. Lajta, prope pag. Hegyeshalom, 120 m, 10.04.1920, leg. Á. Boros, BP 112389; **Danube–Tisza Interface**: 8977/3 Comit. Fejér. In muris ad stationem Aba-Sárkeresztúr, 100 m, 28.11.1929, leg. Á. Boros, BP 112390; **9179/4 Comit. Tolna. In muris loessaceis ripae Danubii ad Dunaföldvár, 100 m, 22.07.1951, leg. Á. Boros, BP 112392; **Tisza–Danube region**: 8194/4 Hajdúnádas. In sebepisignosis, 04.03.1933, leg. E. Bán, BP 112375; 8693/2 Comit. Hajdú. Ad lignum ± putresc. in pag. Kaba, 95 m, 24.05.1938, leg. Á. Boros, BP 112374; **Northern Plains**: 7901/3 Comit. Berge. Ad saxa andesit. collis Tarpai Nagy-hegy, pr. Tarpa, 160 m, 07.05.1955, leg. Á. Boros, BP 112340; **Drava region**: 0071/2 Comit. Somogy. In tectis pagi Darány, 120 m, 08.08.1927, leg. Á. Boros, BP 112445; **Danube inundation region**: 8879/2 Comit. Pest. *Populus nigra* kérgén a dunaparti füzesben Ráczkevével szemben, 100 m, 02.09.1917, leg. Á. Boros, BP 112381.
Fig. 35. *Grimmia teretinervis*. A = moist plant; B = leaves; C = basal leaf cells; D, E = transverse sections of leaves. Scale bar: A – 3 mm; B – 1 mm; D – 400 μm; C, E – 100 μm. (from Herzogia 11)
**Grimmia teretinervis** Limpr.

*Schistidium teretinerve* Limpr.

(Figs 35, 36)

Plants growing in dark green to blackish, dense, easily desintegrating patches up to 1–2 (–3) cm high, with small-leaved young shoots. Central strand weakly developed. Hair-point slightly denticulate, broadly inserted at leaf apex. Leaves from decurrent ovate base linear-lanceolate, up to 1.35 mm long and 0.45 mm wide, ± semicircular in section, lower leaves smaller, muticous or with very short hair-point. Leaf margin plane, weakly recurved below, bistratose above, bistratose part reaching farther down than bistratose lamina, where thus a unistratose lamina zone appears beside the costa. Lamina bistratose in upper part of leaf, unistratose below. Lamina cells 7–9 μm, rounded to rounded-quadrate, incrassate, not to sometimes slightly sinuose, rather uniform throughout the leaf, but short rectangular at leaf base near costa. Costa stout, biconvex, in transverse section rounded prominent on adaxial as well as on abaxial side (Fig. 35E), interior cells only weakly differentiated, with a ± well-developed central group of hydroids. Gemmae unknown. (LIMPRICHT 1889, p. 718 reports gemmae, but these were produced by *Didymodon rigidulus* growing in the same cushion, CORRENS 1899, pp.113–114).

Only female plants are known, sporophytes unknown.

**Habitat and distribution** (2 growth sites): Limestone rocks in southern exposition; in Hungary known from two sites in the Bükk Mts, but not seen recently; in Europe a sub-Mediterranean-praealpine species.

**Associated bryophytes:** *Grimmia tergestina.*

**Vertical distribution:** 450–900 m.

![Fig. 36. Distribution of Grimmia teretinervis](image-url)

Literature: This species appears first in ORBÁN and VAJDA (1983), but the report from Bakony Mts: Sümeg is erroneous (the specimens represent G. dissimulata: BP 111991 or a mixture of G. pulvinata and a non-Grimmia species: BP 74224).

Grimmia tergestina Tomm. ex Bruch et Schimp.  
G. poecilostoma Cardot et Sébille  
(Figs 37, 38)

Plants growing in dark green to blackish, hoary, loose, easily desintegrating small tufts or patches adherent to substrate, up to 1 (–2) cm high, with small-leaved young shoots in the interior. Central strand developed. Hair-point smooth to slightly denticulate. Leaves small, muticous at stem base, enlarged in comal tuft, up to 2.8 mm long, from broad, ovate base ± abruptly narrowed to lingulate upper part with rounded apex, concave, semicircular in transverse section. Leaf margin plane, ± incurved above, bistratose (or in 1 cell row unistratose) in bistratose part of lamina, unistratose below. Lamina bistratose from apex to widest part of leaf, unistratose at leaf base. Lamina cells 6–8 (–12) μm rounded quadrate, larger below, basal cells elongate rectangular from costa to near margin, marginal cells shorter, often hyaline, transverse walls of basal marginal cells strongly incrassate. Costa (Fig. 37E) moderately prominent and rounded on abaxial side, not channelled on adaxial side, indistinct near apex, 2 hardly differentiated guide cells are overlaid by ventral lamina cells in upper part of leaf, hydroids present, occasionally transformed to substereids. Gemmae unknown.

Sporophytes not frequent, capsule immersed, erect or inclined, obloid and symmetric or ovoid and ventricose, smooth, seta straight or curved, up to 0.6 mm long, operculum rostrate, beak straight, calyptra mitrate, completely covering operculum, peristome teeth perforated or cleft, papillose.

The small blackish cushions and the calcareous habitat are highly characteristic; species with a somewhat similar leaf form (e.g. G. laevigata) do not usually grow on exposed limestone rocks.

Habitat: On dry limestone in usually southern exposition, but in one instance on base-rich sandstone (Tarna region).


Vertical distribution: 220–900 m.
Fig. 37. Grimmia tergestina. A = moist plant with sporophyte; B = leaves; C, D = basal leaf cells (showing variation in cell pattern); E, F = transverse sections of leaves. Scale bar: A – 2 mm; B – 1 mm; F – 400 μm; C–E – 100 μm. (from Herzogia 11)
**Distribution** (49 growth sites): In Hungary widespread in calcareous mountains of both the northern range (Aggtelek, Bükk) and the Transdanubian region (particularly Gerecse) including the southern mountains (Mecsek, Villány); in Europe a sub-Mediterranean-montane species.

![Map of Hungary with distribution points]

**Fig. 38. Distribution of Grimmia tergestina**

**Selected specimens examined:** **Aggtelek Karst:** 7489/3 Comit. Borsod-Abaúj-Zemplén. Ad rupes Oltár-kő in decl. Nagy-oldal, prope pag. Jósvafő, 540 m, 05.05.1987, leg. M. Rajczy, BP 165302, det. B. Papp; **Bükk Mts:** 7988/3 Comit. Borsod. In rupibus calc. montis Bél-kő, prope Bélápátfalva, 500–780 m, 03.09.1959, leg. Á. Boros, BP 112051; **Tarna region:** 7986/1 Kom. Heves, Gde. Istennezeje NW Eger, Tal Tarna-völgy, Hügeland von Heves-Borsod, Glaucn. Sandsteinfelsen “Noé szőllője” in Ortslage, N 48° 05' 08.7", E 20° 03' 01.1", 240 m, 26.03.2008, leg. T. Pócs and P. Erzberger (B Erzberger 12847); **Pilis Mts:** 8379/4 Comit. Pest. In rupibus calc. mer. montis Öszölő, prope Csohánsa, 300 m, 16.06.1946, leg. Á. Boros, BP 5965; **Buda Mts:** 8479/2 Comit. Pest. In rupibus calc. mer. montis Remete-hegy, prope Máriaremete, 350–400 m, 30.05.1946, leg. Á. Boros, BP 112041; **Gerecse Mts:** 8277/3 Comit. Esztergom. In rupibus calc. mer. montis Nagypisznie, prope pag. Súttó, 500 m, 26.05.1947, leg. Á. Boros, BP 5969; **Vértes Mts:** 8675/2 Comit. Pest. In rupibus calcareis mer. montis Vár-hegy ad Csókakő, 350–400 m, 20.08.1948, leg. Á. Boros, BP 112030; **Bakony Mts:** 8673/3 Comit. Veszprém. In rupibus calcareis apricis montis Vár-hegy, prope pag. Csesznek, montes Bakony, 06.07.1969, leg. L. Vajda, BP 74477 together with *G. anodon*; **Mecsek Mts:** 9875/3 Com. Baranya. In rupibus calcareis siccis in decl. mer.-or. montis Kis-Tubes, prope pag. Pécs, 29.06.1952, leg. L. Vajda, BP 5971; **Villány Mts:** 0176/1 Comit. Baranya. In rupestris in decl. mer. montis Száromlyó, prope pag. Nagyharsány, 200–300 m, 17.02.2000, leg. B. Papp, BP 166486.

**Literature:** The occurrence of this species in the Gerecse Mts “Berg Köpfe bei Komorn (Skofitz)” is already reported in LIMPRICHT (1889: p. 740).

*Studia bot. hung. 40, 2009*
Fig. 39. *Grimmia trichophylla*. A = moist plant with sporophyte; B = leaves; C = hair-point and leaf cells at apex; D = leaf cells in transitional zone; E = basal leaf cells; F–H = transverse sections of leaves. Scale bar: A = 3.25 mm; B = 1 mm; F = 400 μm; C=E, G, H = 100 μm. (from Candollea 56(2))
Grimmia trichophylla Grev.  
(Figs 39, 40)

Plants growing in green, rarely blackish, lax, easily desintegrating tufts up to 3 cm high. Central strand well-developed, clearly defined. Hair-point distantly and bluntly denticulate, muticous forms exist. Leaves when dry loosely and spirally arranged around stem, erecto-patent when moist, imbricate, up to 2.7 mm long, ovate lanceolate to narrowly lanceolate, tapering to acute apex, keeled from apex to mid leaf. Leaf margin plane, recurved on one side at leaf base, bistratose in one to several rows above, unistratose below. Lamina unistratose nearly throughout, rarely few bistratose cell rows in upper part of leaf. Lamina cells 7–9 (–10) μm, rounded above, slightly sinuose below, basal paracostal cells elongate rectangular, with ± smooth (rarely faintly nodulose) walls, towards margin shorter and wider, two rows of hyaline rectangular cells at margin. Costa slightly attenuate towards leaf base, prominent and rounded on abaxial side, channelled on adaxial side, 4 guide cells from insertion to mid leaf, 2 above; at insertion and leaf base 1–2 (–3) additional cells smaller than guide cells, but larger than other costal cells are found in a second row on dorsal side of guide cells (Fig. 39H), few hydroids and substereids can occasionally be observed. Gemmae (to 60 μm diameter) on short stalks on abaxial side of basal lamina, not always present.

Sporophytes not observed in Hungarian material, capsule horizontal to pendent, ellipsoid, urn 1.35 mm long, with 8 distinct ribs, seta arcuate, 3–5 mm long, operculum rostrate, beak oblique, rarely straight, calyptra mitrate, peristome teeth perforated, cleft, papillose.

Habitat: On andesite and other siliceous rocks (e.g. rhiolite-tuff, sandstone, basalt).

Fig. 40. Distribution of Grimmia trichophylla
**Associated bryophytes:** Grimmia hartmanii, G. orbicularis, G. pulvinata, Paraleucobryum longifolium, Rhizomnium punctatum.

**Vertical distribution:** 110–700 m.

**Distribution** (20 growth sites): According to the present state of knowledge scattered in the siliceous parts of Hungary; in Europe a temperate species frequent and widespread in many regions.


**Literature:** Since most specimens under *G. trichophylla* proved to be different species, mostly *G. hartmanii* and *G. muehlenbeckii*, the distribution data of *G. trichophylla* in BOROS (1968) and ORBÁN and VAJDA (1983) have to be corrected: no vouchers were found for the alleged occurrence of *G. trichophylla* in the Mátra Mts, Medves Mts, Keszthelyi Mts and Mecsek Mts (BOROS 1968), Balaton uplands: Tihany, and Bakony Mts (ORBÁN and VAJDA 1983). However, it seems likely that the species might be found in some of these regions when searched for. The occurrence of *G. trichophylla* in Naszály and Pilis Mts is an extension of the area described in the literature.

**Excluded taxa**

*Grimmia alpestris* (F. Weber et D. Mohr) Schleich. – BOROS (1968) reported the species (as var. *subsulcata* (Limp.) Loeske) from the Mátra Mts (Disznó-kô), and the same record is repeated in ORBÁN and VAJDA (1983) under *G. sessitana* De Not. f. *subsulcata* Loeske, but the specimens (BP 26774, 112903) were revised to *G. fionalis* (ERZBERGER and PAPP 2004).

*Studia bot. hung.* 40, 2009
**Grimmia donniana** Sm. – Erroneously reported in ORBÁN and VAJDA (1983) and MUÑOZ and PANDO (2000), see ERZBERGER and PAPP (2004).

**Grimmia incurva** Schwägr. – MUÑOZ and PANDO (2000) reported the species from Hungary, but no specimen could be located (ERZBERGER and PAPP 2004).

**Grimmia poecilostoma** Cardot et Sébille – GREVEN (1995) and FREY et al. (2006) reported this taxon from Hungary without further detail. *G. poecilostoma* is a synonym of *G. tergestina* following CORLEY et al. (1981).

**Grimmia sessitana** De Not. – See note under *G. alpestris* above and ERZBERGER and PAPP (2004).

Artificial key for *Grimmia* and related taxa in Hungary

(*Schistidium flaccidum*, although not treated in this paper, has been included in the key, since it has often been confounded with *Grimmia anodon*)

1a Major part of basal cells elongate, incrassate, nodulose-sinuose  
*Racomitrium*

1b Basal cells never at the same time elongate and nodulose-sinuose  
2

2a Cells in transverse section of costa nearly homogeneous, seta short, columella falling with operculum  
*Schistidium*

2b Transverse section of costa showing different types of cells (guide cells, stereids, sometimes hydroids), operculum falling without columella (*Grimmia, Coscinodon*)  
3

3a Plants with sporophytes  
4

3b Plants without sporophytes  
23

4a Seta short, shorter than or as long as the capsule, capsule therefore immersed in perichaetium or emergent  
5

4b Seta several times longer than capsule, capsule usually exserted above the cushion  
11

5a Seta arcuate (moist)  
6

5b Seta straight (moist)  
9

6a Lamina bistratose from apex to widest part of leaf, leaves semicircular in section, costa only slightly prominent abaxially, peristome present  
*G. tergestina*

6b Lamina unistratose or unistratose with bistratose patches, margins unistratose or bistratose, leaves ± concave, costa ± prominent abaxially, peristome present or absent  
7
7a Peristome absent, leaves concave in basal part only, obtusely keeled towards apex, lamina unistratose with bistratose margin and bistratose patches

    G. anodon

7b Peristome present, lamina completely unistratose (margin sometimes locally bistratose)

8a Leaves spathulate, their greatest width above middle, hair-point usually long to very long, broadly inserted, margin completely unistratose, seta as long as capsule

    G. crinita

8b Leaves not spathulate, their greatest width at or below middle, hair-point not particularly long, ± narrowly inserted, margins partly bistratose, seta shorter than capsule

    G. plagiopodia

9a Lamina unistratose, margin bistratose in 1 or more cell rows, costa in section homogeneous, peristome rudimentary

    Schistidium flaccidum

9b Upper lamina and margin bistratose, costa in section heterogeneous, peristome perfect

10a Leaves plicate, costa recessed in a deep ventral groove extended to leaf base, some leaves with plicae pluristratose, resembling “additional costae”, peristome teeth cribrose (= strongly perforated), calyptra wide, campanulate, plicate, nearly enclosing the urn

    Coscinodon cribrosus

10b Leaves not plicate, semicircular in section, costa, calyptra not as above

    G. tergestina

11a Seta arcuate (moist)

11b Seta straight (moist)

12a Lamina bistratose in upper part of leaf, costa recessed in a ± deep ventral groove, without hydroids, lamina and costa usually with scattered hemispherical papillae, rarely without, weak stems and branches lack central strand

    G. elatior

12b Lamina usually unistratose in upper part of leaf, sometimes with bistratose margins or striae, costa not grooved, with hydroids, cells epipillose, stem with central strand

13a Leaves ovate, widest at or shortly above middle, apex ± broad, lamina usually unistratose, margin unistratose or bistratose in 1 or more cell rows, gemmae unknown

13b Leaves lanceolate, from ovate base tapering to acuminate apex, lamina unistratose or with bistratose patches, margin unistratose or bistratose, sometimes with gemmae
14a Leaf margins unistratose or one row of cells bistratose at one side of leaf only, margin and bistratose lamina of equal thickness, costa slightly attenuate towards leaf base, capsule ovate, operculum mamillate, flat, basal cells beside costa usually elongate (4–8 times as long as wide)  
*G. orbicularis*

14b Pluristratose leaf margins thickened, costa not attenuate towards leaf base, capsule oblong, operculum usually rostrate, basal cells mostly shortly rectangular to quadrate (2–4 times as long as wide)  
*G. pulvinata*

15a Leaves asymmetric, costa towards apex approaching one of the margins, not median, rope-like young shoots present in the interior of the cushion, gemmae unknown  
*G. funalis*

15b Leaves symmetric, costa towards apex median, young shoots of different shape or absent, short-stalked gemmae sometimes at leaf base  
16

16a Costa above mid-leaf rectangular in section, with edges angulate to winged; hyaline hair-point denticulate, lamina in upper part of leaf with bistratose patches or sometimes completely bistratose, leaves sometimes with gemmae  
*G. muehlenbeckii*

16b Costa above mid-leaf rounded, not angulate or winged, hyaline hair-point denticulate or smooth, gemmae present or absent  
17

17a Lamina cells in leaf apex longer than wide, slightly sinuose, costa very wide at leaf base, often > 80 μm, hair-point denticulate, gemmae unknown  
*G. decipiens*

17b Lamina cells in leaf apex rounded, costa usually less wide at leaf base, hair-point nearly smooth, sometimes with gemmae  
18

18a Guide cells at leaf insertion and leaf base in 2 layers, the inner one consisting of 1–2(3) cells intermediate in size between adaxial layer of guide cells and the other costa cells; plants of siliceous substrates  
*G. trichophylla*

18b Guide cells at leaf base in 1 layer, substrate calcareous or siliceous  
19

19a Guide cells 4 at leaf insertion, leaves erecto-patent to patulous when moist, plants usually on calcareous substrates  
*G. dissimulata*

19b Guide cells 6 at leaf insertion, leaves erecto-patent to squarrose-recurved when moist, plants of siliceous substrates  
*G. lisae*
| 20a | Leaves semicircular in transverse section ± from base to apex |
| 20b | Leaves ± keeled, not semicircular in transverse section (in *G. longirostris*, the leaf appears semicircular in apical part, especially in dorsal view, but is keeled further down) |
| 21a | Leaves ovate, usually rounded at apex, detached leaves lie flat on a slide, margin unistratose in bistratose upper part of leaf, most basal cells oblate, incrassate, few elongate paracostal cells |
| 21b | Leaves lanceolate, tapering from distinct shoulder to narrow apex, detached leaves on a slide usually fold along the costa and appear in lateral view, margin bistratose, most basal cells elongate, some nodulose, towards margin shorter |
| 22a | Costa in transverse section recessed in a deep groove in upper part of leaf, leaves with distinct shoulder, basal cells quadrate to short rectangular with incrassate transverse walls, hair-point denticulate |
| 22b | Costa not recessed in groove, leaves without shoulder, basal cells elongate-rectangular with thin transverse walls, hair-point smooth |
| 23a | Leaf apex without any hyaline cell, leaves asymmetric, costa towards apex approaching one of the margins, not median, rope-like young shoots present in the interior of the cushion (muticous leaves can occur in *G. anodon*, too) |
| 23b | Leaf apex with hair-point or at least some hyaline cells |
| 24a | Cells of hair-point with cell lumen clearly visible, hair-point denticulate, central strand absent, globular multicellular gemmae at leaf tips often present |
| 24b | Cells of hair-point with very narrow, hardly visible lumen, central strand present (lacking in weak stems and branches of *G. elatior*), without globular multicellular gemmae at leaf tips |
| 25a | Lamina usually unistratose in upper part of leaf, margin unistratose or margin pluristratose in one or several rows |
| 25b | Lamina bistratose in upper part of leaf or lamina unistratose with some bistratose cell rows, margin pluristratose in several rows |
| 26a | Lamina unistratose, margin unistratose (or at one side of leaf a single marginal row bistratose) |
| 26b | Lamina usually unistratose, margin pluristratose in one or several rows |
27a Leaves spathulate, their greatest width above middle, margin completely unistratose  
*G. crinita*

27b Leaves not spathulate, their greatest width at or below middle, margins unistratose or partly bistratose  
28

28a Leaves spoon-like, concave, margin unistratose to partly bistratose, basal cells short  
*G. plagiopodia*

28b Leaves not spoon-like, not concave, with an obtuse keel, leaf halves forming a right or obtuse angle in transverse section, leaf margins unistratose or one row of cells bistratose at one side of leaf only, margin and unistratose lamina of equal thickness, costa slightly attenuate towards leaf base, basal cells beside costa usually elongate (4–8 times as long as wide)  
*G. orbicularis*

29a Section of costa nearly homogeneous, never with hydroids, guide cells only visible at leaf base, margin recurved in mid-leaf  
*Schistidium flaccidum*

29b Cells in transverse section of costa heterogeneous, with or without hydroids, margin different  
30

30a Leaves asymmetric, costa towards apex approaching one of the margins, not median, rope-like young shoots present in the interior of the cushion, gemmae unknown  
*G. funalis*

30b Leaves symmetric, costa towards apex median, young shoots of different shape or absent, short-stalked gemmae sometimes at leaf base  
31

31a Leaves ovate, widest at or shortly above middle, apex ± broad, leaf halves forming approximately a right angle in transverse section, basal cells mostly shortly rectangular to quadrate (2–4 times as long as wide), gemmae unknown  
*G. pulvinata*

31b Leaves lanceolate, from ovate base tapering to acuminate apex, sometimes with gemmae  
17

32a Lamina continuously bistratose at least in upper part of leaf (in *G. laevigata* margin in part unistratose, in *C. cribrosus* some unistratose cell rows)  
33

32b Lamina unistratose even in upper part of leaf, with some cell rows bistratose, margin pluristratose in several rows  
41

33a Leaves semicircular in transverse section  
34

33b Leaves not semicircular in transverse section  
37
34a Costa biconvex, prominent on adaxial and abaxial sides, with a centrally placed group of hydroids, guide cells indistinct, plants of exposed calcareous rocks

\textit{G. teretinervis}

34b Costa not biconvex, guide cells distinct, substrate siliceous or calcareous

35

35a Leaves lanceolate, tapering from wide base to narrow apex, detached leaves on a slide usually fold along the costa and appear in lateral view, margin bistratose, most basal cells elongate, some nodulose, towards margin shorter

\textit{G. ovalis}

35b Leaves ovate, usually rounded or obtuse at apex, detached leaves lie flat on a slide, margin bistratose or unistratose, basal cells short or long

36

36a Margin towards leaf base unistratose in a widening zone, guide cells in a shallow groove with incrassate adaxial walls in mid leaf, most basal cells oblate, incrassate, few elongate paracostal cells, hair-point strongly denticulate

\textit{G. laevigata}

36b Margin bistratose throughout bistratose part of lamina, costa not grooved, guide cells hardly discernible, adaxial walls not incrassate, basal paracostal elongated cells usually extending far towards margin, where cells are shorter, hair-point smooth or faintly denticulate

\textit{G. tergestina}

37a Costa in transverse section of upper part of leaf appearing recessed in a ± deep groove, leaves with or without shoulder, basal cells with thin or ± incrassate transverse walls

37b Costa not grooved ventrally, leaves without shoulder, basal cells elongate with thin transverse walls

38

38a Costa without hydroids, adaxial side of pluristratose costa with 1 to several layers of wide cells of guide-cell-like appearance, lamina and costa usually with scattered hemispherical papillae, rarely without, a wide band of strongly elongate paracostal cells with thin transverse walls at leaf base, leaves without distinct shoulder

\textit{G. elatior}

38b Costa with hydroids, lamina and costa without papillae, basal cells with ± incrassate transverse walls, paracostal basal cells shorter, elongate in few rows, leaves with ± distinct shoulder

39
Leaves strongly plicate, some leaves with plicae pluristratose, resembling “additional costae”, shoulder poorly developed, hair-point nearly smooth

39a

Coscinodon cibrosus

39b Leaves faintly plicate, without additional costae, with distinct shoulder, hair-point denticulate

G. montana

40a Costa rounded at abaxial side, margin not thickened, hair-point smooth

G. longirostris

40b Costa above mid-leaf rectangular in section, with edges angulate to winged, margin thickened, hyaline hair-point denticulate, short-stalked gemmae sometimes at leaf base

G. muehlenbeckii

41a Costa biconvex, prominent on adaxial and abaxial sides, with a centrally placed group of hydroids, guide cells indistinct, plants of exposed calcareous rocks

G. teretinervis

41b Costa not biconvex, guide cells distinct, substrate siliceous or calcareous

42

42a Leaves asymmetric, costa towards apex approaching one of the margins, not median, rope-like young shoots present in the interior of the cushion, gemmae unknown

G. funalis

42b Leaves symmetric, costa towards apex median, young shoots of different shape or absent, short-stalked gemmae sometimes at leaf base

43

43a Leaves ovate, widest at mid leaf, basal cells shortly rectangular, marginal cells incrassate, gemmae unknown

G. anodon

43b Leaves lanceolate, from ovate base tapering to acuminate apex, sometimes with gemmae

16

Evaluation of the revision:
reliability of original names versus proportion of detection

The specimens revised in this paper form in their majority the basis of publications on Hungarian bryophytes (e.g. SZEPESFALVI 1941, BOROS 1968, ORBÁN and VAJDA 1983). It is therefore of interest to analyse in detail in which cases a taxon name had to be replaced during revision, and to draw conclusions with respect to the published statements concerning these taxa.

In Table 1, the revision data are arranged in the following way: each taxon is represented by a code (first column and first row), explained in the second column. The true identity of specimens (according to the results of
this revision) is given by the code in the first column. For example in the row labelled 1 (*Coscinodon cribrosus*) the numbers of all specimens that are truly this taxon appear under the column heading for the name found originally on the specimen label. In the example of *C. cribrosus*, only 1 specimen was correctly named. Hence “sum” and “percent” (last two columns) are 1 and 100, respectively, *i.e.*, the detection rate for *C. cribrosus* is 100%, all plants of that taxon were detected and correctly named before the revision. However, the name *C. cribrosus* also erroneously appears on the label of a specimen that in reality contained *G. muehlenbeckii*. Hence “sum under name”, denoting the number of specimens under the name of *C. cribrosus* (true and erroneous together), and reliability of that name (see last two rows) are 2 and 50%, respectively.

The reason for this seemingly complicated arrangement is that the misidentification of a specimen can be thought of as consisting of two separate errors. In the example of the specimen of *G. muehlenbeckii* that was misnamed *C. cribrosus*, the first error is not recognising *G. muehlenbeckii*, the second error is mistaking it for *C. cribrosus*. In analogy to medical diagnostic tests, the first type of error could be called negative error (as in giving a false negative diagnosis, in not recognising a particular ailment, *e.g.* cancer), the second type of error would be called positive.

The last column gives the proportion of detection, *i.e.* 100 minus percentage of negative errors, and the last row gives the reliability of the name of the corresponding column, *i.e.* 100 minus percentage of positive errors.

Duplicate gatherings were not counted in this evaluation, and mixed gatherings were also excluded. Specimens that had been revised before this revision were evaluated under their first determination only.

236 out of 1,074 specimens with the name of some species of *Grimmia* (in the modern sense, *i.e.* excluding *Schistidium*) on the label did not contain the correct taxon, *i.e.* the rate of positive errors is 22%. Similarly, 265 out of 1,104 specimens actually containing some species of *Grimmia* were not correctly identified prior to this revision, *i.e.* negative error rate is 24%. This clearly demonstrates the necessity of the revision and of improving identification of *Grimmia* species in the future by providing a key, amended descriptions and illustrations.

Two species are perfect in the sense that no error of any of the two kinds occurred: *G. crinita* (found by B. Papp during the preparation of the
manuscript as new to Hungary) and *G. plagiopodia*. (This is true for the specimens examined, for erroneous literature data see above).

In the case of *Coscinodon cribrosus* and *G. montana*, no negative errors were found, but the positive error rate is high: the corresponding name is incorrect in half of the specimens named *C. cribrosus* and in more than three quarters of the specimens named *G. montana*. Obviously, the collectors had no sufficiently clear notion of the circumscription of these (and other) taxa.

Species with detection rates > 80% (i.e. negative error percentage < 20%) are the widespread and characteristic species *G. anodon*, *G. laevigata*, *G. pulvinata*, *G. ovalis*, *G. orbicularis* and *G. tergestina*. The reliability of these names is also in the range above 80%, with the exception of the name of *G. ovalis*, which has more than one third positive errors, as is seen in column 19 of Table 1. The name *G. commutata*, formerly in use for *G. ovalis*, appears literally “true”!

The case of *G. hartmanii* is also instructive and converse to that of *G. ovalis*. 95% of specimens labelled as *G. hartmanii* were correctly named, but only 66% of all *G. hartmanii* plants were correctly identified, many were misnamed as *G. trichophylla* or *G. muehlenbeckii*. There is an evident explanation for this situation: *G. hartmanii* with an abundance of typical gemmae is very characteristic, but plants without gemmae are less easily identified.

Since many of these specimens had been named as *G. trichophylla*, the reliability of that name is the lowest of all, only 13%. Nearly half of all specimens named *G. trichophylla* were *G. hartmanii*, and ca 25% *G. muehlenbeckii*. However, detection rate of *G. trichophylla* is 75%.

Another instructive case is that of *G. muehlenbeckii*. Less than one third of all *G. muehlenbeckii* plants were detected, and nearly half of all labels with that name cover other species, particularly *G. hartmanii*.

Low detection rates are found in the recently discovered species *G. decipiens*, *G. lisae* (0% each), *G. elatior* (the 22.2% represent recently collected specimens), and of course the recently described *G. dissimulata* (4.5% representing recently collected specimens). Table 1 shows that specimens of this widespread species have been erroneously given nine different names: *G. montana*, *G. muehlenbeckii*, *G. orbicularis*, *G. ovalis*, *G. teretinervis*, *G. tergestina*, *G. trichophylla*, *Schistidium apocarpum*, *S. brunnescens*.
| Code | Name of species            | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | i | other | sum | %  |
|------|---------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|
| 1    | C. cribrosus              | 1 |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 1  | 100.0 |
| 2    | G. anodon                | 52 | 1 |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 54 | 96.3 |
| 4    | G. crinita               | 1 |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 1  | 100.0 |
| 5    | G. decipiens             | 0 | 1 | 2 |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 4  | 0.0  |
| 6    | G. dissimulata           | 2 | 1 | 3 | 10| 1 | 9 | 1 | 7 | 8 | 1  |    |    |    |    |    |    |    |    |    |    |    |    | 44 | 44  |
| 8    | G. elatior               | 2 | 1 | 3 |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 9  | 22.2 |
| 10   | G. fionalis              | 4 |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 6  | 66.7 |
| 11   | G. hartmanii             | 157| 23| 6 | 50| 1 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 237| 66.2 |
| 12   | G. laevigata             | 110| 1 | 2 | 2 |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 115| 95.7 |
| 13   | G. lisae                 | 0 | 2 | 2 | 1 |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 5  | 0.0  |
| 14   | G. longirostris          | 1 | 4 |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 5  | 20.0 |
| 15   | G. montana               | 3 |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 3  | 100.0 |
| 17   | G. muehlenbeckii         | 1 | 6 | 5 | 34| 34| 25| 2 | 2 | 3 | 112| 31.2|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |  |
| 18   | G. orbicularis           | 29| 5 | 1 |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 35 | 82.9 |
| 19   | G. ovata                 | 4 | 2 | 112| 2 | 2 | 122| 91.8|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |  |
| 20   | G. plagiotropis          | 5 | 1 | 4 | 252| 1 | 2 | 1 | 1 |    |    | 267| 94.4|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |  |
| 22   | G. teretinervis          | 1 | 1 |    |    | 2 | 50.0|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |  |
| 23   | G. tergestina            | 2 | 1 | 1 | 2 | 58 | 1 | 65 | 89.2|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |  |
| 25   | G. trichophylla          | 1 |   | 12| 1 | 2 | 16 | 75.0|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |  |

"sum under name" | 2 | 54 | 1 | 0 | 2 | 2 | 4 | 165 | 121 | 0 | 2 | 11 | 61 | 32 | 179 | 8 | 265 | 3 | 71 | 93 | 12 | 15 | 3 | 5 | 1,106 |

reliability name % | 50 | 96 | 100 | 100 | 100 | 100 | 95 | 91 | 50 | 27 | 56 | 91 | 63 | 100 | 95 | 33 | 82 | 13 |    |    |    |    |    |    |    |    |    |    |

Abbreviations: C. = Coscinodon, G. = Grimmia; i. = indet.; S.a. = Schistidium apocarpum (s. l.); S.b. = Schistidium brunescen
In species with few specimens, the calculated proportions are subject to stochastic error and thus less instructive. Yet, *G. longirostris* and *G. teretinervis* are remarkable. *G. longirostris* has been misnamed as *G. ovalis* in 4 out of 5 specimens, and these species do bear some superficial similarity. *G. teretinervis*, finally, has been erroneously named as *S. brunnescens*, and *G. dissimulata* and *G. pulvinata* have been erroneously taken for *G. teretinervis* in 1 case each.

In the case of the following species, misidentifications were few and thus do not essentially impair the validity of information given in BOROS (1968) and ORBÁN and VAJDA (1983): *G. anodon*, *G. funalis*, *G. hartmanii*, *G. laevigata*, *G. orbicularis*, *G. pulvinata*, *G. tergestina*. However, in the case of *G. anodon*, *G. hartmanii*, *G. laevigata*, and *G. tergestina*, information in BOROS (1968) and ORBÁN and VAJDA (1983) on rarity and distribution is incomplete.

Incidence of sporophytes

During revision, sporophytes were observed in some of the specimens. *Grimmia* species differ greatly in the abundance of sporophytes in Hungary. Table 2 shows the proportion of specimens with sporophytes.

The highest proportion of sporophytes is observed in *G. crinita*, *G. plagiopodia* (100% each), *G. pulvinata* (87.4%), *G. longirostris* (80%), *G. orbicularis* (78%), *G. anodon* (57.6%) and *G. ovalis* (50%). A small or very small fraction of sporophytes is found in *G. muehlenbeckii* (17.8%), *G. laevigata* (14.2%), *G. elatior* (8.3%) and *G. tergestina* (4.2%). All other species are without sporophytes in the collected material. These data, however, are not necessarily true for the populations of the species in Hungary, because collectors might have preferred plants with sporophytes. They are also less reliable in the case of low specimen numbers (e.g. *G. elatior*).

Outside Hungary, sporophytes are unknown in *G. teretinervis*, rare in *G. dissimulata* and very rare in *G. hartmanii*. 

*Studia bot. hung.* 40, 2009

ERZBERGER, P.
Mixed stands and mixed collections

Mixed stands indicate close ecological requirements of taxa. In 12 gatherings, mixed stands could be clearly demonstrated (i.e. different species were arranged in a coherent cushion). Table 3 shows the frequency of the combinations found.

In this way, similar habitat requirements can be deduced for the pairs *G. anodon*/*G. dissimulata*, *G. funalis*/*G. ovalis* and, in particular, *G. laevigata*/*G. ovalis*. The frequent combinations with *G. pulvinata* only indicate the wide ecological amplitude of that species.

In a less convincing way, mixed gatherings may also demonstrate similarity in habitat requirements, but they must be considered with reservations, since it is not always clear that the contents of a specimen convolute were collected at the same microsite. During the revision, 7 gatherings with three different species, and 111 gatherings with two different species of *Grimmia* were discovered (including duplicates; these were not counted in the evaluation). Table 4 shows the frequency of the combinations found. (The data of Table 3 are included).

### Table 2. Sporophytes in *Grimmia* specimens collected in Hungary

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of specimens</th>
<th>No. of specimens with sporophytes</th>
<th>% specimens with sporophytes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Coscinodon cribrosus</em></td>
<td>1</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia anodon</em></td>
<td>59</td>
<td>34</td>
<td>57.6</td>
</tr>
<tr>
<td><em>Grimmia crinita</em></td>
<td>1</td>
<td>1</td>
<td>100.0</td>
</tr>
<tr>
<td><em>Grimmia decipiens</em></td>
<td>4</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia dissimulata</em></td>
<td>65</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia elatior</em></td>
<td>12</td>
<td>1</td>
<td>8.3</td>
</tr>
<tr>
<td><em>Grimmia funalis</em></td>
<td>10</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia hartmanii</em></td>
<td>273</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia laevigata</em></td>
<td>197</td>
<td>28</td>
<td>14.2</td>
</tr>
<tr>
<td><em>Grimmia lisae</em></td>
<td>5</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia longirostris</em></td>
<td>10</td>
<td>8</td>
<td>80.0</td>
</tr>
<tr>
<td><em>Grimmia montana</em></td>
<td>5</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia muehlenbeckii</em></td>
<td>146</td>
<td>26</td>
<td>17.8</td>
</tr>
<tr>
<td><em>Grimmia orbicularis</em></td>
<td>59</td>
<td>46</td>
<td>78.0</td>
</tr>
<tr>
<td><em>Grimmia ovalis</em></td>
<td>233</td>
<td>117</td>
<td>50.2</td>
</tr>
<tr>
<td><em>Grimmia plagiodenia</em></td>
<td>15</td>
<td>15</td>
<td>100.0</td>
</tr>
<tr>
<td><em>Grimmia pulvinata</em></td>
<td>349</td>
<td>305</td>
<td>87.4</td>
</tr>
<tr>
<td><em>Grimmia teretinervis</em></td>
<td>6</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><em>Grimmia tergestina</em></td>
<td>96</td>
<td>4</td>
<td>4.2</td>
</tr>
<tr>
<td><em>Grimmia trichophylla</em></td>
<td>26</td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
G. pulvinata occurs in combination with 8 other species in a total of 52 collections, underlining the weedy character of this ubiquitous species and its ability to grow in a variety of different habitats. Omitting all mixed gatherings with G. pulvinata, the observed relations can be visualised as shown in Figure 41. The high number of mixed collections with G. ovalis and G. laevigata show the close similarity in habitat requirements of these two species: they usually grow on acidic to base-rich siliceous substrates in rather open situations. The fact that G. ovalis has been collected together with 9 other species, among them plants of siliceous (e.g. G. elatior, G. funalis, G. hartmanii, G. laevigata, G. lisae, G. longirostris, G. muehlenbeckii), as well as

### Table 3. Combinations of Grimma species in mixed stands, no. of specimens

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. Combinations of Grimma species in mixed gatherings, no. of specimens

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>11</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
calcareous substrates (*G. dissimulata*), indicates a wide ecological amplitude with respect to substrate. In a similar way, a rather wide range of possible substrates is documented for *G. laevigata* appearing in combination with acidophytic species (*G. elatior*, *G. montana*), as well as with subneutrophytic species (*G. orbicularis*). For both species, *G. ovalis* and *G. laevigata*, direct information on substrate from the specimen labels is in agreement with the inferences from the associated species: they prefer siliceous substrates of various acidity, but rarely also occur on calcareous substrates. In Figure 41, the basiphytic to subneutrophytic species (*G. anodon*, *G. dissimulata*, *G. orbicularis*, *G. teretinervis* and *G. tergestina*) form a cluster around the latter. *G. muehlenbeckii*, *G. hartmanii*, *G. longirostris* and *G. trichophylla*, on the other hand, form the core of a cluster of more acidophytic species that includes – via *G. ovalis* and *G. laevigata* – also *G. montana*, *G. elatior*, *G. lisae* and *G. funalis*.

**Frequency and rarity of Grimmia species in Hungary**

Figure 42 shows the proportion of each species in a total of 846 sites of all specimens examined. The most frequent species are *G. pulvinata* (28.3%), *G. hartmanii* (14.4%), *G. ovalis* (12.8%), *G. laevigata* (11.1%) and *G. muehlenbeckii* (9.7%). With the exception of the weedy *G. pulvinata*, these species exhibit a preference for siliceous substrates and cover 48% of all sites (not counting the sites of *G. pulvinata*). The high number of collection sites for these species reflects their wide distribution in suitable areas of Hungary (the siliceous mountain and hill regions: Zemplén Mts, parts of Bükk Mts, Mátra Mts, Karancs–Medves Mts, Cserhát hills, Börzsöny Mts, Visegrád Mts, parts of Naszály, parts of Pilis Mts, parts of Buda Mts, Velence Mts, parts of Balaton uplands, parts of Keszthely Mts, and parts of Mezsek Mts). A second group of species, of medium frequency, comprises most of the subneutrophytic to basiphytic species: *G. tergestina* (5.8%), *G. dissimulata* (4.7%), *G. orbicularis* (3.9%), and *G. anodon* (3.7%), and some rarer acidophytic species: *G. trichophylla* (2.4%), *G. longirostris* (0.8%), and *G. elatior* (0.7%). Finally, there is a third group of species, apparently rare, with a few sites each: *G. lisae* (5 sites), *G. plagiopodia* (3 sites), *G. decipiens* and *G. teretinervis* (2 sites each), and *Coscinodon cribrosus*, *G. crinita*, *G. funalis*, and *G. montana* (1 site each).
Fig. 41. Ecological relations of Hungarian Grimmia species (G. pulvinata omitted) as observed in mixed collections (numbers are numbers of mixed collections)

Fig. 42. Frequency of Coscinodon and Grimmia species in Hungary
In order to estimate the diversity of *Grimmia* in different regions of Hungary, the number of collection sites in each region and their number of species was evaluated. Only regions with more than 10 sites are shown (Table 5).

**Table 5.** Regions with most growth sites of *Grimmia* and *Coscinodon* in Hungary

<table>
<thead>
<tr>
<th>Region (as defined in Boros 1968)</th>
<th>No. of sites</th>
<th>No. of species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visegrád Mts</td>
<td>105</td>
<td>8</td>
</tr>
<tr>
<td>Börzsöny Mts</td>
<td>80</td>
<td>7</td>
</tr>
<tr>
<td>Balaton uplands</td>
<td>79</td>
<td>11</td>
</tr>
<tr>
<td>Mátra Mts</td>
<td>75</td>
<td>7</td>
</tr>
<tr>
<td>Zemplén Mts</td>
<td>73</td>
<td>8</td>
</tr>
<tr>
<td>Bükkt Mts</td>
<td>56</td>
<td>11</td>
</tr>
<tr>
<td>Buda Mts</td>
<td>49</td>
<td>9</td>
</tr>
<tr>
<td>Gerecse Mts</td>
<td>46</td>
<td>6</td>
</tr>
<tr>
<td>Vértes Mts</td>
<td>40</td>
<td>7</td>
</tr>
<tr>
<td>Pilis Mts</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>Bakony Mts</td>
<td>27</td>
<td>8</td>
</tr>
<tr>
<td>Cserhát hills</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>Karancs–Medves Mts</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>Danube–Tisza Interfluve</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Tiszántúl region</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Velence Mts</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Mecsek Mts</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Villány Mts</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Aggtelek Karst</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Keszthely Mts</td>
<td>11</td>
<td>7</td>
</tr>
</tbody>
</table>

The data on collection sites are, however, subject to bias of collectors, and must therefore be interpreted with caution. It is very likely, that regions close to the capital (e.g. Visegrád Mts) were more often visited than more distant regions, and that could well result in a higher number of collection sites.

The five regions with most growth sites (> 70) represent siliceous areas (Visegrád Mts to Zemplén Mts), followed by the Bükkt Mts, with varied geological underground, and then followed by five regions with predominantly limestone or dolomite (Buda Mts to Bakony Mts). Apart from the importance of the chemical nature of the substrate, the number of growth sites depends naturally on the size of the region in question. Thus, smaller geographical units like Karancs–Medves Mts, Velence Mts, Mecsek Mts, Villány Mts, Keszthely Mts, Naszály, Sopron Mts or Kőszeg Mts get an unfavourable ranking according to sites, whereas they may house more species than larger regions. As an example for the opposite case, large regions
with few species, consider the lowland regions east of the Danube (Danube–Tisza Interfluve and Tiszántúl region): the 2 species found are *G. pulvinata* and *G. ovalis/G. muehlenbeckii*, respectively, and nearly all collection sites are man-made constructions with *G. pulvinata*. Thus, their contribution to species richness is rather low.

Considering numbers of species, the Búkk Mts and the Balaton uplands stand out with 11 species each, followed by the Buda Mts (9 species), and the Visegrád Mts, Zemplén Mts, Pilis Mts, Bakony Mts, Cserhát hills (8 species each). 7 species each are found in the Börzsöny Mts, Mátra Mts, Vértes Mts, the Karancs–Medves Mts, and Keszthely Mts; 6 species in the Gerecse Mts and Mecsek Mts.

The Búkk Mts (with *G. anodon*, *G. dissimulata*, *G. hartmanii*, *G. laevigata*, *G. lissae*, *G. muehlenbeckii*, *G. ovalis*, *G. pulvinata*, *G. teretinervis*, *G. tergestina*, and *G. trichophylla*) and the Balaton uplands (with *G. decipiens*, *G. dissimulata*, *G. elatior*, *G. hartmanii*, *G. laevigata*, *G. lissae*, *G. muehlenbeckii*, *G. orbicularis*, *G. ovalis*, *G. pulvinata*, and *G. trichophylla*) are geologically diverse and their species spectrum includes acidophytic, as well as basiphytic species (*rarities* in bold type).

The Visegrád and Zemplén Mts share several acidophytic species (*G. hartmanii*, *G. laevigata*, *G. muehlenbeckii*, *G. ovalis*, *G. pulvinata*, *G. trichophylla*) and of course *G. pulvinata*. As additional rare species, there is *G. decipiens* in the Visegrád Mts and *G. longirostris* in the Zemplén Mts. On the other hand, the Buda Mts, the Pilis Mts and the Bakony Mts have several basiphytic species in common (*G. anodon*, *G. dissimulata*, *G. orbicularis*, and *G. tergestina*), but they also offer favourable substrates for *G. laevigata*, *G. ovalis*, and *G. pulvinata*. In addition, *G. muehlenbeckii* and *G. trichophylla* grow in the Buda Mts, and *G. trichophylla* in the Pilis Mts (on sandstone in both cases), whereas *G. hartmanii* grows in the Bakony Mts (on basalt).

The volcanic Börzsöny Mts, Mátra Mts and Karancs–Medves Mts again have the common set of the frequent acidophytic species (*G. hartmanii*, *G. laevigata*, *G. muehlenbeckii*, *G. ovalis*), and the indifferent *G. pulvinata*; *G. trichophylla* and the rare *G. lissae* were collected in the Börzsöny Mts; in the Karancs–Medves Mts the only site of *Coscinodon cribrosus* was found, and in the adjacent Tarna region *G. laevigata* grows on base-rich sandstone; the Mátra Mts are home to the only growth site of *G. funalis*, and to three sites of *G. longirostris*.

*Studia bot. hung.* 40, 2009
The Vértes Mts are a very special region, mostly made up of dolomitic rocks. Their *Grimmia* species include basiphytic to subneutrophytic species, viz. *G. anodon*, *G. dissimulata*, *G. orbicularis*, and *G. tergestina*, but also species like *G. muehlenbeckii* and *G. ovalis*, that do not normally grow on dolomite, and of course *G. pulvinata*. This occurrence of more or less acidophytic species on the dolomite of the Vértes Mts has an interesting parallel in *Schistidium*: *S. lancifolium*, a species with a preference for siliceous rocks, was collected in several sites in the Vértes Mts on dolomite (ERZBERGER and SCHRODER 2008).

The Cserhát hills consist mostly of andesite, but in some places calcareous rocks are also present. Their *Grimmia* species are the basiphytic-subneutrophytic species *G. anodon*, *G. dissimulata*, *G. orbicularis*, the acidophytic *G. hartmanii*, *G. laevigata*, *G. muehlenbeckii*, *G. ovalis*, and in addition *G. pulvinata*. With the exception of the indifferent *G. pulvinata* and of *G. laevigata*, which was found on an erratic sandstone boulder, the *Grimmia* species of the Gerecse Mts are basiphytic-subneutrophytic: *G. anodon*, *G. dissimulata*, *G. orbicularis*, and *G. tergestina*. The Keszthely Mts, comprising basaltic as well as calcareous rocks, do not, apart from *G. lisae*, have any remarkable *Grimmia* species (*G. dissimulata*, *G. hartmanii*, *G. laevigata*, *G. muehlenbeckii*, *G. ovalis*, *G. pulvinata*). The Mecsek Mts, however, contain the only growth site of *G. montana*, on sandstone, and one of the few occurrences of *G. elatior*, on andesite, apart from *G. laevigata*, *G. muehlenbeckii*, *G. pulvinata*, and *G. tergestina*.

Bryogeographical considerations

From a phytogeographical point of view, the 20 species under consideration may be roughly grouped as follows (Table 6).

*G. plagiopodia*, a subcontinental rare species without a closed area, cannot be placed in this scheme.

Considering their distribution in Hungary, three types of patterns can be distinguished (Table 7).

Species denoted with an asterisk have only very few records; their placement must therefore be considered with reservations. Species are enclosed in brackets if their pattern is not very pronounced.
A comparison of these two types of grouping of the species under consideration reveals a close correlation between the southern, sub-Mediterranean element and mainly Transdanubian distribution. This is another indication of the importance of the Danube as a border of floristical regions, as already noted by ZÓLYOMI (1942).

**Table 6.** Phytogeographical elements of Hungarian *Grimmia* and *Coscinodon* species

<table>
<thead>
<tr>
<th>Boreal-montane</th>
<th>Temperate-montane</th>
<th>Southern (submed., med.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Coscinodon cribrosus</em></td>
<td><em>G. anodon</em></td>
<td><em>G. crinita</em></td>
</tr>
<tr>
<td><em>G. elatior</em></td>
<td><em>G. montana</em></td>
<td><em>G. decipiens</em></td>
</tr>
<tr>
<td><em>G. funalis</em></td>
<td><em>G. muehlenbeckii</em></td>
<td><em>G. dissimulata</em></td>
</tr>
<tr>
<td><em>G. hartmanii</em></td>
<td><em>G. trichophylla</em></td>
<td><em>G. laevigata</em></td>
</tr>
<tr>
<td><em>G. longirostris</em></td>
<td></td>
<td><em>G. lisae</em></td>
</tr>
<tr>
<td><em>G. ovalis</em></td>
<td></td>
<td><em>G. orbicularis</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>G. pulvinata</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>G. terestinervis</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>G. tergestina</em></td>
</tr>
</tbody>
</table>

**Table 7.** Distribution patterns of Hungarian *Grimmia* and *Coscinodon* species

<table>
<thead>
<tr>
<th>Mainly northern mountain range</th>
<th>Nearly equally distributed between northern range and Transdanubian region</th>
<th>Mainly Transdanubian</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Coscinodon cribrosus</em></td>
<td><em>G. pulvinata</em></td>
<td><em>G. anodon</em></td>
</tr>
<tr>
<td><em>G. funalis</em></td>
<td><em>G. ovalis</em></td>
<td><em>G. crinita</em></td>
</tr>
<tr>
<td><em>G. hartmanii</em></td>
<td><em>G. tergestina</em></td>
<td><em>G. dissimulata</em></td>
</tr>
<tr>
<td><em>G. lisae</em></td>
<td></td>
<td><em>G. orbicularis</em></td>
</tr>
<tr>
<td><em>G. longirostris</em></td>
<td></td>
<td><em>(G. laevigata)</em></td>
</tr>
<tr>
<td><em>G. muehlenbeckii</em></td>
<td></td>
<td><em>(G. montana)</em></td>
</tr>
<tr>
<td><em>G. terestinervis</em></td>
<td></td>
<td><em>(G. plagipodium)</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>G. decipiens</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>G. elatior</em></td>
</tr>
</tbody>
</table>

**Conservation**

On the basis of the present revision, the Hungarian species of *Grimmia* and *Coscinodon* can be assigned to one of the following five groups (IUCN 2001, HALLINGBÄCK *et al.* 1998; Table 8).

1. Widespread, “weedy” (*i.e.* wide ecological profile, readily establishing new colonies, also on man-made constructions, *e.g.* concrete): definitely not threatened (**).
2. Widespread, nearly always found in suitable sites: not threatened because a sufficient number of populations exist, and no factors are known that negatively influence the quality of the sites under question (*).

3. Not frequent, occurring in a fraction only of probably suitable sites (comparable to those where the species is found), with a total of 5–10 occurrences: vulnerable (VU).

4. Rare species, occurring in a very small number of sites (2–4): endangered (EN).

5. Very rare species, with only one existing population: critically endangered (CR).

The first two groups comprise species that seem to be not actually threatened and correspond to the IUCN category of “lower risk, least concern”: LR(lc) (IUCN 2001).

All growth sites of vulnerable, endangered and critically endangered species should be protected. Although most may already profit from some kind of protection in national parks or other protected areas, it seems important to draw attention to their populations and to avoid any changes that have a negative influence. Therefore, in Table 8 the growth sites are listed with the name of the county responsible.

One crucial type of information for the assessment of threat categories is the development of populations during longer periods of time, and in many cases this information is lacking for the species under discussion.

On the other hand, Hungarian bryology is in a fortunate situation thanks to the extensive collections of Boros and Vajda in the 20th century, and numerous cases have been documented by the study of herbarium specimens presented here, where the same species has been collected in the same locality in the middle of the 20th century and at present.

In principle, this could indicate the persistence of one population throughout the time interval between the past and the recent collection. The same observation would be made, however, if the population had disappeared from the site after the first collection, and subsequently a new population had established in the same locality, perhaps only recently.
In the case of widespread and frequent species, re-colonisation and co-
olonisation of new habitats could probably be easily achieved due to the close
proximity of other populations of the species that could provide diaspores.
On a larger spatial scale, the population of a locality given on a specimen label,

Table 8. Preliminary red list information on Coscinodon and Grimmia in Hungary and
growth sites of rare species proposed for protection

<table>
<thead>
<tr>
<th>Name of species</th>
<th>Red list symbol</th>
<th>Growth sites</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Coscinodon cribrosus</em></td>
<td>CR</td>
<td>Nógrád County, Bárna, Nagy-kő</td>
</tr>
<tr>
<td><em>Grimmia anodon</em></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>G. crinita</td>
<td>CR</td>
<td>Győr-Sopron-Moson County, Fertőrákos, Köfejtő</td>
</tr>
<tr>
<td>G. decipiens</td>
<td>EN</td>
<td>Komárom-Esztergom County, Dömös, Vadálló-kövek</td>
</tr>
<tr>
<td>G. dissimulata</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>G. elatior</td>
<td>EN</td>
<td>Pest County, Vác/Kosd, Naszály</td>
</tr>
<tr>
<td>G. funalis</td>
<td>CR</td>
<td>Heves County, Parádfürdő, Disznó-kő</td>
</tr>
<tr>
<td>G. hartmanii</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>G. laevigata</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>G. lisae</td>
<td>VU</td>
<td>Heves County, Szarvaskő</td>
</tr>
<tr>
<td>G. longirostris</td>
<td>VU</td>
<td>Nógrád County, Peröcsény, Holló-kő</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nógrád County, Diósjenő, Kemence-patak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Veszprém County, Hegymagas, Szent György-hegy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zala County, Zalaszántó, Tátika</td>
</tr>
<tr>
<td>G. montana</td>
<td>CR</td>
<td>Baranya County, Pécs, Jakab-hegy</td>
</tr>
<tr>
<td>G. muehlenbeckii</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>G. orbicularis</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>G. ovalis</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>G. plagiotopodia</td>
<td>EN</td>
<td>Borsod-Abaúj-Zemplén County, Boldogköváralja, Boldog-kővár</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pest County, Visegrád, Fellegvár</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pest County, Pomáz, Kö-hegy</td>
</tr>
<tr>
<td>G. pulvinata</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>G. teretinervis</td>
<td>EN</td>
<td>Borsod-Abaúj-Zemplén County, Lillafüred, Szinva-völgy</td>
</tr>
<tr>
<td>G. tergestina</td>
<td>*</td>
<td>Heves County, Felsőtárkány, Tar-kő</td>
</tr>
<tr>
<td>G. trichophylla</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

*Studia bot. hung. 40, 2009
e.g. the name of a hill, is made up of numerous subpopulations growing in suitable microsites, and would appear to persist through time even if local extinction and re-colonisation are of some importance. Thus there exists a high probability of re-finding such species at historical collection sites, and in fact many such cases have been found in the present study (the number of sites where the species has been re-found is given in parentheses): *G. anodon* (3), *G. hartmanii* (9), *G. laevigata* (7), *G. muehlenbeckii* (9), *G. orbicularis* (2), *G. ovalis* (12), *G. tergestina* (7).

For rare species, on the other hand, once a population has disappeared, re-colonisation must appear difficult due to the lack of diaspores and the great distance of other populations. The cases listed in Table 9, therefore, very likely indicate the persistence of those populations.

Table 9. Persistence of populations of some rare *Grimmia* species in Hungary

<table>
<thead>
<tr>
<th>Name of species</th>
<th>Collection site</th>
<th>Years of first and most recent collections</th>
<th>Time interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>G. decipiens</em></td>
<td>Balaton uplands: Haláp</td>
<td>1955–2005</td>
<td>50</td>
</tr>
<tr>
<td><em>G. elatior</em></td>
<td>Naszály</td>
<td>1951–2008</td>
<td>57</td>
</tr>
<tr>
<td><em>G. funalis</em></td>
<td>Mátra Mts: Disznó-kő</td>
<td>1931–2007</td>
<td>76</td>
</tr>
<tr>
<td><em>G. montana</em></td>
<td>Mecsek Mts: Jakab-hegy</td>
<td>1951–2007</td>
<td>56</td>
</tr>
<tr>
<td><em>G. plagiopodia</em></td>
<td>Zemplén Mts: Boldogkővár alja</td>
<td>1952–2004</td>
<td>52</td>
</tr>
<tr>
<td><em>G. plagiopodia</em></td>
<td>Visegrád Mts: Visegrád</td>
<td>1922–2004</td>
<td>82</td>
</tr>
<tr>
<td><em>G. plagiopodia</em></td>
<td>Visegrád Mts: Kő-hegy</td>
<td>1916–2004</td>
<td>82</td>
</tr>
</tbody>
</table>

It is often rather by chance that the same species has been re-found (e.g. *G. decipiens* in Balaton uplands, *G. elatior* at Naszály). The few sites where the rare species *G. funalis*, *G. montana* and *G. plagiopodia* have been collected in the past, have been visited repeatedly up to the present, and therefore their populations are known to exist still. This kind of monitoring should be continued and extended to all the localities listed in Table 8, in order to increase our knowledge of the populations of rare and endangered species and help to protect them from negative influences due to the deterioration of their habitats.

***

Acknowledgements – The author is deeply indebted to E. Maier (Geneva), not only for the revision of countless specimens evaluated in this paper, but also for numerous discussions, constant advice and encouragement, without which this work could never have
been undertaken, and for reading the manuscript. Last but not least, the drawings published here are her work. Thanks go to the editors of Herzogia and Candollea, the copyright holders, for the permission to reproduce some drawings initially published in Herzogia 11 (1995) and in Candollea 56(2) (2002), 57 (2002). The author is also grateful to B. Papp, the curator of BP, for generous loan of specimens and contribution of her own unpublished data, to Z. Barina (Budapest), for substantial help in localising numerous specimen data, to L. Lőkös (Budapest), for the preparation of the distribution maps, and to R. McF. Craig for correcting the English.

REFERENCES


*Studia bot. hung. 40, 2009*


(Received 14 November, 2008)