

INSTITUT D'ESTUDIS CATALANS

HANDBOOK OF MOSSES OF THE IBERIAN PENINSULA AND THE BALEARIC ISLANDS

C. Casas
M. Brugués
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NEW EDITION
fully updated and revised
M. Brugués and E. Ruiz 2020



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OF THE IBERIAN PENINSULA
AND THE BALEARIC ISLANDS

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INSTITUT D'ESTUDIS CATALANS
SECCIÓ DE CIÈNCIES BIOLÒGIQUES

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Illustrated keys to genera and species

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BARCELONA, 2020

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FOREWORD

This book, a floristic study of the mosses of the Iberian Peninsula and the Balearic Islands, is the first part of a work addressing the whole group of Bryophytes, and will of course be completed by a second volume devoted to liverworts. The genesis and the approach of the work are to be found in *Flora dels briòfits dels Països Catalans*, published in two volumes by the same institution.

The *Institut d'Estudis Catalans* (Institute of Catalan Studies, IEC) is the national academy of sciences and humanities of Catalonia, a centenary institution engaged in scientific research and knowledge promotion. Within its different lines of research, priority is given, on the one hand, to interdisciplinary projects - often somewhat neglected by conventional scientific centres -, and to studies pertaining to Catalan culture and language - its mandate is to codify and standardise Catalan language- and those dealing with the Catalan Countries (Catalonia, the Valencian Country and the adjacent area of Aragon, Andorra, Northern Catalonia and the Balearic Islands). It normally publishes in the language of the country, although it also publishes the journal *Contributions to Science* in English, aiming to promote the international dissemination of scientific research conducted in Catalonia. In exceptional cases, as in the case of this work, prepared in collaboration with investigators of other nationalities, it accepts English as a language of communication.

The first three signatories of this flora form the core of a research team with longstanding experience in the field of Bryology and which enjoys well deserved international prestige. Its director, Creu Casas, is a member of the Institute of Catalan Studies and for many years was a lecturer at the University of Barcelona, and later of the Autonomous University of Barcelona. The IEC was greatly interested in having this team lead the aforementioned flora of bryophytes of the Catalan Countries and is pleased with the result and its impact in a large part of Europe. It should be said that not only has C. Casas led Catalan bryology, setting it on the right road, but she has also had a notable influence throughout Spain and is regarded as a major authority on the topic. Thus, once the flora of the Catalan Countries had been undertaken, and leveraging the effort made, it was only logical that the team extend it to the Iberian Peninsula territory; and even more so taking into account the fact that this extension did not entail the addition of a major proportion of taxa. The collaboration between the Catalan team and the Portuguese team led by the investigator Cecilia Sergio made things even easier and was a sound guarantee of success.

This volume presents a comprehensive and well-structured synthesis of the current knowledge available on the mosses in the peninsular and Balearic territory; and the volume on liverworts will follow a similar pattern. Like the work that preceded it, this one provides information on the morphology, systematic, ecology and the distribution of the taxa addressed. It contains determination keys and includes numerous illustrations, led by

Anna Barrón and Iolanda Filella on the basis of a rigorous scientific analysis and, as you will see, with outstanding mastery.

The author of this foreword, as well as the institution publishing the work, is convinced that this new flora will be well-received, not just by professional bryologists, but also by all nature scholars, and that it will be just as useful - which would be enough in itself as the preceding one.

Josep Vigo Bonada
Biological Sciences Section, IEC

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We thank A.R. Perry for his helpful comments on the manuscript, as well as the accurate revision of the English text.

Some specimens in the BCB Herbarium have been revised by specialist bryologists, and for their valuable help we express our gratitude to I. Alvaro, H.H. Blom, M.A. Bruggeman-Nannenga, M.J. Cano, A. Ederra, J.-P. Frahm, M. T. Gallego, R. Gauthier, J. Guerra, L. Hedenäs, P. Heras, D. T. Holyoak, M. Infante, J. A. Jiménez, F. Lara, B.M. Murray, J. Muñoz, R. Ochyra, D. Orgaz, R.B. Pierrot, F. Puche and R.M. Ros, among others.

The Keepers and Curators of the following herbaria are thanked: BC, BCC, BM, FCO-Briof, G, GDAC, MA, MAUAM, MUB, PC, SANT-Bryo, VAB-BRIOF, VIT, in particular the collections of J.P. Hébrard, F. Rumsey, J.A. Rosselló and F. Koppe.

This work is part of the project "Flora i Cartografia de les Plantes i la Vegetació" of the Institut d'Estudis Catalans and has been carried out entirely in the Laboratory of Bryology (Botany) in the Department of Animal Biology, Plant Biology and Ecology, Autonomous University of Barcelona.

INTRODUCTION

The present book, devoted to mosses of the Iberian Peninsula and the Balearic Islands, has its bases in the volume I of *Flora dels Briòfits dels Països Catalans* (2001). By adding about 15% more species we were able to cover all the moss flora of the Iberian Peninsula and Balearic Islands. We were thus encouraged to prepare this work, for which we had the collaboration of C. Sérgio who contributed the Portuguese species.

This flora comprises identification keys to specific level with corresponding illustrations. Thanks to the numerous specimens deposited in the BCB Herbarium, collected over more than 50 years by the authors and others, and to data provided by colleagues from other universities, we had the basis of this elementary bryophyte flora. The keys are for the use of botanists, students, excursionists and people generally keen on bryology. It is not only of special interest to Spanish and Portuguese people but to foreigners collecting in our area of study, and for the latter we thought that an English version would make its use easier.

At the present time there is no updated and complete flora for moss identification in the Iberian Peninsula and Balearic Islands. “Sinopse das Briófitas de Portugal” (Machado, 1928-1931) published in *Boletim da Sociedade Broteriana*, is an incomplete work, as is *Flora Ibérica, Briófitas (2ª parte) Musgos* (Casares, 1932) published by Museo Nacional de Ciencias Naturales.

Botanists interested in detailed descriptions have so far had to turn to floras from other European countries which, however, may lack many of our southern-occidental taxa. For this reason, the *Sociedad Española de Briología* has started producing *Flora Briofítica Ibérica*, edited by J. Guerra, M. J. Cano, M. Brugués and R.M. Cros. This flora contains very detailed descriptions of each species, its ecology, provincial distribution, notes and observations and, additionally, complete illustrations. It is an essential reference work for anyone interested in bryophyte taxonomy.

The study area for the present work is located in the extreme southwest of Europe and includes the Iberian Peninsula (peninsular Spain, Portugal and Andorra), and the Balearic Islands. Biogeographically it covers the Mediterranean and Euro-Siberian regions (Fig. 1). There is a noteworthy climate variability and a wide range of altitudes from sea levels to summits over 3000 m in the Pyrenees and Sierra Nevada, as well as a rich diversity of soil types. All these circumstances produce very different and often contrasting environments and, as a consequence, a high bryophyte richness overall, representing about 65% of the European moss flora.



FIGURE 1. Map of the Iberian Peninsula and the Balearic Islands, with the mountains cited in the text.

Illustrations. The illustrations are from those in the *Flora dels Briòfits dels Països Catalans* Vol. I. *Moltes* (2001) with further original drawings for most of the species added. Habitat drawings were made by A. Barrón and I. Filella, the former also being responsible for the microscopical drawings.

PRACTICAL INSTRUCTIONS

Determination keys. The artificial key to genera comprises two parts. In the first part, by means of the use of morphological characters, usually of easy interpretation, different groups are delimited. In the second part the genera gathered in these artificial groups are separated. For family classification and order, as well as for most of the generic names and authorities, we followed Hill *et al.* (“An annotated checklist of the mosses of Europe and Macaronesia”, in *Journal of Bryology*, 2006).

Each genus includes a short morphological description referring only to the species that appear in the present *Flora*. In monospecific genera the species name follows the description; if plurispecific a key to species is given. The specific name is in bold type, in many cases followed by the most-used synonyms. We have tried to base our keys on gametophytic characters as far as possible but in some species and even genera we have found it necessary to refer to fertile material.

After the specific name, in addition to the differential characters, information to achieve the correct identification is supplied. After this we mention the growth form, ecology and vegetation zone. Geographical distribution (Fig. 1) is given in the broad sense in the Iberian Peninsula but for more localized species the specific isle or isles of the Balearic Islands, or the mountain ranges where they occur are given. Countries in the Iberian Peninsula are abbreviated: Esp (continental Spain), Prt (Portugal), And (Andorra). For the Balearic Islands we specify the different isles: Mallorca (which includes the small isles of Cabrera and Dragonera), Menorca, and Pithyusic Islands (including Eivissa and Formentera).

Illustrations were made mainly from moist material. The leaves shown are ventral aspects of stem leaves unless otherwise indicated. When possible, similar details have similar or equal magnifications, although this information is always indicated in the legends.

ARTIFICIAL KEY TO GENERA

- | | | | |
|----|---|--------------------|-----|
| 1 | Leaf lamina consisting of narrow green cells in a network enclosing large, inflated, hyaline cells; plants with branches in fascicles | Sphagnum | 57 |
| 1 | Plants lacking above combination of characters | | 2 |
| 2 | Plants dark brownish, reddish or blackish, saxicolous; laminal cells thick-walled, reddish to brownish; capsule dehiscing by 4 longitudinal slits | Andreaea | 69 |
| 2 | Plants lacking above combination of characters | | 3 |
| 3 | Basal cells of lamina narrow, elongate, sinuose, nodulose, cells above strongly sinuose | Racomitrium | 109 |
| 3 | Laminal cells lacking above combination of characters | | 4 |
| 4 | Stem leaves arranged in 2 ranks, distichous (occasionally with a third ventral row), or complanate | A | 14 |
| 4 | Stem leaves arranged in 3 or more ranks, not complanate | | 5 |
| 5 | Nerve with filaments or longitudinal lamellae on ventral side | B | 15 |
| 5 | Nerve without filaments or longitudinal lamellae on ventral side | | 6 |
| 6 | At least upper leaves ending in hyaline point or nerve excurrent in hyaline hair-point | C | 16 |
| 6 | Leaves without hyaline point or nerve excurrent in hyaline hair-point | | 7 |
| 7 | Leaves bordered with several rows of narrower cells or leaf margin pluristratose | D | 17 |
| 7 | Leaves unbordered, margin 1-2-stratose | | 8 |
| 8 | Plants acrocarpous | | 9 |
| 8 | Plants pleurocarpous | | 30 |
| 9 | Capsule present | | 10 |
| 9 | Capsule lacking | | 20 |
| 10 | Capsule indehiscent | AA | 18 |

10	Capsule dehiscent	11	
11	Capsule immersed or emergent	AB	20
11	Capsule exserted	12	
12	Capsule larger than plant, ovoid, asymmetrical; seta papillose; leaves minute, ephemeral; perichaetial leaves ciliate	Buxbaumia	80
12	Plants lacking above combination of characters	13	
13	Capsule globose or sub-globose	AC	21
13	Capsule ovoid, oblong, cylindrical, ellipsoid or pyriform	14	
14	Capsule strumose	AD	21
14	Capsule not strumose	15	
15	Peristome rudimentary or lacking	AE	22
15	Peristome well developed	16	
16	Capsule striate or sulcate when dry	AF	23
16	Capsule smooth or only slightly striate when dry	17	
17	Capsule erect or nearly so; seta straight, rarely curved	18	
17	Capsule inclined to pendulous; seta straight or curved	19	
18	Peristome teeth 4 or 16, entire, divided at tips only or slightly and irregularly divided	AG	25
18	Peristome teeth 16, divided to half way or more (32 teeth)	AH	27
19	Peristome single	AI	28
19	Peristome double	AJ	29
20	Propagules present on stem or leaves or in receptacles	AK	30
20	Propagules lacking on stem or leaves or in receptacles	21	
21	Nerve wide, 1/3 or more of leaf base	AL	31
21	Nerve narrow, less than 1/3 of leaf base or without nerve	22	

22	Laminal cells 18 μm wide or more	AM	32
22	Laminal cells less than 18 μm wide	23	
23	Alar cells differentiated from other basal cells	AN	35
23	Alar cells not differentiated	24	
24	Laminal cells \pm isodiametric	25	
24	Laminal cells longer than wide	29	
25	Leaf margin denticulate or dentate, at least near apex or at base	AO	35
25	Leaf margin entire, crenulate or papillose-crenulate	26	
26	Nerve excurrent	AP	37
26	Nerve not excurrent or lacking	27	
27	Leaf apex rounded or obtuse, apiculate or not	AQ	40
27	Leaf apex acute, sub-acute or acuminate	28	
28	Leaf margin recurved at least on one side	AR	41
28	Leaf margin plane or recurved only at base	AS	42
29	Leaf apex acuminate or subulate, apex consisting largely or entirely of nerve	AT	43
29	Leaf apex obtuse to acuminate, nerve percurrent to excurrent or short or lacking	AU	44
30	Nerve single, extending more than 1/2 way up leaf	31	
30	Nerve single and extending less than 1/2 way up leaf, double, short or long, or lacking	35	
31	Laminal cells short, to twice as long as wide, or median cells elongate and marginal cells short	PA	45
31	Laminal cells elongate, more than twice as long as wide	32	
32	Leaves longitudinally plicate, at least at base	PB	47
32	Leaves plane or only slightly longitudinally plicate	33	
33	Leaves squarrose, falciform or circinate	PC	48
33	Leaves straight or nearly so	34	

34	Leaf apex rounded, obtuse or apiculate	PD	49
34	Leaf apex acute or acuminate	PE	49
35	Lamina cells short, to twice as long as wide, or median cells elongate and marginal cells short	PF	52
35	Lamina cells elongate, more than twice as long as wide	36	
36	Leaf apex rounded, obtuse or apiculate	PG	52
36	Leaf apex acute or acuminate	37	
37	Leaves distinctly falciform or squarrose	PH	53
37	Leaves straight or weakly falciform or squarrose	PI	54

A. Leaves distichous or complanate

1	Leaves distichous, arranged on stem in two opposite rows, with or without a third ventral row	2	
1	Leaves complanate, arranged in more than 2 rows on stem but flattened into more or less one plane	5	
2	Plants with a ventral row of leaves different from the lateral leaves	Hypopterygium	271
2	Plants without a ventral row of leaves different from the lateral leaves	3	
3	Lower part of leaf conduplicate	Fissidens	128
3	Leaf not conduplicate	4	
4	Leaves decurrent, without sheathing base, apex acute or acuminate; nerve lacking	Schistostega	149
4	Leaves not decurrent, with sheathing base, narrowed to subulate point; nerve present	Distichium	136
5	Leaves with a border of narrow elongated cells; nerve double	Cyclodictyon	273
5	Leaves unbordered; nerve single, double or lacking	6	
6	Lamina cells 60-80 μm wide	Hookeria	271
6	Lamina cells 4-45 μm wide	7	
7	Nerve single	8	

7	Nerve short and double or lacking		10
8	Nerve extending to 2/3 way up leaf; leaves lanceolate or ovate-lanceolate	Leptodictyum	283
8	Nerve extending 1/2-4/5 way up leaf; leaves oblong to spatulate		9
9	Leaves oblong to spatulate, not undulate; leaf apex dentate	Homalia	344
9	Leaves oblong, transversely undulate; leaf apex finely denticulate	Neckera	344
10	Leaves oblong, oblong-lanceolate or oblong-ovate, non-decurrent; stem pinnately or irregularly branched		11
10	Leaves lanceolate, ovate or ovate-lanceolate, decurrent or not; stem irregularly branched		14
11	Leaves transversely undulate or not; stem pinnately branched		12
11	Leaves not transversely undulate; stem irregularly branched		13
12	Leaves asymmetrical; plants without flagelliform branches	Homalia	344
12	Leaves symmetrical; plants sometimes with flagelliform branches	Neckera	344
13	Plants small; median laminal cells 5-8 μm wide	Taxiphyllum	324
13	Plants medium-sized; median laminal cells 20-30 μm wide	Tetrastichium	272
14	Alar cells hyaline, differentiated	Plagiothecium	335
14	Alar cells green or yellowish, differentiated or not		15
15	Plants medium-sized, rare		16
15	Plants slender or small, common		17
16	Alar cells not differentiated	Tetrastichium	272
16	Alar cells differentiated	Isopterygium	340
17	Flagelliform propagules in leaf axils, with small primordial leaves	Pseudotaxiphyllum	338
17	Flagelliform propagules lacking	Isopterygiopsis	332

B. Nerve with filaments or longitudinal lamellae on ventral side

1	Nerve with branched or unbranched filaments at least in the upper part		2
1	Nerve with longitudinal lamellae at least in the upper part		3
2	Leaf margin widely incurved; leaves rigid	Aloina	166
2	Leaf margin recurved or plane; leaves not rigid	Crossidium	173
3	Plants to 0,5 cm tall; nerve with 2-4 lamellae; peristome rudimentary or lacking	Pterygoneurum	194
3	Plants 0,5-6 cm tall; nerve usually with 4 lamellae or more; peristome well developed, of 32 or 64 teeth		4
4	Nerve narrow, with 3-7 lamellae; leaves with a border of long, narrow cells	Atrichum	72
4	Nerve broad, with more than 7 lamellae; leaves unbordered		5
5	Nerve with 8-12 sinuose lamellae	Oligotrichum	74
5	Nerve with more than 12 lamellae, not sinuose		6
6	Leaves muticous; apical cells of lamellae rounded in cross section; capsule not angled, without apophysis; peristome teeth 32	Pogonatum	74
6	Leaves muticous or ending in hair-point; apical cells of lamellae ovate, elliptical, pyriform, flat or emarginated in cross section; capsule angled or not, with apophysis; peristome teeth 64	Polytrichum + Polytrichastrum	75

C. Leaves with hyaline point or with nerve excurrent in hyaline hair-point

1	Leaves with hyaline point		2
1	Leaves, at least the upper ones, with nerve excurrent in hyaline hair-point		8
2	Nerve lacking	Hedwigia	236
2	Nerve present		3
3	Plants silvery or whitish when dry	Bryum	243
3	Plants neither whitish nor silvery when dry		4
4	Median cells of lamina 10-25 µm wide	Orthotrichum	222
4	Median cells of lamina 6-12 µm wide		5

5	Leaves longitudinally plicate on both sides of nerve	6	
5	Leaves not longitudinally plicate on both sides of nerve	7	
6	Laminal cells smooth; capsule immersed or emergent; calyptra campanulate, plicate	Coscinodon	94
6	Laminal cells usually papillose; capsule exserted; calyptra cucullate, non-plicate	Grimmia	95
7	Capsule immersed or emergent; lid coming off attached to columella	Schistidium	113
7	Capsule immersed or exserted; lid not coming off attached to columella	Grimmia	95
8	Nerve wide, 1/3-1/2 of width of leaf base	Campylopus	159
8	Nerve narrow, less than 1/3 of width of leaf base	9	
9	Laminal cells finely papillose or smooth	10	
9	Laminal cells strongly papillose	12	
10	Capsule immersed, indehiscent	Phascum	189
10	Capsule exserted or emergent, dehiscent	11	
11	Capsule exserted; calyptra cucullate	Pottia	191
11	Capsule emergent; calyptra mitriform, with 8 plicae	Goniomitrium	92
12	Basal cells of leaves not forming a distinct ovate group on both sides of nerve	13	
12	Basal cells of leaves forming a distinct ovate group on both sides of nerve	14	
13	Capsule immersed, indehiscent	Phascum	189
13	Capsule exserted or emergent, dehiscent	Tortula	206
14	Peristome teeth spirally twisted; calyptra partially covering the capsule	Syntrichia	196
14	Peristome teeth not twisted or lacking; calyptra covering the whole capsule	Encalypta	82

D. Leaves bordered with narrow cells or margin pluristratose

1	Marginal cells short, 2-5-stratose	2
1	Marginal cells longer and narrower than the rest of laminal cells, uni- to pluristratose	

2	Leaf margin recurved; laminal cells strongly papillose; stem with central strand	Dialytrichia	175
2	Leaf margin plane; laminal cells smooth or faintly papillose; stem without central strand	Cinclidotus	172
3	Laminal cells papillose	Tortula	206
3	Laminal cells smooth	4	
4	Plants rhizomatous; leaves crowded in terminal rosette	Rhodobryum	257
4	Plants not rhizomatous; leaves crowded in terminal rosette or not	5	
5	Nerve ending below apex	Epipterygium	258
5	Nerve percurrent or excurrent	6	
6	Marginal cells yellow	Entosthodon	267
6	Marginal cells not yellow	7	
7	Leaf margin entire or denticulate at apex	8	
7	Leaf margin dentate or spinosely dentate	10	
8	Leaf apex acute or acuminate; leaves ovate to ovate-lanceolate	Bryum	243
8	Leaf apex obtuse, rounded or emarginate; leaves rounded, rounded-ovate or elliptical	9	
9	Leaf margin pluristratose or at least bistratose in lower part; leaf apex rounded	Rhizomnium	266
9	Leaf margin unistratose; leaf apex obtuse	Cyrtomnium	267
10	Leaf margin with geminate teeth	Mnium	264
10	Leaf margin with simple teeth	Plagiomnium	267

AA. Acrocarpous with indehiscent capsule

1	Capsule exserted	2	
1	Capsule immersed or emergent	5	

2	Capsule with perceptible neck, 1/3-1/2 of the capsule length	Bruchia	141
2	Capsule without perceptible neck		3
3	Capsule globose	Microbryum	187
3	Capsule cylindrical or ellipsoidal		4
4	Lid differentiated but persistent	Protobryum	193
4	Lid not differentiated	Microbryum	187
5	Plants with persistent protonema		6
5	Plants without persistent protonema		7
6	Protonema abundant; capsule apiculate	Ephemerum	84
6	Protonema scarce; capsule without apiculus	Micromitrium	86
7	Laminal cells smooth, more than 25 μm wide	Physcomitrella	92
7	Laminal cells smooth or papillose, less than 15 μm wide		8
8	Capsule with \pm differentiated lid; leaves crisped when dry	Astomum	168
8	Capsule without lid; leaves not crisped when dry		9
9	Capsule globose, with translucent wall; spores 16-20 in number, 180-225 μm	Archidium	127
9	Capsule globose or \pm apiculate, with opaque wall; spores numerous, less than 60 μm		10
10	Laminal cells rectangular or linear		11
10	Laminal cells quadrate, rounded, hexagonal, rhomboidal or elliptical		12
11	Leaves subulate, at least the upper ones; laminal cells 8 μm wide	Pleuridium	139
11	Leaves acuminate; laminal cells 9-13 μm wide	Pseudephemerum	140
12	Plants bulbiform; leaves ovate to elliptic; capsule non apiculate or only minutely apiculate	Acaulon	164
12	Plants not bulbiform; leaves oblong-lanceolate or ovate-lanceolate; capsule apiculate		13
13	Nerve with dorsal and ventral stereids	Aschisma	168
13	Nerve with only dorsal stereids	Phascum	189

AB. Acrocarpous with immersed or emergent capsule

1	Capsule large, ovoid, asymmetrical; perichaetial leaves ciliate	Diphyscium	80
1	Capsule and perichaetial leaves not as above		2
2	Leaves without nerve		3
2	Leaves with nerve		4
3	Plants terricolous; leaves abruptly apiculate; Mediterranean plants	Gigaspermum	94
3	Plants saxicolous; leaves not abruptly apiculate; Eurosiberian plants	Hedwigia	236
4	Lid slightly differentiated	Astomum	168
4	Lid well differentiated		5
5	Lid coming off attached to columella; capsule smooth	Schistidium	113
5	Lid not coming off attached to columella; capsule smooth or sulcate		6
6	Seta curved; capsule gibbous at base	Campylostelium	122
6	Seta straight or curved; capsule not gibbous at base		7
7	Peristome lacking	Amphidium	142
7	Peristome present		8
8	Peristome single; capsule straight or curved	Grimmia	95
8	Peristome double; capsule straight		9
9	Leaves concave; margin erecto-incurved or involute; apex obtuse or rounded	Nyholmiella	222
9	Leaves more or less keeled; margin recurved or flat; apex acute, obtuse or rounded		10
10	Leaves lanceolate or linear-lanceolate with plane margins; propagule abundant	Pulviger	231
10	Leaves ovate-lanceolate to oblong; with recurved margins; propagule sometimes present		11
11	Stomata immersed; spores less than 20 μm in diameter	Orthotrichum	222
11	Stomata superficial; spores more than 20 μm in diameter	Lewinskya	219

AC. Acrocarpous with exserted, globose or sub-globose capsule

1	Capsule blackish, to 1 mm in diameter	Catoscopium	237
1	Capsule green or brownish, more than 1 mm in diameter		2
2	Peristome lacking	Pyramidula	93
2	Peristome single or double		3
3	Leaves imbricate, 5-ranked; peristome teeth joined at apex forming a cone	Conostomum	239
3	Leaves erecto-patent to spreading, not 5-ranked; peristome not as above		4
4	Capsule inclined to pendulous; leaves lanceolate to ovate-lanceolate; peristome double		5
4	Capsule straight or slightly inclined; leaves narrowly lanceolate to linear-lanceolate; peristome double or single		6
5	Leaves longitudinally plicate; seta cygneous	Breutelia	239
5	Leaves not longitudinally plicate or weakly so; seta straight	Philonotis	240
6	Capsule asymmetrical; laminal cells finely papillose-striate; peristome double	Plagiopus	242
6	Capsule symmetrical or asymmetrical; laminal cells mamilllose; peristome double or single	Bartramia	238

AD. Acrocarpous with exserted, strumose capsule

1	Neck of capsule as long as urn	Trematodon	142
1	Neck of capsule shorter than urn or indistinct		2
2	Peristome teeth divided near to base, reddish, with a hyaline and papillose border	Ceratodon	135
2	Peristome teeth divided to half way, reddish, striate in the lower part		3
3	Nerve without stereids	Kiaeria	146
3	Nerve with stereids		4
4	Alar cells differentiated	Oncophorus	147

4	Alar cells not differentiated		5
5	Upper laminal cells quadrate or oblate	Cynodontium	143
5	Upper laminal cells rectangular	Dicranella	150

AE. Acrocarpous with exerted capsule and peristome lacking or rudimentary

1	Seta curved, twisted when dry	Funariella	91
1	Seta straight when dry		2
2	Calyptra inflated, 4-angled; spores 50-60 μm	Pyramidula	93
2	Calyptra not inflated or angled; spores smaller		3
3	Capsule striate or sulcate when dry		4
3	Capsule smooth when dry		5
4	Leaves mostly linear-lanceolate; gemmae lacking	Amphidium	142
4	Leaves oblong-lanceolate to lingulate or lanceolate; with ovoid gemmae	Zygodon	234
5	Median cells of lamina 20-50 μm wide, thin-walled		6
5	Median cells of lamina less than 20 μm wide, thin-walled or thick-walled		8
6	Exothecial cells longer than wide	Entosthodon	86
6	Exothecial cells isodiametric		7
7	Calyptra mitriform	Physcomitrium	92
7	Calyptra cucullate	Entosthodon	86
8	Plants minute	Seligeria	125
8	Plants small to robust		9
9	Calyptra cylindrical, covering capsule; basal cells forming a well-delimited group	Encalypta	82
9	Calyptra cucullate not covering capsule; basal cells not forming a well-delimited group		10
10	Nerve excurrent		11

10	Nerve not excurrent		14
11	Leaves linear-lanceolate or lanceolate; margin incurved or plane	Weissia	214
11	Leaves ovate-lanceolate, ovate or obovate; margin plane or recurved		12
12	Perichaetial leaves wider than stem leaves, sheathing; laminal cells thick-walled	Pottiopsis	192
12	Perichaetial leaves similar to stem leaves, not sheathing; walls of laminal cells thin-walled or only slightly thickened		13
13	Lid conical	Microbryum	187
13	Lid rostrate	Pottia	191
14	Lid attached to columella after dehiscence		15
14	Lid not attached to columella after dehiscence		16
15	Plants 1,5-10 cm tall; leaves carinate; margin finely crenulate	Hymenostylium	185
15	Plants to 1 cm tall; leaves not carinate; margin dentate at apex	Hennediella	184
16	Leaves carinate	Anoetangium	167
16	Leaves not carinate		17
17	Annulus of capsule of large, vesiculose cells	Gyroweisia	184
17	Annulus of small cells	Gymnostomum	182

AF. Acrocarpous with exerted capsule, striate or sulcate when dry and peristome well developed

1	Plants very small, to 0,3 cm tall, rare	124	116
1	Plants more than 0,3 cm tall, common	2	
2	Seta curved	3	
2	Seta straight	4	
3	Leaves ovate-lanceolate; laminal cells hexagonal or rectangular, 30-50 µm wide, thin-walled	Funaria	91
3	Leaves lanceolate; laminal cells quadrate or rounded, less than 20 µm wide, thick-walled		

		Grimmia	95
4	Peristome teeth in pairs or in groups of 4		5
4	Peristome teeth free, not forming groups		9
5	Calyptra cucullate		6
5	Calyptra not cucullate		7
6	Upper cells of leaf smooth	Codonoblepharon	218
6	Upper cells of leaf smooth	Zygodon	234
7	Marginal cells at leaf base quadrate or shortly rectangular, hyaline, with thickened transverse walls, ascending up margin, basal cells linear	Ulota	231
7	Marginal cells at leaf base elongate, similar to the rest of basal cells		8
8	Stomata immersed; spores less than 20 µm in diameter	Orthotrichum	222
8	Stomata superficial; spores more than 20 µm in diameter	Lewinskya	219
9	Peristome single		10
9	Peristome double		17
10	Peristome teeth spreading	Arctoa	143
10	Peristome teeth erect		11
11	Peristome teeth 16, entire or slightly and irregularly divided		12
11	Peristome teeth 16, divided to half way or more		13
12	Capsule cylindrical, completely covered by the calyptra	Encalypta	82
12	Capsule ovoid to shortly cylindrical, not completely covered by the calyptra	Rhabdoweisia	149
13	Peristome teeth divided to base		14
13	Peristome teeth divided to half way		15
14	Plants glaucous	Saelania	141
14	Plants not glaucous	Ceratodon	135

15	Alar cells ± differentiated	Dicranum	153
15	Alar cells not differentiated		16
16	Laminal cells quadrate	Cynodontium	143
16	Laminal cells rectangular	Dicranella	150
17	Median cells of lamina linear, smooth	Orthodontium	271
17	Median cells of lamina rounded, quadrate or hexagonal, mamilllose or papillose		18
18	Leaves with dentate margins and sheathing base; marginal cells longer and narrower than median cells		Timmia 81
18	Leaves with entire or denticulate margins and the base not sheathing; marginal cells similar to median cells	Aulacomnium	269

AG. Acrocarpous with exserted, erect capsule, peristome teeth 4 or 16, entire or slightly and irregularly divided and seta straight or curved

1	Peristome teeth 4		2
1	Peristome teeth 16		3
2	Stem to 2 cm high; sterile stems ending in a cup of orbicular bracts containing discoid gemmae; nerve ending below apex	Tetraphis	78
2	Stem to 0,2 cm high; gemmae lacking; nerve short or lacking	Tetrodontium	79
3	Median cells of lamina smooth, more than 20 µm wide		4
3	Median cells of lamina smooth or strongly papillose, less than 20 µm wide		6
4	Capsule with apophysis	Splachnum	216
4	Capsule without apophysis		5
5	Leaf apex rounded or obtuse and apiculate or acute; peristome teeth reflexed when dry	Tayloria	217
5	Leaf apex acute; peristome teeth straight or incurved when dry	Entosthodon	86
6	Laminal cells finely striate; alar cells differentiated	Hymenoloma	146
6	Laminal cells smooth or papillose; alar cells differentiated or not		7

7	Alar cells differentiated	Blindia	124
7	Alar cells not or only slightly differentiated	8	
8	Leaves lingulate or spatulate; calyptra completely covering the capsule	Encalypta	82
8	Leaves not as above; calyptra not completely covering the capsule	9	
9	Leaf margin with reflexed teeth at base	Eucladium	182
9	Leaf margin without reflexed teeth at base	10	
10	Plants minute, growing on calcareous rocks	Seligeria	125
10	Plants medium-sized, growing on calcareous rocks or not	11	
11	Leaves obovate, very concave, obtuse and apiculate	Stegonia	196
11	Leaves not as above	12	
12	Nerve excurrent	13	
12	Nerve percurrent	17	
13	Capsule longly cylindrical or ellipsoidal	Trichostomum	212
13	Capsule shortly cylindrical or ovoid	14	
14	Lamina bistratose or pluristratose in the upper part	Grimmia	95
14	Lamina unistratose	15	
15	Leaves linear-lanceolate or lanceolate	Weissia	214
15	Leaves ovate-lanceolate, ovate, obovate, oblong or lingulate	16	
16	Lid conical	Microbryum	187
16	Lid rostrate	Pottia	191
17	Calyptra mitriform	Ptychomitrium	122
17	Calyptra cucullate	18	
18	Leaf apex acuminate	Dicranoweisia	146
18	Leaf apex acute or obtuse	Didymodon	176

AH. Acrocarpous with exserted, erect capsule, peristome teeth 16, divided to half way or to the base (32 teeth) and seta straight

1	Peristome teeth slightly or strongly spirally twisted		2
1	Peristome teeth straight or curved		8
2	Plants very small, to 0,3 cm tall; capsule ovoid to ellipsoidal, peristome teeth weakly spirally twisted		
		Leptobarbula	186
2	Plants small to robust; capsule cylindrical to ovoid, peristome teeth strongly spirally twisted		3
3	Basal cells hyaline, forming a well-delimited group		4
3	Basal cells hyaline or not, not forming a well-delimited group		5
4	Hyaline basal cells of leaf ascending up margins in a v-shape	Tortella	202
4	Hyaline basal cells of leaf forming a ovate group, not ascending up margins	Syntrichia	196
5	Peristome with well-developed basal membrane	Tortula	206
5	Peristome without basal membrane		6
6	Axillary hairs with brown basal cells	Didymodon	176
6	Axillary hairs with hyaline cells throughout		7
7	Margin plane or recurved; nerve with elongate cells on ventral side	Barbula	169
7	Margin revolute; nerve with quadrate or shortly rectangular cells on ventral side	Pseudocrossidium	194
8	Laminal cells mostly rectangular		9
8	Laminal cells mostly quadrate		11
9	Peristome teeth divided to base or near so	Ditrichum	136
9	Peristome teeth divided to near half way		10
10	Leaves squarrose when moist	Dichodontium	145
10	Leaves not squarrose	Dicranella	150

11	Peristome teeth irregularly divided to base or nearly so		12
11	Peristome teeth regularly divided to base or nearly so		15
12	Laminal cells 15-20 µm wide	Tortula	206
12	Laminal cells to 14 µm wide		13
13	Nerve excurrent in apiculus	Trichostomum	212
13	Nerve ending in or below apex		14
14	Plants to 0,5 cm tall; laminal cells mamilllose on both sides	Campylostelium	122
14	Plants more than 0,5 cm tall; laminal cells smooth	Cynodontium	143
15	Leaf lamina bistratose except the lower 1/3		16
15	Leaf lamina unistratose or bistratose at apex		17
16	Calyptra cucullate	Timmiella	202
16	Calyptra mitriform	Ptychomitrium	122
17	Leaves longitudinally plicate at base; laminal cells smooth; calyptra mitriform	Ptychomitrium	122
17	Leaves not longitudinally plicate; laminal cells mamilllose or papillose; calyptra cucullate		18
18	Leaf margin entire or crenulate or slightly dentate near apex	Bryoerythrophyllum	171
18	Leaf margin strongly dentate in the upper 1/3 or more		19
19	Laminal cells pluripapillose	Leptodontium	186
19	Laminal cells mamilllose or unipapillose	Dichodontium	145

AI. Acrocarpous with exserted, inclined to pendulous capsule and peristome single

1	Capsule with distinct neck		2
1	Capsule with indistinct neck		3
2	Plants dioicous; peristome consisting of exostome with papillose teeth	Mielichhoferia	258
2	Plants synoicous; peristome consisting of endostome with smooth or slightly papillose segments	Schizymenium	264

3	Seta curved, at least when moist	Dicranodontium	162
3	Seta straight		4
4	Alar cells differentiated	Dicranum	153
4	Alar cells not differentiated		5
5	Median cells of lamina quadrate or rounded to rectangular, mamilllose on both sides	Dichodontium	145
5	Median cells of lamina long and narrow, smooth		6
6	Leaves squarrose when moist	Dichodontium	145
6	Leaves not squarrose when moist	Dicranella	150

AJ. Acrocarpous with exserted, inclined to pendulous capsule and peristome double

1	Plants bluish when dry	Mnium	264
1	Plants not bluish when dry		2
2	Nerve 1/3 or more of leaf base		3
2	Nerve less than 1/3 of leaf base		5
3	Leaves lingulate with rounded apex	Meesia	218
3	Leaves not lingulate with acute to acuminate apex		4
4	Leaves oblong-lanceolate	Amblyodon	217
4	Leaves linear	Leptobryum	217
5	Plants julaceous		6
5	Plants not julaceous		7
6	Neck as long as urn; median cells of lamina hexagonal to rhomboidal	Plagiobryum	256
6	Neck half length of urn; median cells of lamina narrowly hexagonal to vermicular	Anomobryum	243
7	Peristome teeth sigmoid; capsule asymmetrical	Entosthodon	86

7	Peristome teeth straight; capsule symmetrical, cylindrical to pyriform	8
8	Laminal cells rhomboidal or hexagonal, to 4 times as long as wide; basal cells quadrate to rectangular	Bryum 243
8	Laminal cells linear to narrowly hexagonal, 5 or more times as long as wide; basal cells not differentiated	Pohlia 259

AK. Acrocarpous with propagules

1	Plants with axillary bulbils	2
1	Plants lacking axillary bulbils	3
2	Laminal cells to 4 times as long as wide; basal cells quadrate to rectangular	Bryum 243
2	Laminal cells 5 or more times as long as wide; basal cells not differentiated	Pohlia 259
3	Plants with foliose propagules in upper leaf axils	Syntrichia 196
3	Plants with gemmae	4
4	Gemmae crowded at ends of stems	5
4	Gemmae in leaf axils or on leaves	7
5	Gemmae globose, ovoid or fusiform, in globose clusters on ends of leafless prolongations of stems	Aulacomnium 269
5	Gemmae lenticular or discoid, in the centre of a rosette of apical leaves	6
6	Plants growing on soils; nerve excurrent in apiculus	Oedipodiella 94
6	Plants growing on rotting wood; nerve ending below apex	Tetraphis 78
7	Gemmae unicellular	Bryoerythrophyllum 171
7	Gemmae pluricellular	8
8	Gemmae globose or ellipsoidal on axillary filaments	9
8	Gemmae globose or ellipsoidal and sessile, or filamentous or cylindrical	11
9	Leaves with hyaline point	Grimmia 95

9	Leaves without hyaline point		10
10	Leaves oblong-lanceolate; ventral surface cells of nerve rectangular	Barbula	169
10	Leaves widely ovate to lanceolate; ventral surface cells of nerve quadrate	Didymodon	176
11	Gemmae at tips of leaves, globose, more than 80 µm	Grimmia	95
11	Gemmae on nerve, on lamina or in leaf axils, if at tips of leaves then not globose or less than 80 µm		12
12	Gemmae irregularly globose, on nerve	Syntrichia	196
12	Gemmae filamentous, cylindrical, fusiform, ovoid or ellipsoidal on lamina, on leaves or in leaf axils		13
13	Basal cells of leaves hyaline, forming a well-delimited group	Encalypta	82
13	Basal cells of leaves hyaline or not, not forming a well-delimited group		14
14	Leaves bordered, with 1-3 rows of elongate cells; laminal cells rectangular-hexagonal, smooth		
		Bryum	243
14	Leaves unbordered; laminal cells rounded, usually papillose		15
15	Leaves concave; margin erecto-incurved or involute; apex obtuse or rounded	Nyholmiella	222
15	Leaves more or less keeled; margin recurved or flat; apex acute, obtuse or rounded		16
16	Gemmae on stems and in leaf axils	Zygodon	234
16	Gemmae on leaves		17
17	Gemmae at tips of leaf nerve	Plenogemma	230
17	Gemmae on leaf lamina		18
18	Leaves lanceolate or linear-lanceolate with plane margins; propagule abundant	Pulviger	231
18	Leaves ovate-lanceolate to oblong; with recurved margins; propagule scarce or abundant		
		Orthotrichum	222

AL. Acrocarpous with nerve 1/3 or more of leaf base

1	Nerve excurrent in hyaline hair-point	Campylopus	159
1	Nerve percurrent or excurrent in a coloured hair-point		2

2	Alar cells differentiated		3
2	Alar cells not differentiated		5
3	Nerve consisting of green cells and hyaline cells	Paraleucobryum	158
3	Nerve with stereids and guide cells		4
4	Nerve with stereids on dorsal side only or without stereids	Campylopus	159
4	Nerve with stereids on dorsal and ventral side	Dicranodontium	162
5	Nerve with a central layer of chlorophyllose cells covered on both sides by hyaline cells; plants whitish to glaucous	Leucobryum	164
5	Nerve not as above; plants green or brownish		6
6	Laminal cells papillose	Gymnostomum	182
6	Laminal cells smooth		7
7	Leaves lingulate, with rounded apex	Meesia	218
7	Leaves not lingulate, with acuminate apex		8
8	Leaves oblong to oblong-lanceolate; nerve without guide cells	Amblyodon	217
8	Leaves linear to lanceolate; nerve with guide cells		9
9	Laminal cells 45-55 μm long; rhizoidal gemmae abundant	Leptobryum	217
9	Laminal cells less than 45 μm long; rhizoidal gemmae scarce or lacking		10
10	Nerve more than 180 μm wide near base	Campylopus	159
10	Nerve to 130 μm wide near base		11
11	Peristome teeth divided to base	Ditrichum	196
11	Peristome teeth divided to middle	Dicranella	150

AM. Acrocarpous with laminal cells 18 μm wide or more

1	Leaves without nerve; capsule immersed		2
1	Leaves with nerve; capsule immersed or exerted		3
2	Leaves orbicular or obovate, with obtuse to rounded apex, apiculate; capsule dehiscent	Gigaspermum	94
2	Leaves lanceolate or linear-lanceolate, with acuminate apex; capsule indehiscent	Micromitrium	86
3	Nerve 1/3 or more of leaf base	Amblyodon	217
3	Nerve less than 1/3 of leaf base		4
4	Laminal cells quadrate, rounded or shortly polygonal		5
4	Laminal cells longly polygonal or elliptical		11
5	Nerve ending below apex; plants bluish when dry	Mnium	264
5	Nerve excurrent in apiculus or hair-point; plants not bluish when dry		6
6	Leaves apiculate, with reflexed, brownish yellow apiculus; margin irregularly denticulate	Chenia	186
6	Leaves lacking above combination of characters; margin entire		7
7	Capsule immersed	Physcomitrella	92
7	Capsule exerted or emergent		8
8	Calyptra small, cucullate; spores less than 40 μm		9
8	Calyptra large, mitriform or cucullate; spores 40-60 μm		10
9	Capsule dehiscent	Pottia	191
9	Capsule indehiscent	Protobryum	193
10	Capsule exerted; calyptra cucullate, distinctly 4-angled	Pyramidula	93
10	Capsule emergent; calyptra mitriform, 8-plicate	Goniomitrium	92
11	Plants bulbiform	Acaulon	164
11	Plants not bulbiform		12

12	Plants rhizomatous, with erect branches; upper leaves crowded in a conspicuous terminal rosette	Rhodobryum	257
12	Plants not rhizomatous, erect; upper leaves crowded in terminal rosette or evenly arranged along stem		13
13	Capsule sulcate	Funaria	91
13	Capsule smooth		14
14	Neck of capsule wider than the urn, globose	Splachnum	216
14	Neck of capsule narrower than the urn or not differentiated		15
15	Neck of capsule not differentiated; capsule immersed dehiscent	Physcomitrella	92
15	Neck of capsule differentiated; capsule exerted, dehiscent		16
16	Plants growing on rotten stumps and herbivore dung	Tayloria	217
16	Plants growing on soil or rocks		17
17	Seta short, curved	Funariella	91
17	Seta long, straight		18
18	Capsule asymmetrical and curved		19
18	Capsule symmetrical and straight		20
19	Capsule horizontal to pendulous; peristome without sigmoid teeth	Plagiobryum	256
19	Capsule inclined to horizontal; peristome with sigmoid teeth		20
20	Capsule pendulous		21
20	Capsule erect or inclined		22
21	Laminal cells to 4 times as long as wide; capsule cylindrical to pyriform, rarely ovoid	Bryum	243
21	Laminal cells 5 or more times as long as wide; capsule ovoid to cylindrical	Pohlia	259
22	Exothecial cells elongate, rectangular	Entosthodon	86
22	Exothecial cells more or less isodiametric		23
23	Calyptra mitriform; lid rostellate; spores spinose	Physcomitrium	92
23	Calyptra cucullate; lid convex or plane; spores not spinose	Entosthodon	86

AN. Acrocarpous with alar cells differentiated

1	Lamina finely striate	Hymenoloma	146
1	Lamina not striate		2
2	Nerve with stereids		3
2	Nerve without stereids		4
3	Leaf base concave; leaf margins plane; capsule not strumose	Dicranum	153
3	Leaf base sheathing; leaf margins recurved; capsule strumose	Oncophorus	147
4	Leaves rigid, fragile, mostly broken	Dicranum	153
4	Leaves not as above		5
5	Capsule asymmetrical	Kiaeria	146
5	Capsule symmetrical		6
6	Capsule striate when dry; peristome teeth divergent or spreading; seta to 3,5 mm	Arctoa	143
6	Capsule smooth; peristome teeth not spreading; seta more than 4 mm	Blindia	124

AO. Acrocarpous with laminal cells isodiametric and leaf margin denticulate or dentate, at least near apex or base

1	Leaf margin denticulate at base, with hyaline, reflexed teeth	Eucladium	182
1	Leaves not as above		2
2	Plants glaucous	Saelania	141
2	Plants not glaucous		3
3	Leaves squarrose when moist		4
3	Leaves not squarrose		5

4	Basal cells hyaline, ascending up margin; leaf margin dentate above; plants common, growing on dry, open, calcareous soils	Pleurochaete	190
4	Basal cells not as above; leaf margin sharply serrate; plants very rare, growing on peaty soils	Meesia	218
5	Leaves obovate, very concave	Stegonia	196
5	Leaves oblong, ovate or lingulate to lanceolate, flat	6	
6	Stem with dense, brownish tomentum and usually with gemmae in clusters at the tip	Aulacomnium	269
6	Stem not as above	7	
7	Leaves linear-lanceolate, fragile, notched; margin dentate at apex in young leaves	Didymodon	176
7	Leaves not as above	8	
8	Leaves lanceolate to lingulate, with wide, acute or obtuse apex	9	
8	Leaves ovate to linear-lanceolate, with gradually acuminate apex	11	
9	Laminal cells smooth	Rhabdoweisia	149
9	Laminal cells papillose or mamillose	10	
10	Laminal cells pluripapillose	Leptodontium	186
10	Laminal cells mamillose or unipapillose	Dichodontium	145
11	Leaf margin plane or incurved	12	
11	Leaf margin recurved	17	
12	Marginal cells thick-walled, some longer but not forming distinct border; lid attached to columella after dehiscence	Henediella	184
12	Marginal cells similar to the rest of laminal cells; lid not attached to columella after dehiscence	13	
13	Leaves plicate at base; margin plane, recurved at base	Ptychomitrium	122
13	Leaves not plicate at base; margin plane or incurved	14	
14	Leaves with channelled subula; plants rare	Rhamphidium	141

14	Leaves not subulate; plants rare or common		15
15	Lamina bistratose in the upper part	Timmiella	202
15	Lamina unistratose		16
16	Median cells of lamina smooth on both sides	Oncophorus	147
16	Median cells of lamina mamilllose on ventral side	Timmia	81
17	Leaves crisped when dry		18
17	Leaves flexuose, slightly twisted or straight when dry		21
18	Leaves lanceolate, acuminate; margin unistratose		19
18	Leaves linear-lanceolate or ovate-lanceolate, acute; margin unistratose or bistratose		20
19	Plants pale green; median cells of lamina mamilllose; stem circular in cross section	Bartramia	238
19	Plants dark green; median cells of lamina finely papillose-striate; stem triangular in cross section		Plagiopus 242
20	Leaf base sheathing; laminal cells smooth; capsule smooth, strumose	Oncophorus	147
20	Leaf base not sheathing; laminal cells smooth or mamilllose; capsule striate, strumose or not or smooth and not strumose	Cynodontium	143
21	Leaf margin dentate, at least in the upper half	Bartramia	238
21	Leaf margin denticulate only at apex		22
22	Leaf margin crenulate or papillose; apex denticulate, with hyaline teeth; laminal cells papillose; capsule erect, smooth, not strumose	Bryoerythrophyllum	171
22	Leaf margin not crenulate or papillose; apex slightly denticulate; laminal cells smooth; capsule inclined, striate, strumose	Ceratodon	135

AP. Acrocarpous with isodiametric laminal cells and excurrent nerve

1	Basal cells of leaf hyaline, ascending up margins in a v-shape	Tortella	202
1	Basal cells of leaf hyaline or not, not ascending up margins		2

2	Basal cells of leaf hyaline, forming a well-delimited group on both sides of nerve, in an arch-shaped area		3
2	Basal cells of leaf hyaline or not, transition to cells above gradual		4
3	Peristome teeth spirally twisted; calyptra partially covering the capsule	Syntrichia	196
3	Peristome teeth not twisted or lacking; calyptra covering the whole capsule	Encalypta	82
4	Leaves bistratose or partially bistratose in the upper part		5
4	Leaves unistratose or with bistratose margin		6
5	Lamina partially bistratose; leaf margin bistratose; laminal cells smooth	Schistidium	113
5	Lamina bistratose; laminal cells strongly papillose	Cheilothela	136
6	Laminal cells smooth or mamillose		7
6	Laminal cells papillose		10
7	Leaves obovate-lanceolate; plants growing on rotting wood	Zygodon	234
7	Leaves ovate or ovate-lanceolate; plants growing on soil or rocks		8
8	Nerve excurrent in hyaline or yellowish hair point, rarely in apiculus; capsule, when present, indehiscent	Phascum	189
8	Nerve ending below apex, percurrent, shortly or longly excurrent; capsule, when present, dehiscent		9
9	Nerve ending below apex, percurrent, or shortly excurrent; sterile or fertile plants	Didymodon	176
9	Nerve excurrent in arista; sterile plants	Ceratodon	135
10	Leaf margin revolute or recurved on one or both sides, at least partially		11
10	Leaf margin plane or incurved		20
11	Leaf margin strongly revolute		12
11	Leaf margin recurved on one or both sides		13
12	Leaves lanceolate to ovate-lanceolate, triangular or lingulate	Pseudocrossidium	194
12	Leaves oblong, ovate, elliptical or obovate	Tortula	206

13	Capsule indehiscent		14
13	Capsule dehiscent		16
14	Lid differentiated but persistent	Protobryum	193
14	Lid not differentiated		15
15	Stereids numerous, in 2-3(4) layers; capsule immersed or slightly emergent	Phascum	189
15	Stereids few (2-3), in 1-2 layers; capsule exserted, rarely immersed or emergent	Microbryum	187
16	Peristome with straight teeth, rudimentary or lacking		17
16	Peristome with filiform, spirally twisted teeth		19
17	Capsule globose	Microbryum	187
17	Capsule ellipsoidal or cylindrical		18
18	Perichaetial leaves wider and more concave than stem leaves, sheathing; laminal cells thick-walled		Pottiopsis 192
18	Perichaetial leaves similar in shape to stem leaves, not sheathing; laminal cells with thin or with slightly thickened walls		Pottia 191
19	Cells of axillary hairs hyaline	Barbula	169
19	Basal cell of axillary hairs brown	Didymodon	176
20	Capsule immersed		21
20	Capsule exserted		22
21	Plants to 0,25 cm tall	Aschisma	168
21	Plants more than 0,5 cm tall	Astomum	168
22	Leaves 0,3-0,5 mm long; margin plane, sinuose, notched	Trichostomum	212
22	Leaves usually to 0,3 mm long; margin plane or incurved, entire		23
23	Leaf margin plane or cucullate at apex, occasionally incurved; capsule longly cylindrical or ellipsoidal; peristome teeth straight or twisted, perforated	Trichostomum	212
23	Leaf margin incurved, at least in the upper part, sometimes plane; capsule shortly cylindrical or ovoid; peristome teeth lacking or straight, entire	Weissia	214

AQ. Acrocarpous with isodiametric laminal cells, rounded or obtuse leaf apex, apiculate or not and nerve not excurrent

1	Laminal cell walls \pm sinuose or incrassate with stellate lumen		2
1	Laminal cell walls neither sinuose nor incrassate with stellate lumen		4
2	Laminal cells thick-walled with stellate lumen	Aulacomnium	269
2	Laminal cells with \pm sinuose walls		3
3	Leaves lanceolate or narrowly lingulate; lamina unistratose or partially bistratose above; margin plane or recurved; capsule immersed	Schistidium	113
3	Leaves ovate to lanceolate, concave; lamina unistratose; margin plane or incurved in the upper part, recurved at base; capsule exserted	Grimmia	95
4	Laminal cells smooth or slightly papillose		5
4	Laminal cells papillose or mamilllose		7
5	Leaves ovate, concave	Grimmia	95
5	Leaves lanceolate, usually cucullate		6
6	Plants aquatic, 1-4 cm tall	Barbula	169
6	Plants saxicolous, to 0,5 cm tall	Ptychomitrium	122
7	Leaves ovate-triangular; margin recurved to apex; laminal cells papillose on both sides, with c-shaped papillae	Bryoerythrophyllum	171
7	Characters not as above		8
8	Plants epiphytic		9
8	Plants not epiphytic		10
9	Leaves concave; margin erecto-incurved or involute	Nyholmiella	222
9	Leaves more or less keeled; margin recurved or flat	Orthotrichum	222
10	Leaf margin plane or incurved		11

10	Leaf margin recurved		16
11	Leaves lanceolate to linear	Leptobarbula	186
11	Leaves lingulate		12
12	Plants growing on heavy metal- or humus-rich substrata		13
12	Plants growing on calcareous soils or rocks		14
13	Lamina unistratose; plants growing on heavy metal-rich substrata	Scopelophila	195
13	Lamina bistratose; plants growing on humus-rich substrata	Diphyscium	80
14	Median cells of lamina mamillose, bulging on ventral side	Hyophila	186
14	Median cells of lamina pluripapillose on both sides		15
15	Basal cells of leaves smooth, inflated; annulus of large, vesiculose cells	Gyroweisia	184
15	Basal cells of leaves smooth or slightly papillose, not inflate; annulus of small cells		
		Gymnostomum	182
16	Leaves mostly ovate-lanceolate; axillary hairs of 2-8 cells, with 1-2(3) brownish basal cells		
		Didymodon	176
16	Leaves mostly obovate, lingulate or elliptical; axillary hairs of 4-5 hyaline cells	Tortula	206

AR. Acrocarpous with isodiametric laminal cells, acute, sub-acute or acuminate leaves, margins recurved and nerve not excurrent, or lacking

1	Nerve lacking	Hedwigia	236
1	Nerve present		2
2	Basal cells of leaf sinuose	Grimmia	95
2	Basal cells of leaf not sinuose		3
3	Upper cells of leaf mamillose on both sides	Cynodontium	143
3	Upper cells of leaf smooth or papillose on one or both sides		4
4	Laminal cells with high papillae, to 12 µm high	Triquetrella	214

4	Laminal cells smooth or with low papillae		5
5	Laminal cells smooth		6
5	Laminal cells papillose or mamilllose		7
6	Leaves acute or acuminate; urn cylindrical, striate, strumose	Ceratodon	135
6	Leaves longly acuminate; urn ellipsoidal, not striate or strumose	Dicranoweisia	146
7	Leaves ovate, elliptical or oblong	Tortula	206
7	Leaves linear to ovate-lanceolate	Didymodon	176

AS. Acrocarpous with isodiametric laminal cells; acute, sub-acute or acuminate leaves, margin plane or recurved at base and nerve not excurrent

1	Leaf margin entire		2
1	Leaf margin crenulate or papillose-crenulate		9
2	Laminal cells smooth		3
2	Laminal cells papillose		6
3	Peristome double; laminal cells hexagonal, 11-24 μm wide	Zygodon	234
3	Peristome single or lacking; laminal cells quadrate or rounded, 6-16 μm wide		4
4	Leaves widest at or above middle; plant growing on mineral-rich substrata	Scopelophila	195
4	Leaves widest at base plant not growing on mineral-rich substrata		5
5	Plants to 5 cm high, growing on volcanic rocks; calyptra plicate, covering at least half of capsule; seta straight	Ptychomitrium	122
5	Plants to 0,5 cm high, growing on basic soils or acidic rocks; calyptra smooth, covering only the lid; seta flexuose or cygneous when moist	Campylostelium	122
6	Plants rusty red; laminal cells with c-shaped papillae	Bryoerythrophyllum	171
6	Characters not as above		7
7	Laminal cells incrassate, with stellate lumen	Aulacomnium	269

7	Lamina cells not as above	8	
8	Lamina cells rounded or hexagonal, strongly papillose; gemmae fusiform, pluricellular	Zygodon	234
8	Lamina cells quadrate or rounded, papillose and finely striate; gemmae lacking	Amphidium	142
9	Leaf margin irregularly notched	Didymodon	176
9	Leaf margin not notched	10	
10	Leaves carinate	11	
10	Leaves not carinate	12	
11	Stem without central strand; nerve with dorsal and ventral stereids; lid attached to columella after ripening of spores	Hymenostylium	185
11	Stem with central strand; nerve with only dorsal stereids; lid not attached to columella after ripening of spores	Anoetangium	167
12	Plants medium-sized more than 0,5 cm tall	Trichostomum	212
12	Plants minute, to 0,5 cm tall	13	
13	Leaves obovate; lamina cells 12-20 μm	Chenia	186
13	Leaves lanceolate; lamina cells 5-6 μm	Leptobarbula	186

AT. Acrocarpous with elongate lamina cells; acuminate or subulate leaves and apex consisting largely or entirely of nerve

1	Lamina cells mamilllose	2	
1	Lamina cells smooth	3	
2	Leaves ovate-lanceolate; margin recurved in lower half	Anacolia	237
2	Leaves linear-lanceolate to lanceolate; margin plane	Bartramia	238
3	Sheathing base of leaves as long as subula	Trematodon	142
3	Sheathing base of leaves lacking or shorter than subula	4	
4	Capsule indehiscent	5	

4	Capsule dehiscent	6	
5	Capsule exerted, neck distinct, 1/3-1/2 of the capsule length	Bruchia	141
5	Capsule immersed, neck indistinct	Pleuridium	139
6	Nerve of homogeneous cells in cross section	Seligeria	125
6	Nerve of heterogeneous cells in cross section	7	
7	Peristome teeth divided to base	Ditrichum	136
7	Peristome teeth divided to middle	Dicranella	150

AU. Acrocarpous with elongate laminal cells; obtuse to acuminate leaves and nerve percurrent to excurrent, short or lacking

1	Protonema persistent; plants minute	Ephemerum	84
1	Protonema not persistent; plants small to robust	2	
2	Leaves longitudinally plicate	Breutelia	239
2	Leaves not plicate or plicate only near base	3	
3	Laminal cells mamilllose; leaf margin dentate or serrate	4	
3	Laminal cells smooth or mamilllose; leaf margin entire or dentate in the upper part	5	
4	Leaves narrowly lanceolate or linear-lanceolate, with sheathing base; margin with single teeth	Bartramia	238
4	Leaves lanceolate to ovate-lanceolate, without sheathing base; margin with single or geminate teeth	Philonotis	240
5	Laminal cells quadrate to rectangular	6	
5	Laminal cells narrowly hexagonal, rhomboidal or linear	11	
6	Leaf apex obtuse or rounded; leaves squarrose	Dichodontium	145
6	Leaf apex acute or acuminate; leaves not squarrose	7	
7	Leaves imbricate, arranged in 5 rows, acuminate; nerve excurrent	Conostomum	239

7	Leaves erect, patent to flexuose, or if imbricate then not arranged in 5 rows, apiculate; nerve percurrent to excurrent	8
8	Median cells of lamina quadrate to rectangular, thick-walled; capsule globose, less than 1 mm	Catoscopium 237
8	Median cells of lamina rectangular, thin-walled; capsule cylindrical or ovoid, more than 1 mm	9
9	Leaf margin sharply serrate	Philonotis 240
9	Leaf margin entire	10
10	Capsule dehiscent, exerted	Dicranella 150
10	Capsule indehiscent, immersed	Pseudephemerum 140
11	Leaves imbricate	12
11	Leaves erecto-patent to spreading, rarely imbricate	15
12	Leaves denticulate at apex in the upper part; peristome single	13
12	Leaves entire or only slightly denticulate at apex; peristome double	14
13	Laminal cells 7-20 μm wide; exostome teeth papillose, endostome lacking or rudimentary	Mielichhoferia 258
13	Laminal cells 7-8 μm wide; exostome lacking, endostome segments smooth or slightly papillose	Schizymenium 264
14	Median cells of lamina hexagonal to rhomboidal, 16-24 μm wide	Plagiobryum 256
14	Median cells of lamina vermicular or rhomboidal, less than 10 μm wide	Anomobryum 243
15	Median cells of lamina hexagonal or rhomboidal-hexagonal; nerve percurrent or excurrent in long or short point	Bryum 243
15	Median cells of lamina hexagonal, narrow to linear; nerve extending to near apex, rarely excurrent	16
16	Capsule inclined to pendulous; plants common	Pohlia 259
16	Capsule straight; plants rare	Orthodontium 271

PA. Pleurocarpous with nerve long and short laminal cells, at least at margin

1	Leaf apex rounded	Leptodon	347
1	Leaf apex obtuse, acute or acuminate		2
2	Branch leaves strongly dentate; plants dendroid	Thamnobryum	347
2	Branch leaves entire or denticulate; plants pinnately or irregularly branched		3
3	Plants pinnately branched		4
3	Plants irregularly branched		5
4	Stem 1-pinnate	Abietinella	293
4	Stem 2-3-pinnate	Thuidium	294
5	Laminal cells papillose or prorate, at least above		6
5	Laminal cells smooth		11
6	Nerve extending to 1/2-2/3 way up leaf	Heterocladium	326
6	Nerve nearly reaching apex		7
7	Leaf margin strongly dentate from base to apex	Claopodium	351
7	Leaf margin entire or sparsely dentate at apex		8
8	Alar cells not differentiated	Anomodon	350
8	Alar cells differentiated		9
9	Laminal cells prorate	Lescuraea	289
9	Laminal cells with 1 central papilla		10
10	Laminal cells with 1 central papilla on each side; leaf apical cells 15-35 μm long	Lescuraea	289
10	Laminal cells with one central papilla on dorsal side; leaf apical cells 10-12 μm long	Leskea	292
11	Plants small or slender; leaves lanceolate to ovate-lanceolate, longly acuminate, plicate at base; capsule exerted	Pseudoleskeella	292
11	Plants medium-sized; leaves lanceolate to ovate, with obtuse or shortly acuminate apex, not plicate at base; capsule immersed	Cryphaea	341

PB. Pleurocarpous with longitudinally plicate leaves, nerve long and laminal cells elongate

1	Plants dendroid	Climacium	275
1	Plants pinnately or irregularly branched		2
2	Branch leaves with reflexed teeth at apex	Antitrichia	342
2	Branch leaves without reflexed teeth at apex		3
3	Stem with paraphyllia		4
3	Stem without paraphyllia		6
4	Alar cells large, inflated, well differentiated; plants pinnately or irregularly branched	Palustriella	283
4	Alar cells scarcely differentiated; plants irregularly branched		5
5	Plants robust; leaf margin dentate; paraphyllia branched	Hylocomiastrum	327
5	Plants small to robust; leaf margin entire or denticulate at apex; paraphyllia entire or shortly branched		
		Lescuraea	289
6	Stem leaves straight or only slightly falciform		7
6	Stem leaves strongly falciform		12
7	Plants very small and slender	Pseudoleskeella	292
7	Plants medium-sized to large		8
8	Stem with reddish or brownish tomentum	Tomentypnum	285
8	Stem without tomentum		9
9	Leaves triangular, gradually tapering into long, fine point	Homalothecium	306
9	Leaves lanceolate to ovate, gradually or abruptly tapering into long or short point		10
10	Stem leaves ovate-lanceolate, gradually acuminate; lid conical	Brachythecium	295
10	Stem leaves widely ovate to triangular, sometimes cordate at base, usually abruptly acuminate; lid longly rostrate		11

- | | | | |
|----|--|-------------------------|-----|
| 11 | Stem leaves acuminate in a narrow, long point; nerve to 60-70% way up leaf; alar cells mostly quadrate | Plasteurhynchium | 309 |
| 11 | Stem leaves acute or acuminate in a short, wide point; nerve to 90% way up leaf; alar cells mostly rectangular | Eurhynchium | 304 |
| 12 | Stem with hyaloderm; alar cells inflated, hyaline | Sanionia | 285 |
| 12 | Stem without hyaloderm; alar cells not differentiated | Hamatocaulis | 287 |

PC. Pleurocarpous with squarrose or falciform leaves, long nerve and laminal cells elongate

- | | | | |
|---|---|------------------------|-----|
| 1 | Leaves carinate | Dichelyma | 273 |
| 1 | Leaves not carinate | | 2 |
| 2 | Leaves transversely undulate | Rhytidium | 331 |
| 2 | Leaves not undulate or weakly so | | 3 |
| 3 | Leaf apex acute or obtuse | Hygrohypnum | 280 |
| 3 | Leaf apex acuminate | | 4 |
| 4 | Stem with paraphyllia | | 5 |
| 4 | Stem without paraphyllia | | 6 |
| 5 | Alar cells large, inflated, well differentiated | Cratoneuron | 279 |
| 5 | Alar cells hardly differentiated | Lescuraea | 289 |
| 6 | Leaf acumen channelled | Campyliadelphus | 277 |
| 6 | Leaf acumen not channelled | | 7 |
| 7 | Leaf margin denticulate | Warnstorfia | 288 |
| 7 | Leaf margin entire or nearly so | | 8 |
| 8 | Group of alar cells reaching nerve or nearly so | Drepanocladus | 279 |
| 8 | Group of alar cells small | Scorpidium | 314 |

PD. Pleurocarpous with long nerve, elongate laminal cells and rounded, obtuse or obtuse and apiculate leaf apex

1	Nerve more than 35 µm wide	Hygroamblystegium	280
1	Nerve less than 35 µm wide		2
2	Group of alar cells well differentiated		3
2	Group of alar cells not or hardly differentiated		6
3	Alar cells small, opaque	Isothecium	348
3	Alar cells large, inflated, hyaline		4
4	Leaves ovate-cordate; nerve reaching apex or nearly so	Calliergon	285
4	Leaves oblong or ovate; nerved to 3/4 way up leaf		5
5	Leaves apiculate; plants usually reddish	Warnstorfia	288
5	Leaves not apiculate; plants never reddish	Straminergon	288
6	Plants aquatic		7
6	Plants not aquatic		8
7	Leaf margin entire	Hygrohypnum	280
7	Leaf margin dentate	Platyhypnidium	309
8	Stem and branches not julaceous	Rhynchostegium	311
8	Stem and branches julaceous		9
9	Plants complanate, pinnately branched	Pseudoscleropodium	310
9	Plants not complanate, irregularly branched	Scleropodium	313

PE. Pleurocarpous with long nerve, elongate laminal cells and acute or acuminate leaf apex

1	Branch leaves with reflexed teeth at apex	Antitrichia	342
1	Branch leaves without reflexed teeth at apex		2

2	Leaf margin dentate to ciliate to lacinate	Fabronia	315
2	Leaf margin entire to denticulate		3
3	Median cells 2-6 times as long as wide		4
3	Median cells more than 6 times as long as wide		12
4	Alar cells hyaline, inflated, forming a distinct group	Cratoneuron	279
4	Alar cells forming a poorly-differentiated group		5
5	Median cells of lamina oblong, thick-walled		6
5	Median cells of lamina rhomboidal, thin-walled		7
6	Stem with paraphyllia	Lescuraea	289
6	Stem without paraphyllia	Pseudoleskeella	292
7	Leaf margin with reflexed teeth at base; plants small	Conardia	278
7	Leaf margin without reflexed teeth at base; plants small to medium-sized		8
8	Branch leaves different from stem leaves	Scorpiurium	314
8	Branch leaves similar to stem leaves		9
9	Nerve ending in a projection at back of branch leaves		10
9	Nerve not ending in a projection at back of branch leaves		11
10	Plants minute, to 3 cm; leaves 0,6-0,85x0,25-0,3 mm	Eurhynchium	304
10	Plants medium sized, more than 4 cm long; leaves 1-1,5x0,8-1 mm	Scorpiurium	314
11	Nerve to 3/4 way up leaf, 15-35 µm wide at base	Amblystegium	276
11	Nerve ending near apex, conspicuous, 25-75 µm wide at base	Hygroamblystegium	280
12	Alar cells inflated, hyaline		13
12	Alar cells not inflated or hyaline		17
13	Leaves acute		14
13	Leaves acuminate		15

14	Median cells of lamina 6-10 µm wide; leaf margin denticulate; plant large	Brachythecium	295
14	Median cells of lamina 5-6 µm wide; leaf margin entire; plant medium-sized	Hygrohypnum	280
15	Leaves to 1,3 mm long	Cratoneuron	279
15	Leaves more than 2 mm long		16
16	Leaf margin entire	Drepanocladus	279
16	Leaf margin denticulate	Warnstorfia	288
17	Alar cells small, opaque, thick-walled; branches usually curved	Isothecium	348
17	Alar cells not as above; branches straight		18
18	Leaf acumen channelled	Campyliadelphus	277
18	Leaf acumen not channelled or leaves acute		19
19	Stem with paraphyllia		20
19	Stem without paraphyllia		21
20	Nerve ending in a projection at back of branch leaves	Eurhynchium	304
20	Nerve not ending in a projection at back of branch leaves	Lescuraea	289
21	Leaves spreading or sub-complanate	Leptodictyum	283
21	Leaves not spreading or sub-complanate		22
22	Stem leaves abruptly acuminate in long, fine point	Cirriphyllum	302
22	Stem leaves not as above		23
23	Leaves linear-lanceolate or oblong-lanceolate; plants small, slender; lid rostrate	Rhynchostegiella	310
23	Leaves lanceolate, ovate or triangular; plants small to robust; lid rostrate or conical		24
24	Nerve ending in a projection at back of branch leaves		25
24	Nerve not ending in a projection at back of branch leaves		27
25	Stem leaves lanceolate to ovate-lanceolate, not cordate at base; lid conical	Brachythecium	295
25	Stem leaves ovate or triangular, usually cordate-triangular; lid rostrate		26

26	Stem leaves very concave, suddenly narrowed in a long, sometimes twisted point	Cirriphyllum	302
26	Stem leaves not concave, acuminate	Eurhynchium	304
27	Leaves ovate, lanceolate or triangular; alar cells \pm differentiated; lid conical	Brachythecium	295
27	Leaves ovate to ovate-lanceolate; alar cells not differentiated; lid rostrate		28
28	Plants robust, aquatic; leaf margin denticulate to serrate from base to apex	Platyhypnidium	309
28	Plants medium-sized, not aquatic; leaf margin entire or denticulate	Rhynchostegium	311

PF. Pleurocarpous with nerve short or lacking, short laminal cells at least at margin

1	Leaves longitudinally plicate	Leucodon	343
1	Leaves not plicate or weakly so		2
2	Laminal cells papillose; plants small to medium-sized		3
2	Laminal cells smooth, occasionally prorate; plants small		5
3	Plants medium-sized; branches curved and secund; leaves imbricate	Nogopterium	343
3	Plants small; branches straight; leaves imbricate or not		4
4	Stem leaves very concave, imbricate; plants julaceous	Myurella	334
4	Stem leaves flat or nearly so, patent to squarrose; plants not julaceous	Heterocladium	326
5	Branch leaves ovate, to twice as long as wide; leaf nerve extending to 1/2 way up leaf		
		Pseudoleskeella	292
5	Branch leaves ovate-lanceolate, more than twice as long as wide; leaf nerve extending to 1/6-1/5 way up leaf or nerve lacking		
		Habrodon	326

PG. Pleurocarpous with nerve short or lacking, elongate laminal cells, rounded, obtuse or obtuse and apiculate leaf apex

1	Laminal cells papillose on dorsal side; plants slender	Pterigynandrum	327
1	Laminal cells smooth on dorsal side; plants robust		2

2	Stem and branches cuspidate	Calliergonella	315
2	Stem and branches not distinctly cuspidate		3
3	Plants pinnately branched		4
3	Plants irregularly branched		5
4	Stem reddish; alar cells orange to brownish	Pleurozium	330
4	Stem green, yellow or light brown; alar cells green or hyaline	Entodon	339
5	Leaves longly decurrent; plants not aquatic	Plagiothecium	335
5	Leaves not decurrent or slightly so; plants aquatic		6
6	Plant robust, turgid, growing on waterlogged soils	Scorpidium	287
6	Plants small or medium-sized, not turgid, growing on flushed rocks or in waterfalls	Hygrohypnum	280

PH. Pleurocarpous with falciform or squarrose leaves, nerve short or lacking, elongate laminal cells, acute or acuminate apex

1	Leaves squarrose; acumen ± channelled		2
1	Leaves not squarrose; acumen flat		4
2	Stem reddish	Rhytidiadelphus	330
2	Stem not as above		3
3	Plants medium-sized to robust; leaves with long point; margin entire or finely denticulate; alar cells inflated, well differentiated	Campylium	278
3	Plants small; leaves with long or short point; margin dentate; alar cells poorly differentiated	Campylophyllum	317
4	Leaf apex acute; plants aquatic		5
4	Leaf apex acuminate; plants not aquatic		6
5	Plants robust, with turgid stem and branches, growing on waterlogged soils	Scorpidium	287

5	Plants small to medium-sized, stem and branches not turgid; growing in waterfalls or on flushed rocks	Hygrohypnum	280
6	Leaves widely and shortly acuminate	Calliergonella	315
6	Leaves narrowly and longly acuminate		7
7	Stem reddish; plants irregularly branched	Rhytidiadelphus	330
7	Stem not reddish; plants irregularly or pinnately branched		8
8	Stem leaves longitudinally plicate; plants pinnately branched	Ptilium	324
8	Stem leaves not plicate or weakly so; plants pinnately branched or not		9
9	Leaves cordate at base; branch leaves different from stem leaves; plants pinnately branched	Ctenidium	317
9	Leaves not cordate at base; branch leaves similar to stem leaves; plants irregularly or pinnately branched	Hypnum	318

PI. Pleurocarpous with straight or slightly falciform or squarrose leaves, nerve single short, long and double or lacking, elongate laminal cells, acute or acuminate apex

1	Laminal cells papillose on dorsal side		2
1	Laminal cells smooth		4
2	Plants slender	Pterigynandrum	327
2	Plants robust		3
3	Stem regularly 2-3-pinnate; nerve double, to 1/2 way up leaf	Hylocomium	329
3	Stem irregularly branched; nerve double, to 3/4 way up leaf	Rhytidiadelphus	330
4	Plants aquatic; leaves carinate or not		5
4	Plants not aquatic		6
5	Leaves not carinate; stem leaves cordate-triangular, rapidly narrowed to apex	Hyocomium	318
5	Leaves carinate or not; stem leaves not as above	Fontinalis	274

6	Laminal cells 2-5 times as long as wide; plants very small		7
6	Laminal cells more than 5 times as long as wide; plants small to robust		9
7	Leaf margin entire	Amblystegium	276
7	Leaf margin denticulate, dentate or ciliate		8
8	Leaf margin denticulate	Platydictya	338
8	Leaf margin dentate or ciliate	Fabronia	315
9	Leaves spreading or reflexed	Campylophyllum	317
9	Leaves erect to patent		10
10	Stem with paraphyllia		11
10	Stem without paraphyllia		12
11	Stem leaves strongly plicate; branch leaves with single nerve	Hylocomiastrum	327
11	Stem leaves not or weakly plicate; branch leaves with double nerve	Loeskeobryum	329
12	Alar cells not differentiated or only slightly so		13
12	Alar cells well differentiated		14
13	Leaves longitudinally plicate or leaves concave	Orthothecium	334
13	Leaves not longitudinally plicate or concave	Isopterygiopsis	332
14	Alar cells inflated		15
14	Alar cells not inflated		17
15	Leaf margin denticulate from base to apex	Herzogiella	332
15	Leaf margin entire or slightly denticulate in the upper part		16
16	Stem with hyaloderm	Calliergonella	315
16	Stem without hyaloderm	Sematophyllum	341
17	Alar cells small, opaque; branches curved	Isothecium	348
17	Alar cells not as above; branches straight		18

18	Alar group excavate, of thick-walled cells	Hypnum	318
18	Alar group not excavate, of thin-walled cells		19
19	Leaf margin denticulate from base to apex	Herzogiella	332
19	Leaf margin entire or denticulate only at apex		20
20	Stem with central strand; plants corticolous	Pylaisia	324
20	Stem without central strand; plants corticolous or saxicolous		21
21	Leaf margin narrowly recurved; plants usually with propaguliferous axillary branchlets; corticolous	Platygyrium	340
21	Leaf margin plane; plants usually without propaguliferous axillary branchlets; usually saxicolous	Homomallium	318

Cl. Sphagnopsida

Protonema thalloid. Seta absent; capsule globose, exserted and elevated by a pseudopodium at maturity; peristome absent. In dry conditions, capsule walls shrink building up an internal pressure that blows off the lid and ejects the spores into the air.

O. Sphagnales

Fam. Sphagnaceae

Sphagnum L.

Plants small to robust, green, yellowish, brownish or reddish, growing in wet areas, by streams, around mountain lakes or in sites where seepage water is available. Stem usually erect and branched, with a cortex of 1 or more layers of large, empty, hyaline cells, the hyaloderm. Rhizoids lacking. Branches differentiated into spreading branches and pendent branches, in fascicles of (1-)2-7 around the stem and crowded at the stem tip forming the capitulum, hyaloderm 1-layered. Leaves nerveless, consisting of elongated, narrow green cells in a network enclosing large, inflated, empty hyaline cells, usually with a border of 1-9 rows of elongated cells, dead at maturity. Hyaline cells may be septate, reinforced by fibrils or perforated by pores (fig. 2, 7). The exposure of green cells on the dorsal or ventral surface and their shape in cross section provide important taxonomic characters. Usually, stem and branch leaves vary in size and shape.

- 1 Hyaloderm of stem and branches with spiral fibrils; branch leaves with blunt, cucullate apices, rough at back due to resorption of hyaline cells; plants robust (fig. 2, 1-12) **Sect. Sphagnum** pg. 58
- 1 Hyaloderm of stem and branches without spiral fibrils; branch leaves with acute or truncate apices, never cucullate or rough at back; plants robust or not **2**
- 2 Plants with simple stem or with 1-2 short branches per fascicle; capitula scarcely developed (fig. 2, 13-15) **Sect. Hemitheca** pg. 61
- 2 Plants with well-developed fascicles, rarely of fewer than 3 branches; capitula well developed, although in some species can be concealed by upper branches **3**
- 3 Green cells of branch leaves triangular or trapezoid in section, exposed exclusively or more broadly on ventral surface (fig. 3, 1-17) **Sect. Acutifolia** pg. 61

- 3 Green cells of branch leaves various, but if triangular or trapezoid in section then exposed exclusively or more broadly on dorsal surface **4**
- 4 Branch leaves broadly truncate, margin denticulate; green cells of branch leaves enclosed by hyaline cells; branch cortical cells all retort (fig. 4, 1-5) **Sect. Rigida** pg. 64
- 4 Branch leaves acute or narrowly truncate, margin entire except across the apex; green cells of branch leaves exposed equally on both surfaces or more broadly on dorsal surface; branch cortical cells of 2 kinds, some flat and usually not porose, others retort cells **5**
- 5 Stem leaves large, lingulate, never fibrillose; border not expanded below; pores in middle of branch leaves 12-40 μm , numerous and conspicuous (fig. 4, 6-11) **Sect. Squarrosa** pg. 64
- 5 Stem leaves various, if lingulate and without fibrils, then with borders expanded below; pores of branch leaves less than 12 μm **6**
- 6 Green cells of branch leaves barrel-shaped in section, exposed equally or almost equally on both surfaces (fig. 4, 12-18) **Sect. Subsecunda** pg. 65
- 6 Green cells of branch leaves triangular or trapezoid in section, broadly exposed on dorsal surface (fig. 5, 1-14) **Sect. Cuspidata** pg. 66

Section Sphagnum

- 1 Inside walls of hyaline cells papillose (fig. 2, 9-10) **S. papillosum** Lindb.
Plants robust, ochre-brown; divergent branches short, blunt, not tapering. Stem leaves lingulate or spatulate; hyaline cells 0-1-septate, fibrils near leaf apex scarce or absent. Branch leaves imbricate to spreading, ovate to widely ovate; green cells elliptical to trapezoidal in section, with thickened walls. Forms hummocks or dense turfs in open peatlands, wet heath lands and peaty grasslands, in the northern and central part of the Peninsula. Esp, Prt, And.
- 1 Inside walls of hyaline cells smooth **2**
- 2 Green cells of branch leaves completely enclosed by hyaline cells; plants red or purple **3**

- 2 Green cells of branch leaves exposed on one or both surfaces; plants green, yellowish, brownish or orange but never red 4
- 3 Hyaline cells at base of divergent branch leaves with large pores on dorsal side, mostly filling half or more of cell width (fig. 2, 11) **S. medium** Limpr.
Plants robust; capitulum purple-red; divergent branches thick-cylindrical, short, blunt-tapering. Stem leaves rectangular; hyaline cells usually septate, fibrils near leaf apex scarce or absent. Branch leaves spreading, ovate to elliptical-ovate; green cells narrowly elliptical to circular-elliptical in section, with thickened walls. Forms hummocks or dense turfs in open sites, ombrotrophic mires, by streams, lakes and wet heath lands. Rare, in the Central Pyrenees, the Cantabrian Mountains and the Leon Mountains. Esp.
- 3 Hyaline cells at base of divergent branch leaves with rather small pores on dorsal side, mostly filling out less than half of cell width **S. divinum** Flatberg & Hassel
Plants robust; capitulum varyingly purple-red to wine-red, mottled green and reddish or sometimes wholly green in shaded habitats; divergent branches slender-cylindrical, tapering. Stem leaves rectangular-spathulate; hyaline cells usually not septate, with or without fibrils near leaf apex. Branch leaves imbricate to spreading, broadly ovate to round-ovate; green cells well enclosed on both surfaces, widely elliptical to round-elliptical in section, with thin walls. Grows in peaty woodlands and at mire margins. Rare, in the western Pyrenees. Esp.
- 4 Green cells of branch leaves elliptical in section, exposed on both surfaces and with thickened outer walls (fig. 2, 12) **S. centrale** C.O.E.Jensen
Plants robust, green yellowish brown; divergent branches tapering. Stem leaves spathulate; hyaline cells not septate, fibrils near leaf apex scarce or absent. Branch leaves imbricate to spreading, ovate. Rare in the Central Pyrenees, the Iberian Range and Serra da Estrela. Esp, Prt (Extinct), And.
- 4 Green cells of branch leaves triangular, oval or trapezoidal in section, exposed exclusively or more broadly on ventral surface 5
- 5 Green cells of branch leaves isosceles-triangular in section, with thin walls, the ventral side \pm convex and the lateral sides straight (fig. 2, 1-8) **S. palustre** L.
Plants robust, light-green or green yellowish; divergent branches long tapering. Stem leaves lingulate; hyaline cells usually fibrillose, not septate. Branch leaves imbricate to spreading, ovate to widely ovate. Forms lax turfs and low hummocks by streams, mountains lakes, pools and in peaty sites, in woodlands as well as in open places, distributed throughout the northern half of the Peninsula. Esp, Prt, And.
- 5 Green cells of branch leaves elliptical or trapezoidal in section, with thickened walls, especially on the ventral side, and the lateral sides convex (fig. 2, 9-10) **S. papillosum** Lindb.

Plants robust, ochre-brown; divergent branches short, blunt, not tapering. Stem leaves lingulate or spatulate; hyaline cells 0-1-septate, fibrils near leaf apex scarce or absent. Branch leaves imbricate to spreading, ovate to widely ovate; green cells with inside walls usually papillose, but in some plants papillae indistinct or wholly lacking. Forms hummocks or dense turfs in open peatlands, wet heath lands and peaty grasslands, in the northern and central part of the Peninsula. Esp, Prt, And.

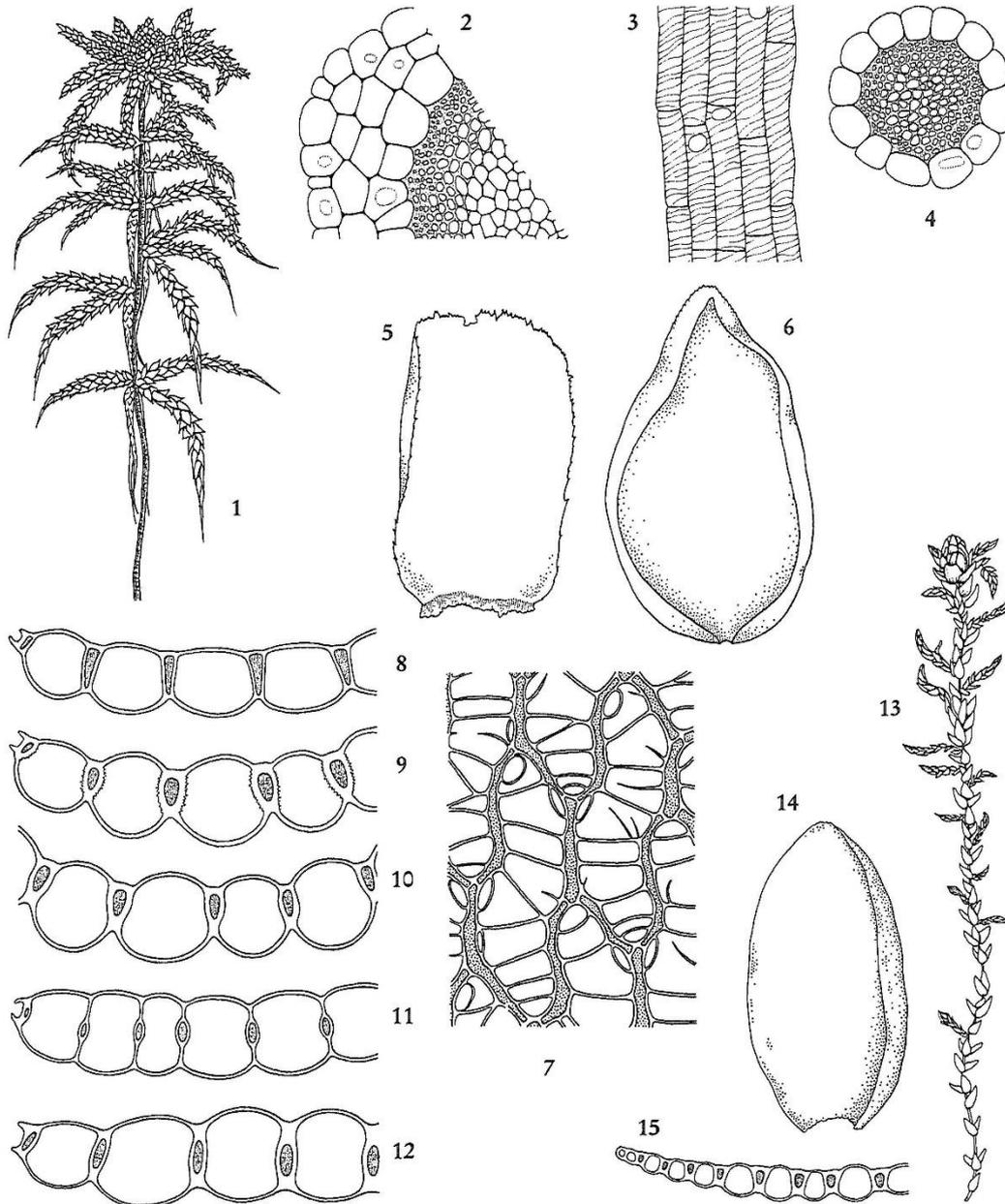


FIGURE 2. **1-8, *Sphagnum palustre***: 1, habit; 2, stem section; 3, branch cortex, surface view; 4, branch section; 5, stem leaf; 6, branch leaf; 7, cells of branch leaf, dorsal side; 8, branch leaf section. **9-10, *S. papillosum***, branch leaf sections. **11, *S. medium***, branch leaf section. **12, *S. centrale***, branch leaf section. **13-15, *S. pylaesii***: 13, habit; 14, stem leaf; 15, branch leaf section. **1, 13 (x2); 5, 6, 14 (x20); 2, 3, 4 (x90); 7, 8, 9, 10, 11, 12, 15 (x275).**

Section Hemitheca

Plants medium-sized but often much elongated, purple, brown-reddish to almost black. Stem simple or poorly branched, cortical cells well differentiated in 1-3 layers. Stem leaves larger and similar to branch leaves. Green cells of branch leaves trapezoid in section and exposed more broadly on ventral surface or barrel-shaped in section and exposed \pm equally on both surfaces (fig. 2, 13-15) **S. pylaesii** Brid.

This species occurs in two habitat forms: Plants prostrate, elongated, poorly branched and brownish-red, which grow on flat granitic rocks that seep throughout the year and plants also prostrate, smaller, almost black, with short branches, which grow in very moist depressions in bogs, in the northwesternmost part of the Peninsula where it is rather locally abundant. Very rare. Esp.

Section Acutifolia

- 1 Branch leaves denticulate along margin (fig. 3, 5-6) **S. molle** Sull.
Plants slender to medium-sized, whitish, pale-green or yellowish sometimes with flecks of red or pink. Fascicles closely set, spreading branches pointing upwards. Stem leaves 1,5-2,0 mm long. In low but dense cushions or extensive turfs on wet slopes and acidic rocks in open places, mainly on northwestern coastal areas. Esp, Prt, And.
- 1 Branch leaves entire, except across the apex **2**
- 2 Plants brown, with dark brown stem (fig. 3, 7) **S. fuscum** (Schimp.) H.Klinggr.
Plants slender. Stem leaves lingulate to slightly spatulate; hyaline cells without fibrils, septa numerous. Forms dense hummocks at the base of mountain pines. Very rare in the Central Pyrenees. Esp.
- 2 Plants reddish, green or green variegated with red, orange, yellow or brown, but not the whole plant brown **3**
- 3 At least some fascicles with 3 spreading branches; branch leaves strongly 5-ranked (fig. 3, 8) **S. quinquefarium** (Braithw.) Warnst.
Plants delicate to medium-sized, green variegated with red. Forms loose patches or hummocks in acidic rocky sites under trees and on shady and seeping slopes in wet forests, in the Pyrenees and the Cantabrian Mountains. Esp, And.
- 3 Fascicles with 2 spreading branches; branch leaves 5-ranked or not **4**
- 4 Stem leaves fimbriate more than 1/2 across the apex; plants green, never with red coloration **5**

- 4 Stem leaves not fimbriate or if fimbriate then less than 1/2 across the apex; plants with red coloration or not 6

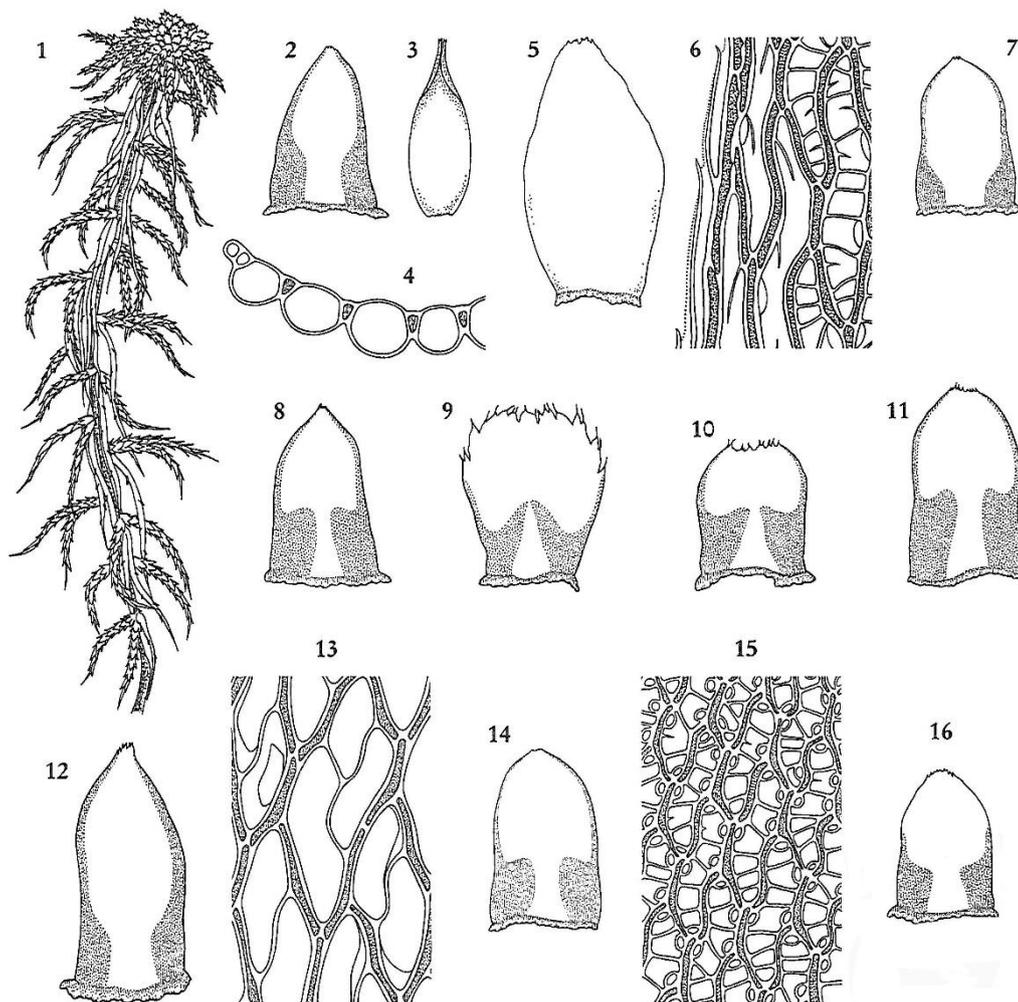


FIGURE 3. 1-4, *Sphagnum capillifolium*: 1, habit; 2, stem leaf; 3, branch leaf; 4, branch leaf section. 5-6, *S. molle*: 5, stem leaf; 6, branch leaf margin. 7, *S. fuscum*, stem leaf. 8, *S. quinquefarium*, stem leaf. 9, *S. fimbriatum*, stem leaf. 10, *S. girgensohnii*, stem leaf. 11, *S. russowii*, stem leaf. 12-13, *S. subnitens*: 12, stem leaf; 13, cells of stem leaf, dorsal side. 14-15, *S. warnstorffii*: 14, stem leaf; 15, cells of branch leaf, dorsal side. 16, *S. rubellum*, stem leaf. 1 (x2); 2, 3, 5, 7, 8, 9, 10, 11, 12, 14, 16 (x20); 4, 6, 13, 15 (x275).

- 5 Stem leaves fimbriate around the whole upper part (fig. 3, 9) ***S. fimbriatum*** Wilson
 Plants medium-sized, tall and thin. Terminal stem bud large. Forms loose patches on acidic substrata by streams and on seeping rocks in wet forests. Scattered in the Cantabrian Mountains, rare in the Pyrenees and in the Iberian Range. Esp, And.
- 5 Stem leaves fimbriate only across the apex (fig. 3, 10) ***S. girgensohnii*** Russow

Plants medium-sized to robust. Terminal stem bud large. Stem leaves with a triangular group of expanded hyaline cells at the middle of the base. Forms turfs in wet grasslands, wooded, shady sites, by streams and mountain lakes and on acidic rocks and slopes, in the Pyrenees and in some northern and western localities. Esp, Prt, And.

- 6 Stem leaves with broadly rounded and erose apex, hyaline cells near the apex short and rhomboidal; cells of stem cortex with pores (staining required) (fig. 3, 11) **S. russowii** Warnst.

Plants delicate to medium-sized, green with red or pink flecks. Terminal stem bud inconspicuous. Hyaline apical cells of branch leaves with 1-3 circular pores per cell, 5-18 μm on ventral side. Forms loose turfs or hummocks in peaty heath lands, wet grasslands, wooded sites and by streams and mountain lakes, in the northern half of the Peninsula. Esp, Prt, And.

- 6 Stem leaves with narrowly rounded to sub-acute apex, not erose, hyaline cells near the apex elongated; cells of stem cortex without pores **7**

- 7 Stem leaf apex acute and cuspidate due to inrolled margins; hyaline cells of stem leaves mostly without fibrils; plants shiny when dry (fig. 3, 12-13) **S. subnitens** Russow & Warnst.

Plants medium-sized to relatively robust, green variegated with yellow, brown or red. Stem leaves triangular to triangular-lingulate, 1,3-2,0 mm long; hyaline cells 1-4 septate. Forms turfs or hummocks in bogs, peaty heath lands, wet grasslands, by streams and mountain lakes and on damp, acidic soils and slopes. Widespread in suitable localities in the Peninsula. Esp, Prt, And.

- 7 Stem leaf apex obtuse or acute; hyaline cells of stem leaves mostly fibrillose; plants not particularly shiny when dry **8**

- 8 Pores on dorsal side of branch leaves near apex 3-6 μm , thick-ringed (fig. 3, 14-15)

S. warnstorffii Russow

Plants small, green or brownish with red coloration or the whole plant red. Branch leaves 5-ranked, with squarrose apices when dry. Forms patches in wet or waterlogged acidic sites, grasslands and by streams and mountain lakes of the Pyrenees. Esp, And.

- 8 Pores on dorsal side of branch leaves near apex 5-20 μm , not thick-ringed **9**

- 9 Stem leaves 1,2-1,5 mm long, triangular to lingulate-triangular; stem leaf hyaline cells 75-100 μm long, mostly 0-1 septate; branch leaf hyaline cells with pores 10-20 μm on dorsal surface (fig. 3, 1-4)

S. capillifolium (Ehrh.) Hedw.

S. nemoreum Scop.

Plants delicate to medium-sized, green variegated with red, yellow or brown, sometimes the whole plant red. Capitula ± hemispherical, fascicles closely packed. Stem leaves fibrillose in the upper half. Branch leaves not 5-ranked. Forms hummocks and dense turfs in bogs, heath lands, damp grasslands and on wet slopes. Widespread in the northern half of the Peninsula. Esp, Prt, And.

- 9 Stem leaves less than 1,2 mm long, oblong to lingulate; stem leaf hyaline cells 70-80 µm long, 1-3 septate; branch leaf hyaline cells with pores 5-13 µm on dorsal surface (fig. 3, 16) **S. rubellum** Wilson
Plants delicate, slender, green variegated with red or the whole plant red. Capitula ± flat. Stem leaves weakly fibrillose, sometimes indistinct. Forms dense turfs and hummocks in damp, open peaty sites and in wet heath lands, in the north and west of the Peninsula. Esp, Prt, And.

Section Rigida

Plants small to occasionally robust, whitish-green, glaucous, ochre or brownish. Stem dark brown to black; branches densely crowded making the capitula hard to discern. Stem leaves very small, up to 0,8 mm long. Branch leaves large, 1,8-3 mm long. Green cells of branch leaves oval in section, completely enclosed by hyaline cells (fig. 4, 1-5) **S. compactum** Lam. & DC.

Forms compact and small cushions and turfs in wet heath lands, bogs and wet grasslands by mountain lakes and high mountain streams as well as on seeping rock ledges. Widespread in the northern half of the Peninsula. Esp, Prt, And.

Section Squarrosa

- 1 Plants robust, green or pale green, rarely pale brown; branch leaves over 2 mm long, squarrose (fig. 4, 6-8) **S. squarrosum** Crome
Stem bud visible but not conspicuous. Forms loose and tall patches by streams and pools, in moist forests, rarely in open sites. Scattered in the northern half of the Peninsula. Esp, Prt, And.

- 1 Plants small or medium-sized, brown, green, golden yellow or pale yellow; branch leaves less than 2,3 mm long, imbricate or squarrose (fig. 4, 9-11) **S. teres** (Schimp.) Ångstr.
Stem bud conspicuous. Forms loose turfs along streams and mountain lakes, waterlogged grasslands and damp peaty soils, rarely in natural clearings in forests. Widespread in Pyrenees, southern side of the Cantabrian Mountains, the Spanish Central Range and the Sierra Nevada. Esp, And.

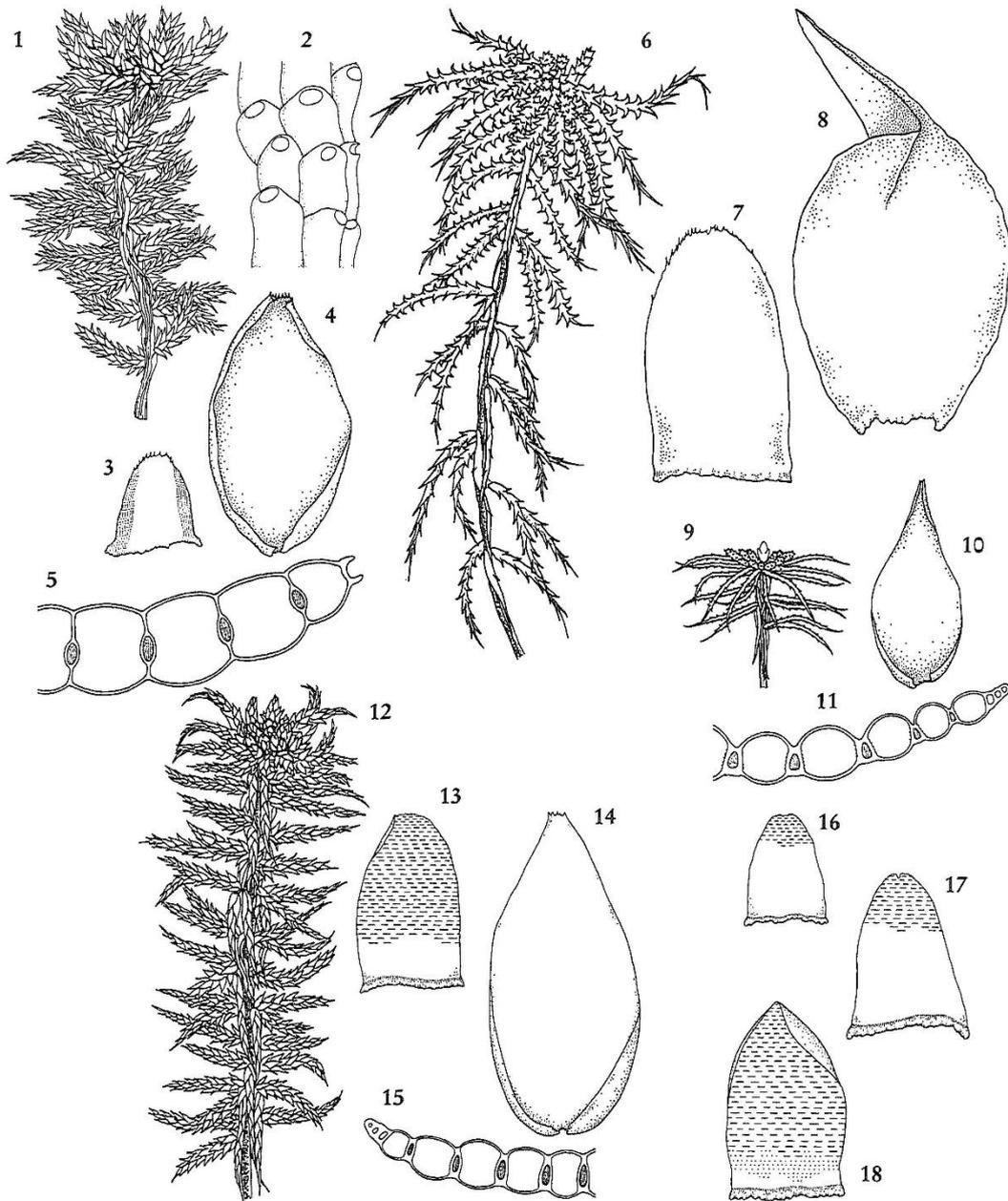


FIGURE 4. **1-5, *Sphagnum compactum***: 1, habit; 2, branch cortex, surface view; 3, stem leaf; 4, branch leaf; 5, branch leaf section. **6-8, *S. squarrosum***: 6, habit; 7, stem leaf; 8, branch leaf. **9-11, *S. teres***: 9, capitulum with terminal bud; 10, branch leaf; 11, branch leaf section. **12-15, *S. auriculatum***: 12, habit; 13, stem leaf; 14, branch leaf; 15, branch leaf section. **16, *S. subsecundum***, stem leaf. **17, *S. contortum***, stem leaf. **18, *S. platyphyllum***, stem leaf. **1, 6, 9, 12 (x2); 3, 4, 7, 8, 10, 13, 14, 16, 17, 18 (x20); 2 (x90); 5, 11, 15 (x275).**

Sect. Subsecunda

- | | | |
|---|-----------------------|---|
| 1 | Hyaloderm 1-layered | 2 |
| 1 | Hyaloderm 2-3-layered | 3 |

- 2 Plants medium-sized; stem leaves 0,5-1,1 mm long, fibrillose in the upper 10-25% (fig. 4, 16)

S. subsecundum Nees

Plants small to medium-sized, golden yellow, yellow variegated with orange or brown, occasionally green in shade; capitula with short and arcuate branches, the upper very curved. Branch leaves with numerous and minute pores, 2-6 μm , on the dorsal surface in series along the commissures. Forms loose turfs above water level, rarely submerged, in open sites such as heath lands, peaty grasslands and mires, in the northern half of the Peninsula and Sierra Nevada. Esp, Prt, And.

- 2 Plants usually robust; stem leaves 1,2-2(-4) mm long, fibrillose in the upper 35-90% (fig. 4, 12-15)

S. auriculatum Schimp.

S. denticulatum Brid.

Plants greenish or brownish, very polymorphic. Forms loose turfs, frequently submerged or semi-submerged, in a wide range of open peaty sites. Widespread in northern half of the Peninsula, very rare in the south where it is localized in Algeciras Mountains. Esp, Prt, And.

In this species are included the plants named *S. inundatum* Russow.

- 3 Stem leaves 0,8-1,2 mm long, fibrillose in the upper 10-35% (fig. 4, 17)

S. contortum Schultz

Plants medium-sized, green variegated with yellow or brown; upper branches of capitula curved as in *S. subsecundum* but the pores on the dorsal surface of the branch leaves are smaller, 1-3 μm . Fascicles of 6-7 branches. Forms loose turfs in base-rich habitats, along the margins of streams and pools, sometimes semi-submerged. Rare in the Pyrenees and in the Cantabrian Mountains. Esp, And.

- 3 Stem leaves 1,2-2 mm long, fibrillose in the upper 80-100% (fig. 4, 18)

S. platyphyllum (Lindb. ex Braithw.) Warnst.

Plants medium-sized, olive green to brownish; capitula hard to discern but with a conspicuous stem bud. Fascicles rarely with more than 3 branches. Forms loose turfs in waterlogged, open high mountain sites. Rare in the northern part of the Peninsula. Esp, Prt, And.

Section Cuspidata

- 1 Branch leaf hyaline cells 20-40 μm wide, 1-4 times as long as wide (fig. 5, 6-8)

S. tenellum (Brid.) Pers. ex Brid.

Plants small and delicate, green or yellow. Pendent branches not different from spreading branches, retort cells very well developed and much larger than the small imperforated cells. Stem leaves ovate-lingulate, 0,9-1,5 x 0,4-0,8 mm, strongly fibrillose in upper half. Branch leaves broadly ovate, concave, like stem leaves in size. Forms loose turfs in open acidic sites by pools, streams, mountain lakes and in peaty heath lands, in the north of the Peninsula. Esp, Prt, And.

- 1 Branch leaf hyaline cells less than 20 μm wide, more than 4 times as long as wide

2

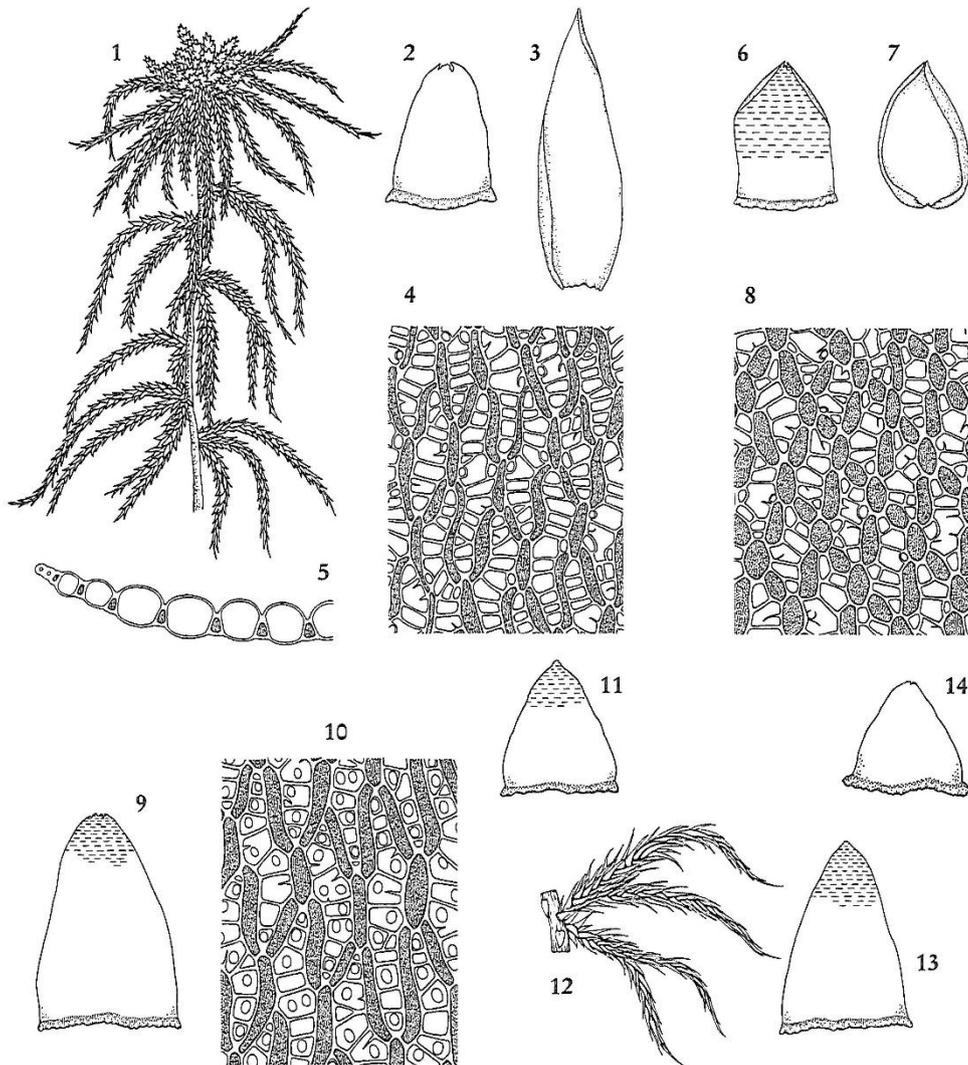


FIGURE 5. **1-5, *Sphagnum flexuosum***: 1, habit; 2, stem leaf; 3, branch leaf; 4, cells of branch leaf, dorsal side; 5, branch leaf section. **6-8, *S. tenellum***: 6, stem leaf; 7, branch leaf; 8, cells of branch leaf, dorsal side. **9-10, *S. majus***: 9, stem leaf; 10, cells of branch leaf, dorsal side. **11, *S. fallax***, stem leaf. **12-13, *S. cuspidatum***: 12, fascicle; 13, stem leaf. **14, *S. angustifolium***, stem leaf. **1** (x2); **12** (x3); **2, 3, 6, 7, 9, 11, 13, 14** (x20); **4, 5, 8, 10** (x275).

2 Branch leaf hyaline cells with numerous pores, 6-15, on dorsal surface (fig. 5, 9-10)

***S. majus* (Russow) C.E.O.Jensen**

Plants medium-sized, green or brownish, sometimes yellowish. Stem with cortex distinct. Stem leaves triangular to triangular-lingulate, 1-1,4 mm long, with concave and obtuse apices. Branch leaves lanceolate to linear-lanceolate, secund, 2,0-2,5 mm long. Forms turfs on open, acidic wetlands, at the wet margins of mountain lakes and by streams, very localized in the Cantabrian Mountains and in the Iberian Range. Esp.

2 Branch leaf hyaline cells with 0-2pores dorsal surface

3

3 Stem leaves with acute or mucronate apices; stem with hyaloderm 4

3 Stem leaves with obtuse or rounded apices; stem without hyaloderm 5

4 Branch leaves lanceolate, 1,3-2,0 mm long; stem leaves with mucronate apices (fig. 5, 11)

S. fallax (H. Klinggr.) H. Klinggr.

Plants medium-sized, green, yellowish to brownish. Fascicles of 5 dimorphic branches. Stem leaves shortly triangular, 0,8-1,3 mm long, with or without fibrils. Branch leaves 5-ranked; green cells isosceles-triangular in section. Forms turfs on acidic wetlands, peaty heath lands and by streams and mountain lakes, in the north of the Peninsula. Esp, Prt, And.

4 Branch leaves lanceolate to linear 1,6-5,0 mm long; stem leaves with acute apices (fig. 5, 12-13)

S. cuspidatum Ehrh. ex Hoffm.

Plants medium-sized, the aquatic forms plumose, the terricolous ones rather compact, green, pale-green or yellowish. Fascicles of 3-4 not dimorphic branches. Stem leaves triangular to triangular-ovate, 0,9-1,7 mm long. Branch leaves spirally arranged; green cells trapezoid in section. Forms loose turfs, often submerged or semi-submerged, in peaty pools and heath lands, in the north and northwest of the Peninsula, absent in the Pyrenees. Esp, Prt.

5 Pendent and spreading branches strongly dimorphic, the pendent branches longer than the spreading; stem leaves 0,7-0,9 mm long (fig. 5, 14) **S. angustifolium** (C.O.E.Jensen ex Russow) C.O.E.Jensen

Plants medium-sized, green, yellowish to brownish. Green cells of branch leaves triangular in section. Forms loose turfs in mires and peaty heath lands and grasslands. Scattered in the northern half of the Peninsula. Esp, Prt.

5 Branches not dimorphic and similar in length; stem leaves 0,8-1,2 mm long (fig. 5, 1-5)

S. flexuosum Dozy & Molk.

Plants medium-sized, green, yellowish to brownish. Green cells of branch leaves trapezoid in section. Forms loose turfs in open acidic wetlands, mires, peaty heath lands and by streams and mountain lakes. Scattered in the northern half of the Peninsula. Esp, Prt.

Cl. Andreaeopsida

Protonema thalloid. Seta absent; capsule exerted, ellipsoidal, elevated by a pseudopodium, dehiscing by 4 longitudinal, incomplete slits; peristome lacking. In dry conditions the columella contracts and the slits open to release the spores.

O. Andreaeales

Fam. Andreaeaceae

Andreaea Hedw.

Plants fragile, stem simple or slightly branched. Leaves small, straight or curved, lanceolate to ovate-lanceolate, nerve present or lacking; laminal cells rounded or rectangular, smooth or papillose, thick-walled, strongly porose or sinuously thickened. Perichaetial leaves large, around pseudopodium. Sporophyte terminal. Forms dark brown, reddish or blackish turfs, 0,5-6 cm high, on siliceous rocks, mainly in high mountains.

- 1 Leaves nerveless or with slightly differentiated nerve; when present, nerve dorsally convex 2
- 1 Leaves with well differentiated nerve for their entire length; nerve dorsally convex, or also ventrally (in *A. frigida*) 6
- 2 Leaves with slightly differentiated nerve at base or at median and upper part 3
- 2 Leaves nerveless 4

- 3 Nerve slightly differentiated in the lower third of leaf, sometimes absent at base, more distinct from middle to apex with 3-4(-5) cells layers; leaf lamina 1(2)-stratose in the upper 2/3, unistratose at margin (fig. 6, 1-3)

A. heinemannii Hampe & Müll.Hal. subsp. **heinemannii**

Plants to 5 cm tall. Leaves abruptly narrowed, often narrowly subulate, subula 2/3-3/4 length of leaf; nerve (45)50-70(-85) µm wide, with 3-4(-5) cell layers. Perigonia without paraphyses, rarely with some. Perichaetial leaves with nerve in upper part. Spores (20-)24-32(-36) µm. Forms dense, brownish to blackish turfs on wet, shaded or exposed, granitic rocks, in montane or high mountain areas of the northern half of the Peninsula. Esp, Prt, And.

- 3 Nerve distinct in the lower third of leaf, with 2-3 cells-layers, nearly imperceptible in the rest; leaf lamina 2-stratose in the upper 2/3, unistratose at margin (fig. 6, 4-5)

A. heinemannii Hampe & Müll.Hal. subsp. **crassifolia** (Luisier) Sérgio

A. crassifolia Luisier

Plants to 5 cm tall. Leaves gradually tapering, sometimes with obtuse apex; nerve (95-)100-110(-112) µm wide, with up to 2-3 cell layers. Perigonia with abundant, yellow to brown paraphyses. Perichaetial leaves nerveless. Spores spherical, 23-35(-39) µm. Forms dense, brown to blackish turfs on dry granitic rocks and walls of exposed, acidic rocks, in montane areas (in lower parts than subsp. *heinemannii*) of the western part of the Peninsula. Esp, Prt.

4 Leaf basal cells quadrate or rounded at margins; spores 12-22(-25) μm (fig. 6, 6-7)

A. mutabilis Hook.f. & Wilson

Plants about 1 cm tall. Leaves lanceolate, straight; laminal cells papillose on dorsal side, basal cells rectangular, smooth, thick-walled. Forms reddish to blackish turfs, sometimes glaucous on vertical walls of acidic rocks, in high mountains of the north of the Peninsula, rarely in montane areas. Esp.

4 Leaf basal cells shortly rectangular or oblate at margins; spores 22-35 μm

5

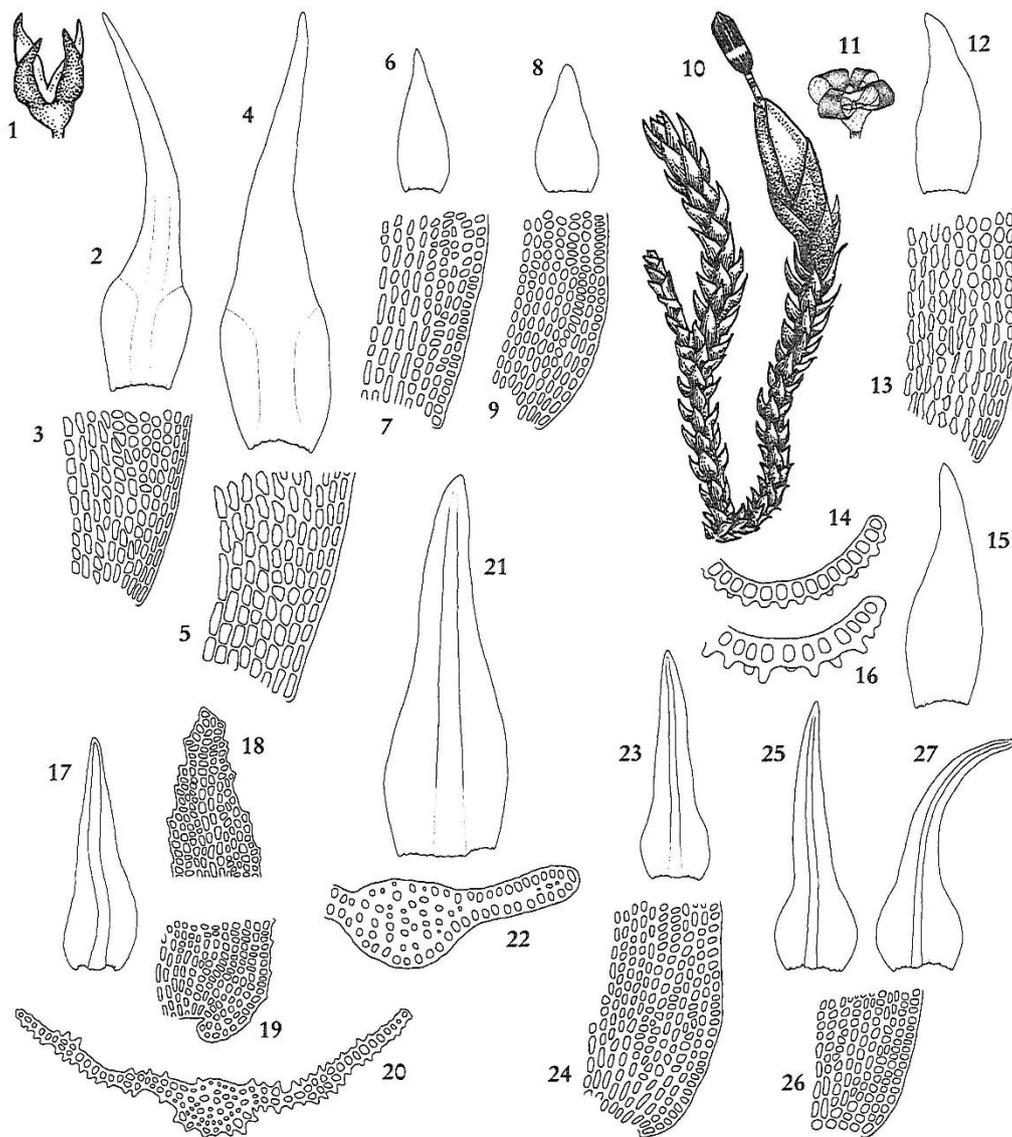


FIGURE 6. 1-3, *Andreaea heinemannii* subsp. *heinemannii*: 1, capsule; 2, leaf; 3, basal cells. 4-5, *A. heinemannii* subsp. *crassifolia*: 4, leaf; 5, basal cells. 6-7, *A. mutabilis*: 6, leaf; 7, basal cells. 8-9, *A. alpestris*: 8, leaf; 9, basal cells. 10-14, *A. rupestris* var. *rupestris*: 10, habit; 11, capsule; 12, leaf; 13, basal cells; 14, leaf section. 15-16, *A. rupestris* var. *papillosa*: 15, leaf; 16, leaf section. 17-20, *A. nivalis*: 17, leaf; 18, leaf apex; 19, basal cells; 20, leaf section. 21-22, *A. frigida*: 21, leaf; 22, leaf section. 23-24, *A. megistospora*: 23, leaf; 24, basal cells. 25-26, *A. rothii* subsp. *rothii*: 25, leaf; 26, basal cells. 27, *A. rothii* subsp. *falcata*, leaf. 10 (x12); 1, 11 (x20); 2, 4, 6, 8, 12, 15, 17, 21, 23, 25, 27 (x30); 3, 5, 7, 9, 13, 14, 16, 18, 19, 20, 22, 24, 26 (x160).

- 5 Transition between basal and upper cells gradual; upper lamina unistratose or irregularly bistratose at middle of leaf (fig. 6, 8-9) **A. alpestris** (Thed.) Schimp.
A. rupestris Hedw. var. **alpestris** (Thed.) Sharp
Laminal cells slightly papillose or papillae lacking on dorsal surface, \pm regularly thick-walled, lumina rounded, basal cells shortly rectangular, slightly porose or not porose. Capsules uncommon; spores 24-32 μm . Forms short, to 1 cm, brown, blackish or reddish turfs on periodically wet vertical walls of acidic rocks, in high mountains mainly in the north of the Peninsula. Esp.
- 5 Transition between basal and upper cells abrupt; lamina unistratose (fig. 6, 10-16) **A. rupestris** Hedw.
Laminal cells papillose on dorsal side, irregularly thick-walled, lumina star-shaped, basal cells longly rectangular, strongly porose.
var. **rupestris**: Stem to 1,5 cm high. Leaves to 1 mm long; laminal cells mostly with hyaline papillae on dorsal side, twice as high as wide. Forms reddish brown turfs on wet, acidic rocks or in sheltered rock crevices, in montane areas and high mountains of the northern half of the Peninsula. Esp, Prt, And (fig. 6, 10-14).
var. **papillosa** (Lindb.) Podp.: Stem to 2,5 cm high. Leaves to 2 mm long, lanceolate, abruptly narrowed to long apex; laminal cells with papillae more than twice as high as wide on dorsal side. Forms blackish turfs on shaded, acidic rocks. Very rare, in high mountains of the Pyrenees. Esp (fig. 6, 15-16).
- 6 Leaf margin irregularly crenulate to denticulate; laminal cells papillose on both sides; perichaetial leaves similar to stem leaves; dioicous (fig. 6, 17-20) **A. nivalis** Hook.
Plants 4-6 cm tall, brownish green. Laminal cells and nerve cells papillose. Sporophyte unknown. Grows on rocks and in wet, acidic rock crevices, in high mountains. Scattered in the northern half of the Peninsula. Esp, And.
- 6 Leaf margin entire; laminal cells smooth; perichaetial leaves convolute, broader than stem leaves; cladautoicous **7**
- 7 Nerve (75-)100-125(-160) μm wide at base, with 5-8(-9) layers of cells; spores (18-)24-32 μm (fig. 6, 21-22) **A. frigida** Huebener
Plants to 4 cm tall. Leaves lanceolate, margin often incurved; nerve in section biconvex. It is remarkable in the abundant perichaetial and pseudopodia along stem. Forms reddish brown turfs on seeping walls of acidic rocks, in the high mountains of the north and west of the Peninsula. Esp, Prt, And.
- 7 Nerve less than (90-)100 μm wide at base, with up to 5(-6) layers of cells; spores more than 30 μm **8**
- 8 Spores 50-80(100) μm (fig. 6, 23-24) **A. megistospora** B.M.Murray

Plants 5-12(-15) mm tall. Leaves ovate, ± abruptly narrowed to acute or slightly rounded apex, margin plane. Forms dense, brownish to blackish turfs on exposed, granitic rocks, in very wet rock crevices and in seeping sites, in montane areas of the northwestern part of the Peninsula. Esp, Prt.

- 8 Spores 30-56 µm, rarely more than 45-50 µm 9
- 9 Inner perichaetial leaves smooth or with low papillae in the upper third at back; leaves not falcate or only slightly so, not or slightly fragile (fig. 6, 25-26) **A. rothii** F.Weber & D.Mohr subsp. **rothii**
Forms dark brown to blackish turfs, 0,5-2,5 cm high, on wet, exposed, acidic rocks. Widely distributed in montane areas and high mountains of the Peninsula. Esp, Prt, And.
- 9 Inner perichaetial leaves densely papillose, with high papillae in the upper third at back; leaves strongly falcate, fragile (fig. 6, 27) **A. rothii** F.Weber & D.Mohr subsp. **falcata** (Schimp.) Lindb.
Forms dark brown to blackish turfs, 0,5-2,5 cm high, on damp. acidic rocks and in seeping sites, rarely on slates. Widely distributed from the lowlands to montane areas of the Peninsula. Esp, Prt, And.

Cl. Polytrichopsida

Protonema filamentous. Plants acrocarpous, usually large. Leaves with well-developed nerve, bearing green lamellae on the ventral surface. Seta long; capsule operculate; peristome single, with lingulate, non-articulate teeth, directed inwards and attached to an epiphragm.

O. Polytrichales

Fam. Polytrichaceae

Atrichum P.Beauv.

Plants to 6 cm tall. Leaves lingulate, ovate-lanceolate or triangular-lanceolate, ± undulate, crisped when dry; nerve and lamina toothed at back, margin with unistratose or pluristratose border of narrow cells, strongly dentate; nerve with 3-7 lamellae on ventral surface, 2-9 cells high. Capsule cylindrical, straight or curved, inclined or horizontal; lid rostrate; peristome with 32 teeth, epiphragm present.

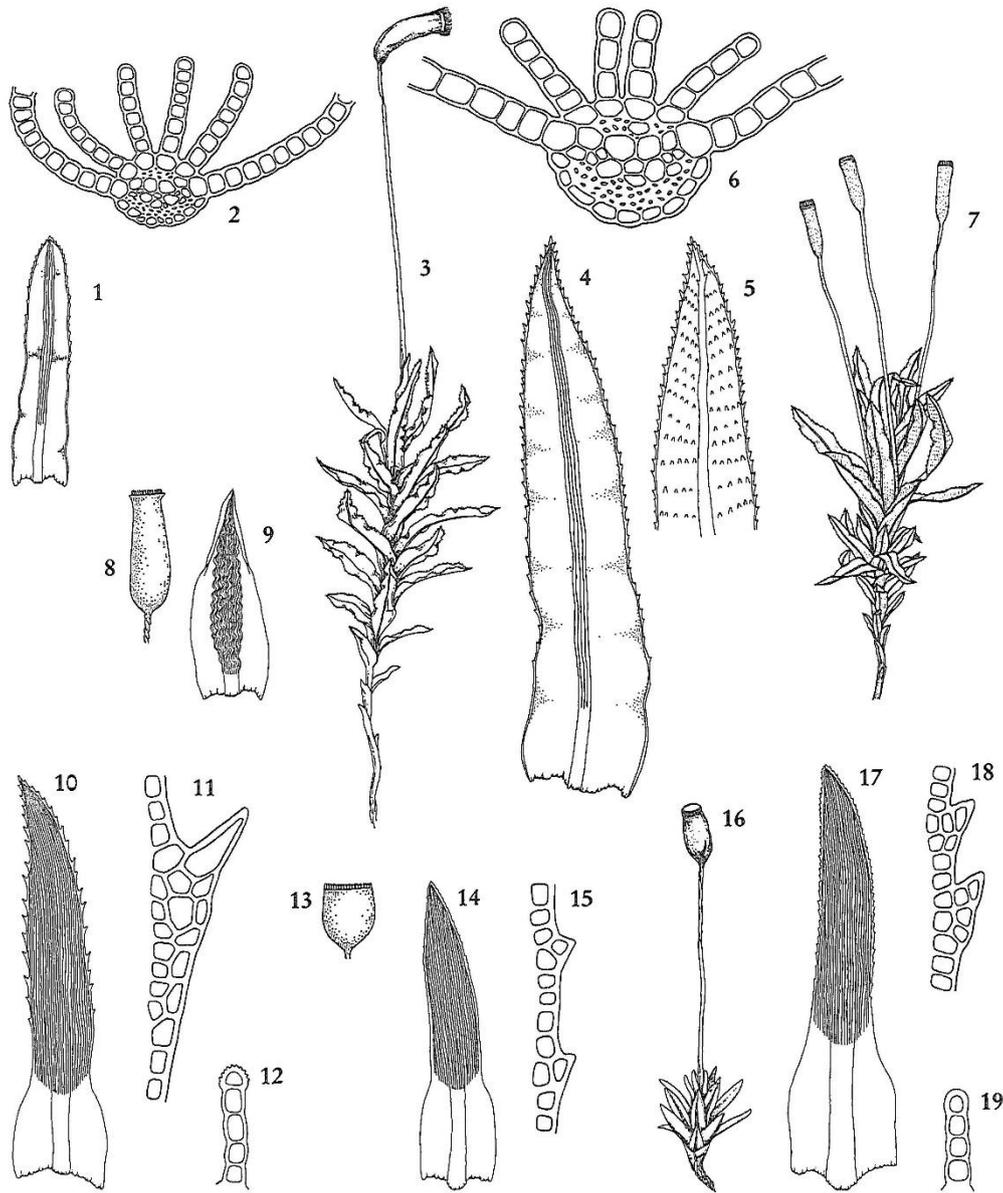


FIGURE 7. 1-2, *Atrichum angustatum*: 1, leaf; 2, nerve section. 3-6, *A. undulatum*: 3, habit; 4, leaf; 5, upper part of leaf, dorsal side; 6, nerve section. 7, *A. flavisetum*, habit. 8-9, *Oligotrichum hercynicum*: 8, capsule; 9, leaf. 10-12, *Pogonatum urnigerum*: 10, leaf; 11, leaf margin; 12, lamella section. 13-15, *P. nanum*: 13, capsule; 14, leaf; 15, leaf margin. 16-19, *P. aloides*: 16, habit; 17, leaf; 18, leaf margin; 19, lamella section. 3 (x2); 7, 16 (x2,5); 8, 13 (x5); 1, 4, 5, 9, 10, 14, 17 (x10); 2, 6, 11, 12, 15, 18, 19 (x200).

1 Leaves narrow, 0,4-0,8 mm wide; median cells to 17 μ m wide; 4-7 lamellae 5-9 cells high; dioicous (fig. 7, 1-2)

***A. angustatum* (Brid.) Bruch & Schimp.**

Leaves \pm undulate, narrow, about 1 mm wide, lingulate or triangular-lanceolate, obtuse or acuminate, lamina toothed at back above, teeth often geminate, margin dentate in the upper half. Seta reddish or yellowish; capsule narrowly cylindrical, curved, straight or slightly inclined; spores 12-14 μ m. Forms lax turfs, to 3 cm high, on damp, shady, acidic slopes, in montane areas. Distributed in the north and west of the Peninsula. Esp, Prt.

1 Leaves more than 0,8 mm wide; median cells more than 17 μm wide; 2-6 lamellae 2-6 cells high; monoicous 2

2 Sporophytes not persistent; seta terminal, 1 (2) per perichaetium, reddish; capsule inclined and curved (fig. 7, 3-6) **A. undulatum** (Hedw.) P.Beauv.

Leaves 1,5-2 mm wide, strongly undulate, lanceolate, lingulate, with acute or acuminate apex, lamina with acute teeth at back above, margin dentate to near base. Capsule cylindrical, curved, inclined to horizontal; spores 16-19 μm . Forms lax turfs, to 6 cm high, on damp, shady, acidic slopes. Common in the lowlands and in the montane areas of the northern half and western part of the Peninsula. Esp, Prt, And.

2 Sporophytes persistent; seta lateral, 2-4 per perichaetium, yellowish; capsule erect and straight (fig. 7, 7) **A. flavisetum** Mitt.

Plants to 2,5 cm tall. Leaves undulate, oblong linear or ovate, with acute or acuminate apex. Perichaetium persistent, several perichaetial per plant. Capsule very narrow; spores 17-18 μm . Grows on wet, acidic slopes in the lowlands and montane areas. Rare, in the northeastern part of the Peninsula. Esp.

NOTE: **Atrichum androgynum** (Müll. Hal.) A.Jaeger, has been cited from Portugal.

Oligotrichum DC.

Plants to 5 cm high. Leaves erect, lanceolate from broad base, apex obtuse, cucullate, crisped and incurved when dry, margin crenulate; nerve broad, with 8-12 sinuose longitudinal lamellae on ventral side. Capsule ovoid to sub-cylindrical, without apophysis; peristome with 32 teeth, epiphragm present (fig. 7, 8-9)

O. hercynicum (Hedw.) Lam. & DC.

Forms dark green turfs or tufts on damp or seeping, acidic rocks and soils, in high mountains, in the Pyrenees and Cantabrian Mountains. Esp, And.

Pogonatum P.Beauv.

Leaves lanceolate, with broad sheathing base, margin dentate; nerve broad, with numerous longitudinal lamellae on ventral surface. Capsule globose to cylindrical, without apophysis; calyptra densely hairy, covering part of the capsule or the whole; peristome with 32 teeth, epiphragm present.

1 Stem to 10 cm high, branched; nerve excurrent; lamellae with papillose apical cells (fig. 7, 10-12)

P. urnigerum (Hedw.) P.Beauv.

Plants glaucous. Leaf margin with acute teeth. Forms lax turfs on damp, shady, acidic or decalcified slopes, in high mountains and montane areas of the northern half of the Peninsula. Esp, Prt, And.

- 1 Stem to 2 cm high, unbranched; nerve not excurrent; lamellae with smooth apical cells 2
- 2 Leaves dentate in the upper third, with blunt teeth, mostly unicellular; 30-40 lamellae; capsule globose or ovoid, turbinate when empty (fig. 7, 13-15) **P. nanum** (Hedw.) P.Beauv.
Plants dark green, 0,5-1 cm high. Exothecial cells smooth. When sterile is hard to distinguish from depauperate specimens of *P. aloides*. Forms lax turfs on damp slopes in the lowlands and montane areas, mainly in the north and west of the Peninsula. Esp, Prt.
- 2 Leaves dentate from near sheathing base, with sharp, pluricellular teeth; 40-60 lamellae; capsule oblong-cylindrical (fig. 7, 16-19) **P. aloides** (Hedw.) P.Beauv.
Plants dark green, to 2 cm high. Exothecial cells mamilllose. Protonema persistent. Forms lax turfs on damp, shady, acidic slopes. Common in montane areas of the Peninsula. Esp, Prt, And.

Polytrichastrum G.L. Sm.

Plants medium-sized to robust, to 15 cm tall. Leaves spreading, lanceolate, with broad and sheathing base, lamina narrow, margin entire or dentate; nerve very broad, with numerous longitudinal lamellae on ventral surface. Capsule erect, inclined or horizontal, cylindrical, ovoid or prismatic, apophysis weakly or well differentiated, shallowly delimited from the urn, calyptra hairy covering part of the capsule, peristome with 64 teeth, epiphragm present.

For key to species see under *Polytrichum* below.

Polytrichum Hedw.

Plants medium-sized to robust, to 30 cm tall. Leaves spreading to squarrose or reflexed, lanceolate, with broad and sheathing base and narrow lamina, margin entire or dentate; nerve very broad, with numerous longitudinal lamellae on ventral surface. Capsule inclined or horizontal, prismatic, 4-6 angled, apophysis well defined, sharply delimited from the urn by a basal constriction, calyptra densely hairy, covering the capsule; peristome with 64 teeth, epiphragm present.

Key to species of Polytrichum and Polytrichastrum

- 1 Upper leaf lamina broadly incurved; leaf margin entire 2

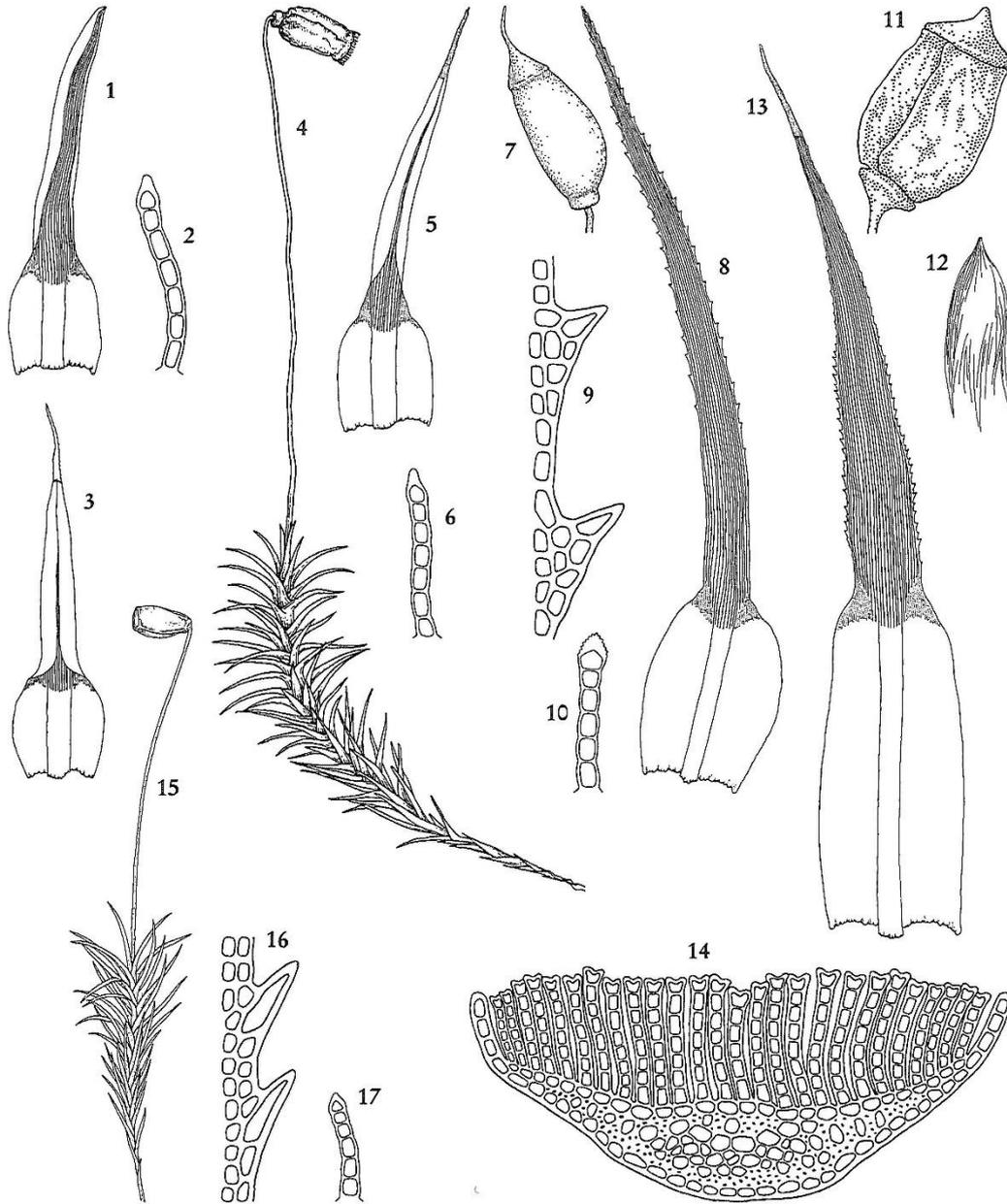


FIGURE 8. 1-2, **Polytrichastrum sexangulare**: 1, leaf; 2, lamella section. 3, **Polytrichum piliferum**, leaf. 4-6, **Polytrichum juniperinum**: 4, habit; 5, leaf; 6, lamella section. 7-10, **Polytrichastrum alpinum**: 7, capsule; 8, leaf; 9, leaf margin; 10, lamella section. 11-14, **Polytrichum commune**: 11, capsule; 12, calyptra; 13, leaf; 14, leaf section. 15-17, **Polytrichum formosum**: 15, habit; 16, leaf margin; 17, lamella section. 4, 15 (x1,8); 7, 11 (x4); 1, 3, 5, 8, 13 (x10); 12 (x20); 2, 6, 9, 10, 14, 16, 17 (x200).

2 Leaf apex cucullate; nerve percurrent or excurrent in apiculus (fig. 8, 1-2)

Polytrichastrum sexangulare (Brid.) G.L.Sm.

Polytrichum sexangulare Brid.

Leaves erecto-patent, incurved at tips when dry; apical cells of lamellae ovate to pyriform in cross section, smooth. Forms lax, dark green turfs, to 5 cm high, on damp soils, frequently on snow-beds, of the Pyrenees. Esp, And.

- 2 Leaf apex not cucullate; nerve excurrent in a hyaline hair point or brownish arista **3**

- 3 Nerve excurrent in long, hyaline hair-point; nerve smooth at back (fig. 8, 3)

Polytrichum piliferum Hedw.

Arista dentate; apical cells of lamellae pyriform in cross section, smooth. Capsule sharply 4-6 angled. Forms lax turfs, to 4 cm high, on sandy ledges and in rock crevices, in dry, exposed, acidic sites, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

- 3 Nerve excurrent in short or long, brownish arista; nerve dentate at back **4**

- 4 Stem with dense and whitish tomentum **Polytrichum strictum** Menzies ex Brid.

Leaves short, erect when dry. Apical cells of lamellae pyriform in cross section, smooth. Forms compact turfs, to 10 cm high, on peaty soils. Scattered in Pyrenees and Cantabrian Mountains. Esp, And.

- 4 Stem not tomentose or with sparse brown tomentum (fig. 8, 4-6) **Polytrichum juniperinum** Hedw.

Leaves long, spreading when dry. Apical cells of lamellae pyriform in cross section, smooth. Forms extensive patches, to 8 cm high, on exposed, acidic soils and slopes, from the lowlands to the high mountains. Widespread in the Peninsula, rare in Mallorca. Esp, Prt, And, Bl.

- 5 Capsule cylindrical or ovoid; leaf margin with teeth of 1-3 cells; apical cells of lamellae ovate or pyriform in cross section, strongly papillose (fig. 8, 7-10) **Polytrichastrum alpinum** (Hedw.) G.L.Sm.

Polytrichum alpinum Hedw.

Stem to 10 cm high. Leaves erecto-patent to reflexed, margin strongly dentate. Capsule erect or inclined, asymmetrical. Calyptra not covering the whole of the capsule. Forms lax turfs on acidic, peaty soils, in rock crevices and on humus-rich slopes, in high mountains of the Peninsula. Esp, Prt, And.

- 5 Capsule prismatic; leaf margin with unicellular teeth; apical cells of lamellae ovate or spherical, flat or emarginate in cross section, smooth or slightly papillose **6**

- 6 Apical cells of lamellae flat or emarginate in cross section (fig. 8, 11-14)

Polytrichum commune Hedw.

Plants to 30 cm tall. Leaves spreading to reflexed; apical cells of lamellae larger than other cells. Capsule sharply 4-6-angled. Forms lax turfs on damp, acidic or peaty soils, in montane areas and high mountains, in the north and west of the Peninsula. Esp, Prt, And.

6 Apical cells of lamellae ovate or elliptical in cross section 7

7 Leaf lamina with 5-12 rows of cells, 13-17 μm wide, at each side of nerve; median sheath cells 13-17 μm wide
Polytrichum longisetum Sw. ex Brid.

Plants to 10-(15) cm tall. Nerve with up to 25-30 lamellae. Capsule erect, obscurely 5-6-angled. Forms dark green turfs, to 8 cm high, on peaty soils in high mountains. Very rare, in the Pyrenees. Esp, And.

7 Leaf lamina with 3-5 rows of cells, 7-11 μm wide, at each side of nerve; median sheath cells 7-11 μm wide (fig. 8, 15-17)
Polytrichum formosum Hedw.

Nerve with up to 70 lamellae. Capsule sharply (4)5-6-angled. Forms dark green turfs, 10-12 cm high, on slightly inclined slopes and damp, shady soils, in montane forests in the north and west of the Peninsula, very rare in the south where it is localized in Algeciras Mountains. Esp, Prt, And.

Cl. Tetraphidopsida

Protonema filamentous; protonemal leaves persistent or not. Plants acrocarpous, small. Seta long; capsule operculate; peristome single, of 4 erect teeth.

O. Tetraphidales

Fam. Tetraphidaceae

Tetraphis Hedw.

Plants small, to 2 cm tall. Sterile stems ending in a cup of orbicular bracts containing numerous discoid gemmae. Leaves orbicular to ovate-lanceolate, acute, margin plane, entire; laminal cells hexagonal, 10-20 μm wide, thick-walled; nerve ending below apex. Capsule exserted, cylindrical and smooth, straight; calyptra mitriform, plicate; peristome single, with 4 triangular teeth wide at base (fig. 9, 1-4) **T. pellucida** Hedw.

Forms loose turfs on rotting fir and beech stumps, in the northern half of the Peninsula. Esp, And.

Tetrodontium Schwäger.

Plants minute, to 0,2 cm tall. Protonemal leaves persistent, linear, entire, 2-3-stratose. Stem leaves ovate to lanceolate, acuminate; cells rectangular, thick-walled, smooth; nerve thin and short or absent. Capsule exserted, ellipsoidal and smooth, straight; peristome single, of 4 triangular teeth wide at base; calyptra smooth (fig. 9, 5-6)

T. brownianum (Dicks.) Schwäger.

Grows in acidic caves and on damp, shaded, acidic rocks. Very rare, in the Basque Mountains. Esp.

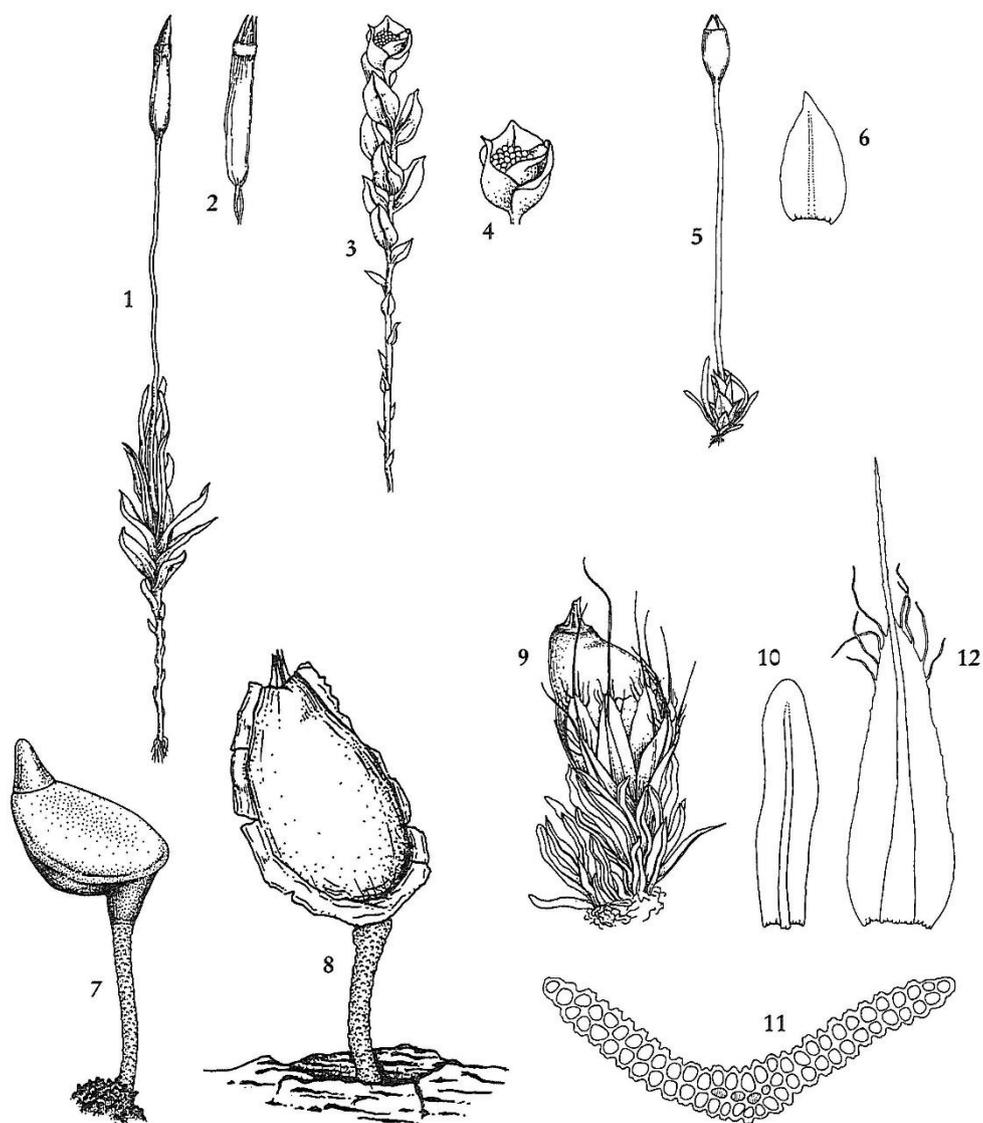


FIGURE 9. 1-4, *Tetraxis pellucida*: 1, habit, plant with sporophyte; 2, capsule; 3, habit, plant with gemmae; 4, gemma cup. 5-6, *Tetrodontium brownianum*: 5, habit; 6, leaf. 7, *Buxbaumia aphylla*, habit. 8, *Buxbaumia viridis*, habit. 9-12, *Diphyscium foliosum*: 9, habit; 10, leaf; 11, leaf section; 12, perichaetial leaf. 7, 8, 9 (x5); 1, 3, 5 (x6); 2, 4 (x10); 6, 10, 12 (x15); 11 (x150).

Cl. Bryopsida

Protonema filamentous. Plants acrocarpous or pleurocarpous, small to large. Seta long or short; capsule dehiscent opening by lid or indehiscent; peristome single or double, exostome with 16 simple or \pm divided, articulate teeth, sometimes peristome reduced or lacking.

O. Buxbaumiales

Fam. Buxbaumiaceae

Buxbaumia Hedw.

Plants small. Stem and leaves minute, ciliate, ephemeral, nerveless. Perichaetial leaves ciliate. Seta long, straight, papillose; capsule inclined, ovoid, asymmetrical, larger than the plant. Protonema persistent.

- 1 Capsule shiny, brown, flattened on the upper surface; cuticle not peeling from back of capsule (fig. 9, 7)

B. aphylla Hedw.

Plants solitary or gregarious on humus-rich soils or rotting fir and beech stumps, in the Pyrenees. Esp.

- 1 Capsule dull, green or pale brown, scarcely flattened on the upper surface; cuticle splitting and peeling from back of mature capsule (fig. 9, 8) **B. viridis** (Moug. ex Lam. & DC) Brid. ex Moug. & Nestl.

Plants solitary or gregarious on rotting fir and beech stumps, in the northeast of the Peninsula. Esp, And.

O. Diphysciales

Fam. Diphysciaceae

Diphyscium D.Mohr

Plants small, green to blackish. Leaves lingulate, narrow, crisped when dry, apex obtuse, margin plane; lamina 2-3-stratose, cells isodiametric, mamilliose; nerve ending below apex. Perichaetial leaves ciliate above; nerve excurrent. Seta smooth, very short; capsule immersed, ovoid, asymmetrical, large (fig. 9, 9-12)

D. foliosum (Hedw.) D.Mohr

Forms dense turfs on slopes and damp, shady and humus-rich soils in beechwoods, fir woods and oakwoods, mainly in montane areas. Distributed in northern half of the Peninsula. Esp, Prt, And.

O. Timmiales

Fam. Timmiaceae

Timmia Hedw.

Plants robust. Leaves lanceolate, widely sheathing at base, margin plane, dentate; median cells of lamina quadrate or hexagonal, mamillate on ventral side, smooth at back, basal cells rectangular, long and narrow, papillose or smooth, narrower at margin; nerve percurrent, smooth at back, papillose or dentate in the upper part. Capsule ellipsoidal, inclined to pendulous, striate when dry; peristome double; calyptra cucullate.

- 1 Leaf sheath slightly differentiated; dorsal part of nerve strongly papillose (fig. 10, 2-4)

T. norvegica J.E.Zetterst.

Plants about 3 cm tall. Forms turfs on wet, calcareous crevices and soil in high mountains. Rare, in the Pyrenees. Esp, And.

- 1 Leaf sheath differentiated; dorsal part of nerve papillose or not 2

- 2 Leaf sheath orange yellowish; dorsal part of nerve dentate near apex (fig. 10, 5-6) **T. austriaca** Hedw.

Forms turfs to 10 cm high on stony soils and in calcareous rock crevices, from the lowlands to high mountains, in the northeastern part of the Peninsula. Esp, And.

- 2 Leaf sheath hyaline or light yellow; dorsal part of nerve smooth 3

- 3 Upper and median laminal cells 6-9 μm long; upper cells of sheath smooth (fig. 10, 1)

T. bavarica Hessel.

Forms lax turfs to 8 cm high, on soils and in calcareous rock crevices, in montane areas of the Peninsula and Mallorca. Esp, And, Bl.

- 3 Upper and median laminal cells 9-11 μm long; upper cells of sheath papillose **T. megapolitana** Hedw.

Forms lax turfs on moist, calcareous, shaded soils, in montane areas in Pre-Pyrenees. Esp.

O. Encalyptales

Fam. Encalyptaceae

Encalypta Hedw.

Plants small to medium-size, mainly on rocks or calcareous soils. Leaves lingulate, spathulate or oblong-lanceolate, erecto-patent, crisped when dry, margin plane or slightly recurved, incurved at apex; laminal cells hexagonal or quadrate, strongly papillose, obscure, basal cells rectangular, hyaline, smooth or papillose, with thickened transverse walls which are often reddish, forming an arch-shaped area, marginal cells narrower; nerve strong, percurrent or excurrent in apiculus or in hair-point. Capsule cylindrical, straight, smooth or finely striate; lid rostrate; calyptra cylindrical, campanulate, covering capsule, entire, erose or fringed; peristome single or double of 16 entire teeth, or rudimentary or absent.

- 1 Stem with abundant axillary filamentous gemmae (fig. 10, 7-8) **E. streptocarpa** Hedw.
Leaves lingulate or spathulate, obtuse; nerve strong, percurrent: Capsule spirally striate; peristome double, spores smooth, 10-14 µm. Rarely with sporophytes. Forms dense turfs, 2-3 cm high, in rock crevices and on damp, calcareous slopes, from the lowlands to high mountains. Widespread in the north and east of the Peninsula, scattered in the south and west and in Mallorca. Esp, Prt, And, Bl.
- 1 Stem without axillary filamentous gemmae **2**
- 2 Leaves oblong-lanceolate, gradually tapering to acute apex (fig. 10, 9) **E. alpina** Sm.
Stem 2 cm high. Leaves with plane and denticulate margin; nerve stout, excurrent. Peristome lacking; spores 28-40 µm. Forms lax turfs in calcareous rock crevices, in montane areas and high mountains in the north of the Peninsula. Esp, And.
- 2 Leaves lingulate, abruptly tapering to obtuse apex **3**
- 3 Basal leaf cells papillose on the dorsal surface (fig. 10, 10) **E. affinis** R.Hedw.
Nerve excurrent. Peristome double. Forms lax turfs, to 2 cm high, in calcareous rock crevices, in montane areas and high mountains, in the northeastern part of the Peninsula. Esp.
- 3 Basal leaf cells smooth **4**
- 4 Calyptra fringed; spores radially ridged **5**
- 4 Calyptra entire or erose; spores with large papillae **6**

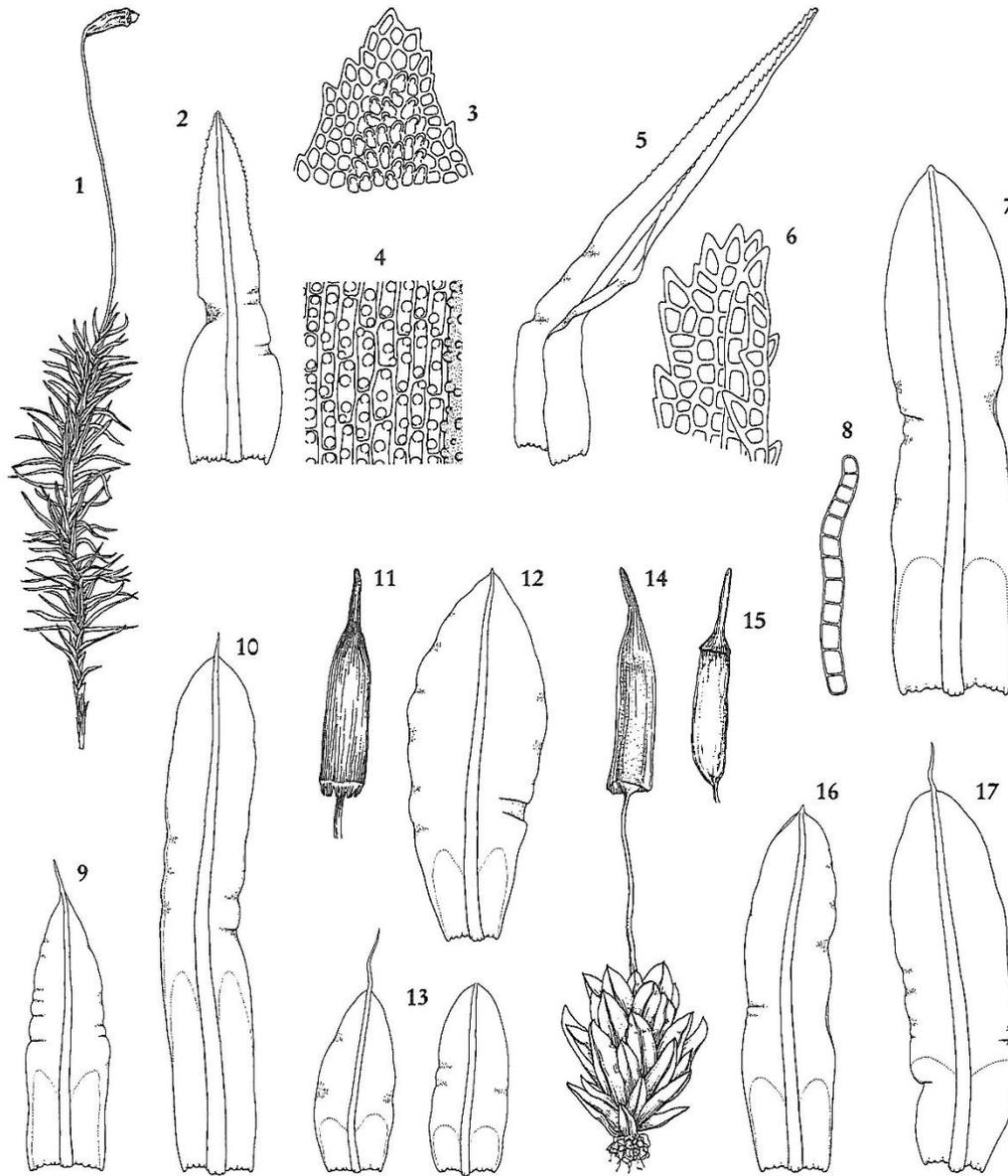


FIGURE 10. 1, *Timmia bavarica*, habit. 2-4, *T. norvegica*: 2, leaf; 3, leaf apex; 4, basal cells. 5-6, *T. austriaca*: 5, leaf; 6, leaf apex. 7-8, *Encalypta streptocarpa*: 7, leaf; 8, gemma. 9, *E. alpina*, leaf. 10, *E. affinis*, leaf. 11-12, *E. ciliata*: 11, calyptra; 12, leaf. 13, *E. rhapsocarpa*, leaves. 14-16, *E. vulgaris*: 14, habit; 15, capsule; 16, leaf. 17, *E. spathulata*, leaf. 1 (x1,8); 11, 14, 15 (x6); 2, 5, 7, 9, 10, 12, 13, 16, 17 (x14); 8 (x90); 3, 4, 6 (x200).

- 5 Capsule contracted below mouth; peristome single, short; leaf margin narrowly recurved in the lower half; nerve excurrent in apiculus or percurrent; calyptra beak more than 1/3 of the calyptra length (fig. 10, 11-12)

***E. ciliata* Hedw.**

Leaves spatulate or ovate, apiculate. Peristome single; spores 30-38 μ m. Plants solitary or forming lax turfs, to 2 cm high, on soils and rocks in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.

- 5 Capsule contracted at the mouth; peristome rudimentary or lacking; leaf margin plane; nerve percurrent; calyptra beak 1/4 of the calyptra length **E. microstoma** Bals.-Criv. & De Not.
Forms lax turfs on dry, calcareous rocks, in montane areas and high mountains. Scattered in the northeastern part of the Peninsula and in Sierra Nevada. Esp.
- 6 Peristome single; capsule longitudinally striate (fig. 10, 13) **E. rhaptocarpa** Schwäger.
Leaf margin plane or recurved near base, inflexed above; nerve excurrent in hair point or percurrent. Spores 34-50 µm. Forms turfs on earthy ledges in montane areas and high mountains in the north of the Peninsula, sporadic in the southeast. Esp, And.
- 6 Peristome lacking or rudimentary; capsule smooth or ± striate **7**
- 7 Nerve percurrent or excurrent in apiculus or short hair-point; calyptra entire or ± erose; peristome lacking or rudimentary (fig. 10, 14-16) **E. vulgaris** Hedw.
Stem 0,5-1,5 cm high. Leaves lingulate or spatulate, acute or obtuse; nerve very stout at back. Calyptra apex scabrous. Spores papillose, 30-45 µm. Forms turfs on dry, calcareous rocks and soils, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 7 Nerve percurrent, in upper leaves excurrent in long hair-point; calyptra glossy, more or less erose; peristome lacking (fig. 10, 17) **E. spathulata** Müll.Hal.
Leaves lingulate to spatulate. Capsule slightly striate. Grows on rocks and calcareous soils in montane areas and high mountains, in the eastern part of the Peninsula, scattered in the northwest and south of the Peninsula and in Mallorca. Esp, And, Bl.

O. Funariales

F. Ephemeraceae

Ephemerum Hampe

Plants annual, minute, 0,1-0,2 mm tall, growing from a persistent protonema. Stem very short. Leaves linear, lanceolate or ovate-lanceolate, crowded in rosette, margin usually dentate or denticulate; nerve present or lacking, occasionally nerve absent at the leaf base. Seta very short; capsule indehiscent, immersed, globose or ellipsoidal, apiculate. Plants growing on wet or periodically waterlogged, exposed soil, usually in the lowlands.

- 1 Leaves with nerve

2

1 Leaves without nerve 5

2 Upper cells of lamina prorate; leaf margin dentate to spinose (fig. 10bis, 1)

E. spinulosum Bruch & Schimp. ex Schimp.

Leaves linear to linear-lanceolate; lamina and nerve with prorate cells above, with prominent spinose projections similar to those of the leaf margin; nerve percurrent or excurrent. Grows on wet mud. Very rare, in the north of the Peninsula. Esp.

2 Upper cells of lamina smooth; leaf margin dentate 3

3 Leaves oblong or oblong-lanceolate; nerve percurrent or ending before apex (fig. 10bis, 2)

E. cohaerens (Hedw.) Hampe

Leaves mostly with asymmetrical shoulders. Grows on wet mud. Very rare, in the north of the Peninsula. Esp.

3 Leaves lanceolate or linear-lanceolate; nerve excurrent 4

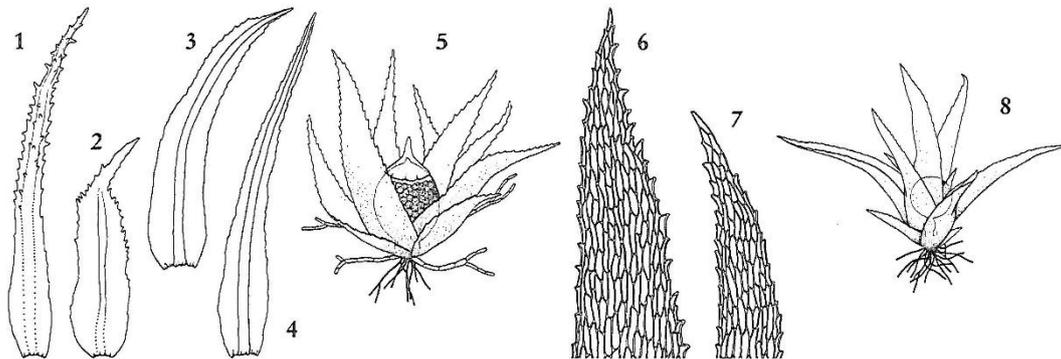


Figure 10bis. **1**, *Ephemeroideae spinulosum*, leaf on dorsal side. **2**, *E. cohaerens*, leaf. **3**, *E. recurvifolium*, leaf. **4**, *E. crassinervium* subsp. *sessile*, leaf. **5-6**, *E. serratum*: **5**, habit; **6**, upper part of leaves. **7**, *E. minutissimum*, upper part of leaf. **8**, *Micromitrium tenerum*, habit. **8** (x12); **5** (x15); **1, 2, 3, 4** (x30); **6, 7** (x40).

4 Capsule with stomata only at base, obliquely apiculate (fig. 10bis, 3) **E. recurvifolium** (Dicks.) Boulay
Leaves with reflexed apex. Spores papillose or nearly so. Grows on periodically inundated, calcareous clayey soil. In the east and south of the Peninsula and in Mallorca. Esp, Prt, Bl.

4 Capsule with stomata scattered over the whole surface, with straight apiculus (fig. 10bis, 4)

E. crassinervium subsp. *sessile* (Bruch) Holyoak

E. sessile (Bruch) Müll.Hal.

Leaves erecto-patent, with flat apex. Spores verrucose. Grows on mud in temporary ponds. In the western and northeastern part of the Peninsula and in Menorca. Esp, Prt, Bl.

- 5 Leaf margin entire or denticulate; leaves spreading in stellate way

E. stoloniferum (Hedw.) L.T.Ellis & M.J.Price

E. stellatum H.Philib.

Leaves lanceolate. Spores 40-70 μm , finely papillose. Grows on open, clayey soils. Very rare, in the western part of the Peninsula. Prt.

- 5 Leaf margin dentate; leaves erect to erecto-patent

6

- 5 Spores finely papillose, covered by a hyaline veil when mature (fig. 10bis, 7) **E. minutissimum** Lindb.

Leaves narrowly lanceolate. Spores 45-80 μm . Grows on bare soils in bush lands, olive tree fields, arable fields and temporary ponds, in the lowlands. Scattered in the Peninsula. Esp, Prt.

- 5 Spores verrucose to papillose, not covered by a hyaline veil when mature (fig. 10bis, 5-6)

E. serratum (Hedw.) Hampe

Leaves lanceolate, rarely faint nerve present in the upper part of leaf. Spores 35-75 μm . Grows on sandy and clayey soils, in temporary ponds and open bush lands, in the northeast and southwest quadrants of the Peninsula. Esp, Prt.

Micromitrium Austin

Plants minute, 0,1-0,3 cm tall, arising from scarce, persistent protonema. Stem very short. Leaves ovate-lanceolate or ovate, acuminate, margin entire or finely denticulate; laminal cells hexagonal, 20-25 μm wide; nerve lacking. Seta very short; capsule indehiscent, globose; calyptra minute (fig. 10bis, 7)

M. tenerum (Bruch & Schimp.) Crosby

Grows on mud by ponds and lake and reservoir margins. Rare, in the north and west of the Peninsula. Esp, Prt.

Fam. Funariaceae

Entosthodon Schwägr.

Plants small, 0,5(-1) cm tall. Leaves mostly concave, upper leaves larger and crowded in rosette at stem apex; laminal cells longly polygonal, more than 20 μm wide, thin-walled, marginal cells narrower, differentiated or not; nerve ending below apex to excurrent. Seta long; capsule pyriform, symmetrical or asymmetrical, often with long neck; peristome lacking, single or double; calyptra mitriform or cucullate.

- 1 Capsule inclined, asymmetrical, mouth oblique; peristome double, with more or less sigmoid teeth

2

1 Capsules straight, symmetrical or nearly so, mouth transverse; peristome double or single, with non-sigmoid teeth, or lacking 5

2 Leaves entire or slightly sinuose, longly pointed; lid conical 3

2 Leaves toothed, shortly or longly pointed; lid conical or convex 4

3 Spores spherical, warty or roughly papillose, 18-22 μm ; leaves acuminate (fig. 11, 5-7)

E. pulchellus (H.Philib.) Brugués

Funaria pulchella H.Philib.

Plants to 0,5 cm tall. Leaves oblong to obovate, gradually tapered to a slender point up to 300 μm long; apical cell to 280 μm long; nerve usually ceasing well below the tip. Neck up to half of the capsule length. Forms small patches or individual yellowish green plants on calcareous soils. Common in montane areas, also occurs in the lowlands of the Peninsula, Mallorca and Menorca. Esp, Prt, Bl.

3 Spores smooth, discoid, angularly collapsed, 18-28 μm ; leaves abruptly tapered

E. kroonkurk Dirkse & Bruges

Plants to 0,5 cm tall. Leaves oblong to obovate, abruptly tapered to a slender, recurved point up to 500 μm . Leaves very concave; nerve usually ceasing well below the tip. Neck up to half of the capsule length. Gregarious or in loose patches. Very rare, in the northeastern part of the Peninsula. Esp.

4 Leaves shortly pointed; lid convex (fig. 11, 8-10)

E. convexus (Spruce) Brugués

Funaria convexa Spruce

Plants to 0,6 cm tall. Leaves obovate with broad apex abruptly contracted to a very short point to 150 μm long, margin dentate above; apical cell to 120 μm long; nerve ceasing well below the tip. Neck nearly half of capsule length. Grows on soil banks, rock ledges and crevices in exposed places on acidic or basic substrata, mainly in the lowlands of the Mediterranean region of the Peninsula, Mallorca and Menorca. Esp, Prt, Bl.

4 Leaves longly pointed; lid conical or convex 5

5 Leaf apices gradually tapering; nerve excurrent; lid convex (fig. 11, 11-16)

E. schimperi Brugués

Funaria durieui Schimp.

Plants to 0,5 cm tall. Leaves ovate-lanceolate or oblong-lanceolate, strongly toothed in upper 2/3; nerve conspicuous, 80 μm wide near base, excurrent in arista to 450 μm long. Capsule weakly inclined, neck to 1/3 length of capsule; lid convex or occasionally plane. Grows on dry and exposed soils in low calcareous mountains of the south of the Peninsula. Esp, Prt.

- 5 Leaf apices suddenly contracted; nerve ceasing below apex; lid conical (fig. 11, 17)

E. muhlenbergii (Turner) Fife

Funaria muhlenbergii Turner

Plants to 0,5 cm tall. Leaves obovate to oblong, fairly slender acuminate, rather suddenly contracted to a long point, up to 700 µm long; apical cell to 400 µm long. Neck nearly half of the total capsule length. Forms yellowish green patches on ledges or crevices of calcareous rocks at high altitudes. Scattered in the north, east and southeast of the Peninsula. Esp.

- 6 Exothecial cells isodiametric to shortly oblong; mouth less than the diameter of the moist capsule 7

- 6 Exothecial cells linear-oblong to oblong; mouth equal the diameter of the moist capsule 8

- 7 Nerve ending in or below apex (fig. 12, 1-4)

E. fascicularis (Hedw.) Müll.Hal.

Funaria fascicularis (Hedw.) Lindb.

Plants to 0,5 cm tall. Leaves oblong-lanceolate, acuminate, toothed; marginal cells narrower forming 1-2 rows. Seta 5-7 mm long; capsule pyriform with short distinct neck, exothecial cells with thickened walls. Small patches or scattered plants usually on damp acidic soils, in arable fields and stream sides in the lowlands, in the north and southwest of the Peninsula. Esp, Prt.

- 7 Nerve excurrent (fig. 12, 5-11)

E. mouretii (Corb.) Jelenc

Funaria mouretii Corb.

Plants to 0,5 cm tall. Leaves oblong-lanceolate or oblong-obovate, acuminate, toothed to middle of leaf with projecting cells; marginal cells scarcely differentiated; nerve excurrent in a long yellow or reddish arista, up to 0,5 mm long. Spores 23-28 µm. Occurs at the margins of periodically waterlogged depressions, on acidic soils in the northeast of the Peninsula. Esp, Prt.

- 8 Leaves distinctly bordered, with 2-3 rows of narrow, incrassate, yellowish cells (fig. 12, 12-13)

E. obtusus (Hedw.) Lindb.

Funaria obtusa (Hedw.) Lindb.

Plants to 0,4 cm tall. Leaves oblong-lanceolate, acuminate, margin entire or slightly denticulate; nerve ending below apex. Seta to 6 mm long; capsule small, pyriform; lid convex; peristome rudimentary or absent. Forms small loose patches on shady and humid banks within holm oak and beech forest, on peat soils in grasslands or headlands. Fairly common in the north and the west of the Peninsula and in Menorca. Esp, Prt, Bl.

- 8 Leaves not bordered with incrassate cells 9

- 9 Peristome absent or rudimentary; rhizoids brown 10

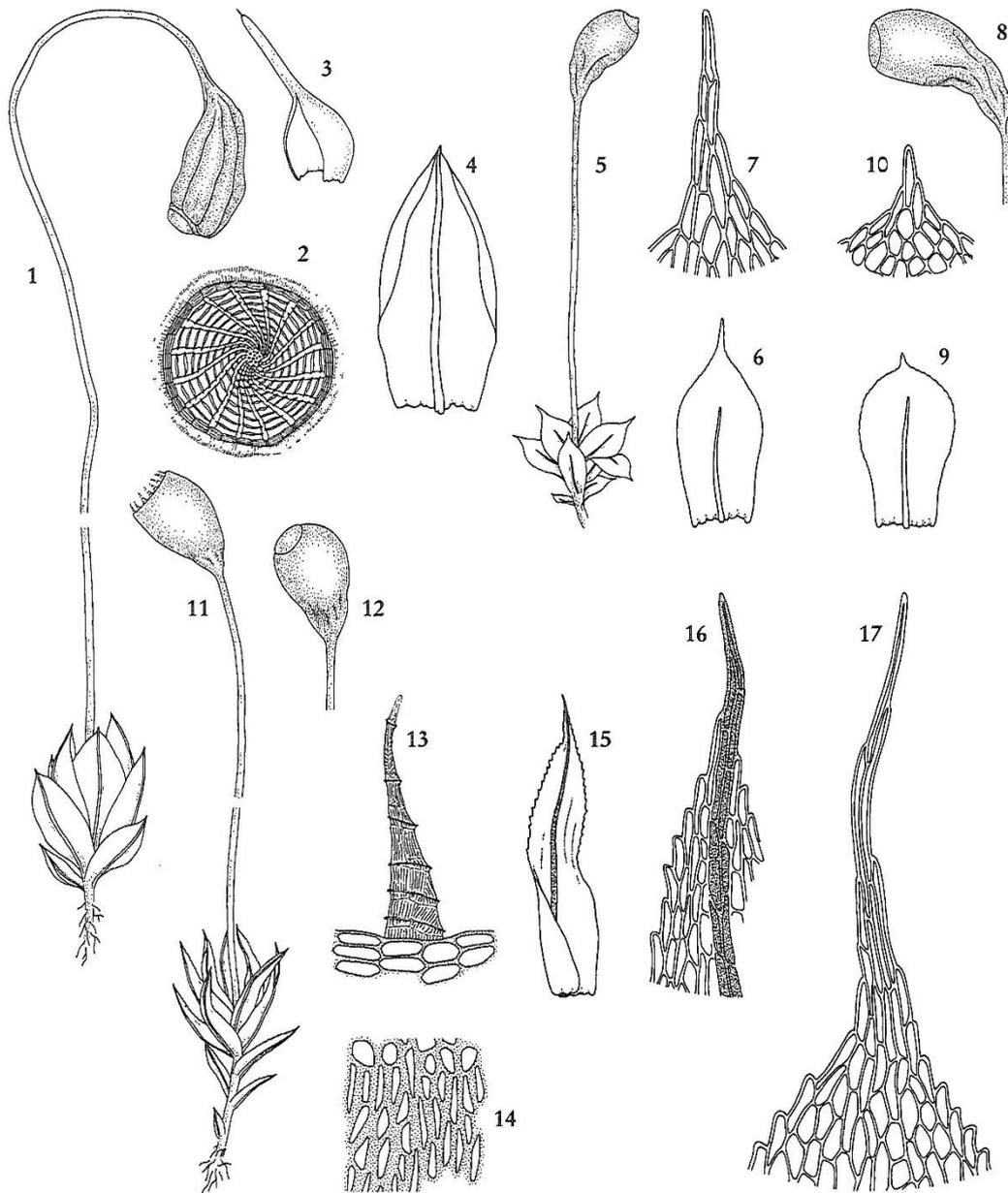


FIGURE 11. 1-4, *Funaria hygrometrica*: 1, habit; 2, capsule mouth and peristome; 3, calyptra; 4, leaf. 5-7, *Entosthodon pulchellus*: 5, habit; 6, leaf; 7, leaf apex. 8-10, *E. convexus*: 8, capsule; 9, leaf; 10, leaf apex. 11-16, *E. schimperi*: 11, habit; 12, capsule; 13, peristome tooth; 14, exothecial cells; 15, leaf; 16, leaf apex. 17, *E. muhlenbergii*, leaf apex. 1, 3, 5, 8, 11, 12 (x7); 4, 6, 9, 15 (x14); 2 (x30); 7, 10, 16, 17 (x80); 13, 14 (x120).

10 Leaves elliptical to obovate or spatulate, acute to obtuse; mouth equalling the diameter of the dry capsule (fig. 12, 18-21)

E. durieui Mont.

E. pallescens Jur.

Plants 0,3-0,4 cm tall, light to yellow green, soft. Leaf margin entire. Seta 4-8 mm long; capsule pyriform, neck as long as urn; lid convex; mature calyptra mitriform. Forms small patches on calcareous rocks and artificial walls. Scattered localities in the peninsular Mediterranean region, as well as in Mallorca and Menorca. Esp, Bl.

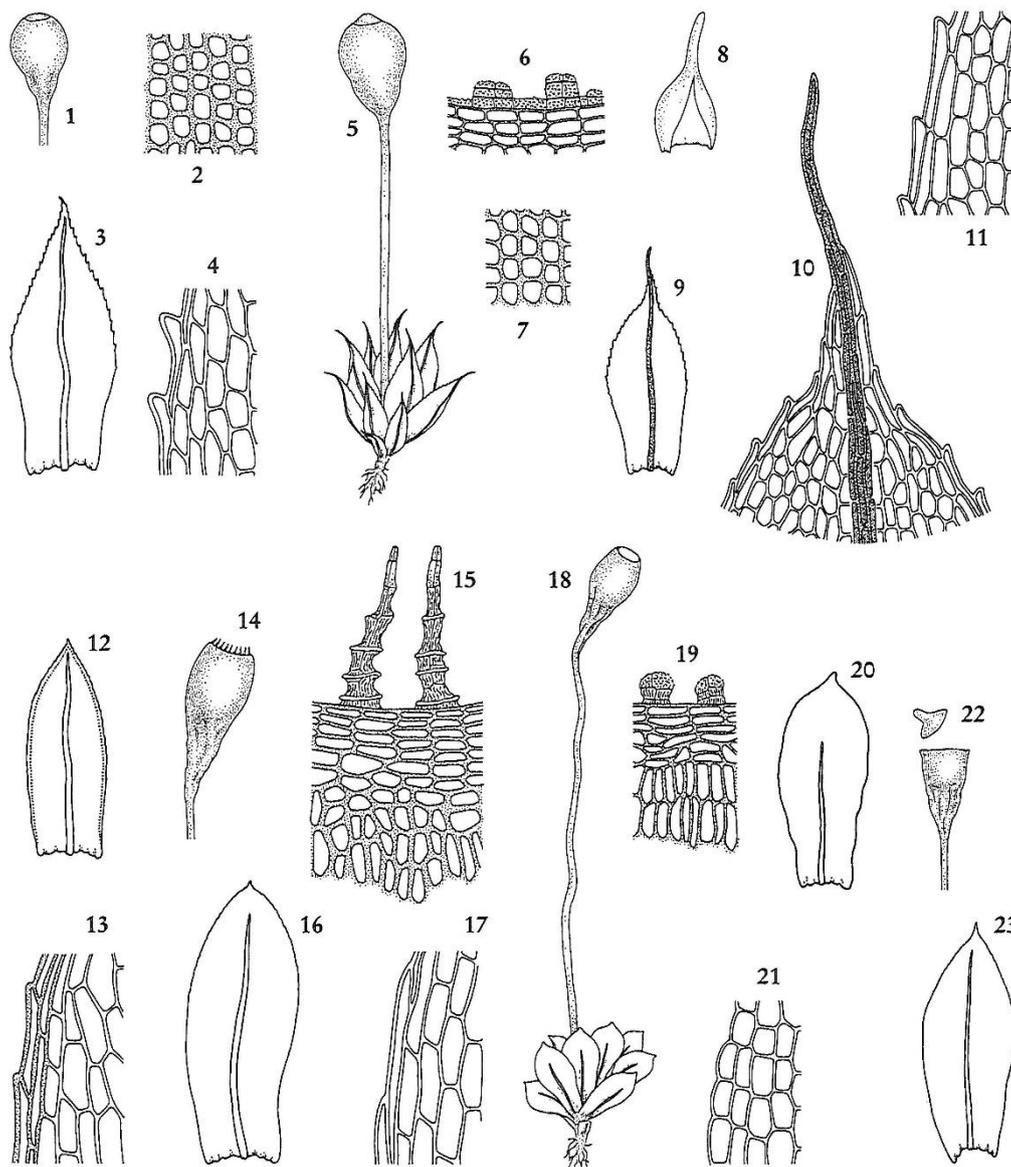


FIGURE 12. **1-4, Entosthodon fascicularis**: 1, capsule; 2, exothecial cells; 3, leaf; 4, marginal cells. **5-11, E. mouretii**: 5, habit; 6, peristome; 7, exothecial cells; 8, calyptra; 9, leaf; 10, leaf apex; 11, marginal cells. **12-13, E. obtusus**: 12, leaf; 13, marginal cells. **14-17, E. attenuatus**: 14, capsule; 15, peristome; 16, leaf; 17, marginal cells. **18-21, E. durieui**: 18, habit; 19, peristome; 20, leaf; 21, marginal cells. **22-23, E. hungaricus**: 22, capsule and lid; 23, leaf. **1, 5, 8, 14, 18, 22** (x7); **3, 9, 12, 16, 20, 23** (x14); **10** (x80); **2, 4, 6, 7, 11, 13, 15, 17, 19, 21** (x120).

10 Leaves oblong to obovate-lanceolate, acuminate; mouth diameter larger than the dry capsule diameter (fig. 12, 22-23)

E. hungaricus (Boros) Loeske
Funaria hungarica Boros

Plants 0,3-0,4 cm tall. Leaf margin entire or faintly denticulate. Seta 3-4 mm long; capsule pyriform or ovate, with long neck; lid with a short, blunt apiculus; calyptra mitriform. Grows on temporarily wet clayey ledges in calcareous areas or on gypsum and arid soils, in the eastern half of the Peninsula. Esp, Prt.

- 11 Rhizoids bright to dark purple; marginal laminal cells narrow (fig. 12, 14-17)

E. attenuatus (Dicks.) Bryhn

Funaria attenuata (Dicks.) Lindb.

Plants 0,3-0,5 cm tall. Leaves obovate or oblong, narrowed into short point, margin entire or almost so, with 1-2 rows of narrow elongated cells but not forming a distinct border; nerve ending in or below apex. Capsule narrowly oblong-pyriform with long neck, half of the capsule length; peristome teeth straight, to 180 µm high. Scattered or tufted plants on moist acidic soils by streams, in rock crevices and on rock ledges, in the lowlands and montane areas of the north and west of the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

- 11 Rhizoids light brown; marginal laminal cells not differentiated **E. commutatus** Durieu & Mont.

Plants 0,2-0,4 cm tall. Leaves oblong, acuminate; nerve extending to 1/2-2/3 way up leaf. Capsule oblong-pyriform, neck 1/2-2/3 of the capsule length; peristome to 320 µm high. On saline soils in the lowlands of southeast of the Peninsula. Esp, Prt.

Funaria Hedw.

Plants to 3 cm tall. Leaves widely ovate-lanceolate, concave; laminal cells hexagonal or rectangular, 30-50 µm wide, thin-walled, marginal cells a little narrower; nerve ending in or below apex. Seta long, flexuose, cygneous; capsule pyriform, asymmetrical, sulcate, deeply furrowed when dry, annulus of large cells, revolvable, curved outwards after dehiscence; peristome double, exostome teeth strongly sigmoid and fused at apices; calyptra cucullate, rarely mitriform (fig. 11, 1-4)

F. hygrometrica Hedw.

Forms yellowish green or green patches or scattered plants on disturbed or cultivated soils, can be abundant after fires. Widespread throughout the territory, mainly in the lowlands of the Peninsula, Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

Funariella Sérgio

Plants small, to 0,5 cm tall. Leaves oblong-obovate to spatulate, acuminate, dentate near apex; cells rectangular, 25 µm wide or more, thin-walled; nerve ending in the apex. Seta 1,2-2 mm long, curved, as long as the capsule; capsule pyriform, symmetrical, inclined to pendulous before dehiscence, erect when mature, with distinct neck, mouth equalling the diameter of the moist capsule; peristome lacking; spores reticulate (fig. 13, 1-4)

F. curviseta (Schwägr.) Sérgio

Entosthodon curvisetus (Schwägr.) Müll.Hal., **Funaria curviseta** (Schwägr.) Milde

Occurs in clefts and crevices of calcareous rocks on wet sites with maritime influence. Distributed in the southern half of the Peninsula, being quite frequent in the west, as well as in Mallorca, Menorca and the Pithyusic Islands. Esp, Prt, Bl.

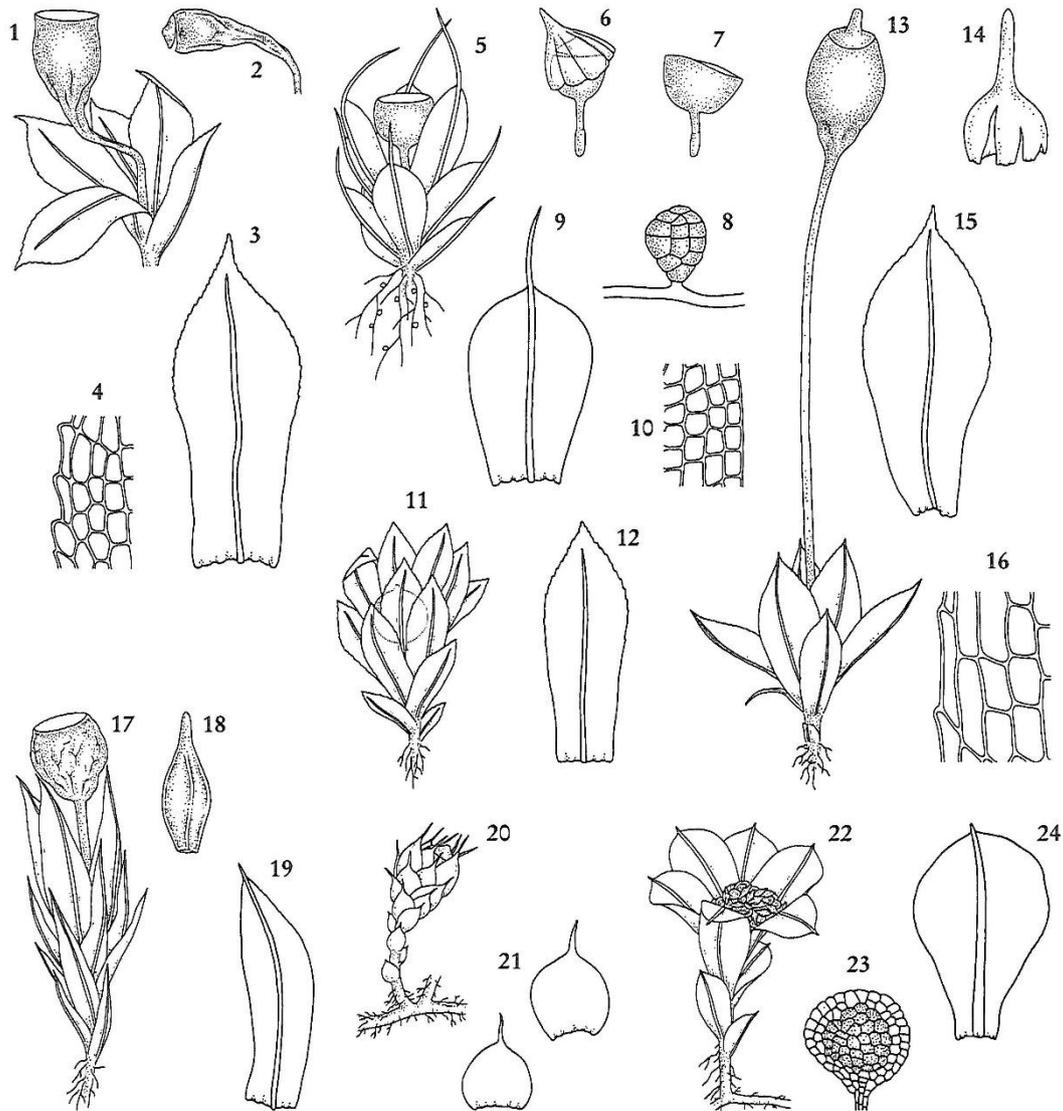


FIGURE 13. 1-4, *Funariella curviseta*: 1, habit; 2, capsule when dry; 3, leaf; 4, marginal cells. 5-10, *Goniomitrium seroi*: 5, habit; 6, capsule with calyptra; 7, mature capsule; 8, rhizoidal gemma; 9, leaf; 10, marginal cells. 11-12, *Physcomitrella patens*: 11, habit; 12, leaf. 13-16, *Physcomitrium pyriforme*: 13, habit; 14, calyptra; 15, leaf; 16, marginal cells. 17-19, *Pyramidula tetragona*: 17, habit; 18, calyptra; 19, leaf. 20-21, *Gigaspermum mouretii*: 20, habit; 21, leaves. 22-24, *Oedipodiella australis*: 22, habit; 23, gemma; 24, leaf. 1, 2, 5, 6, 7, 11, 13, 14, 17, 18, 20, 22 (x8,5); 3, 9, 12, 15, 19, 21, 24 (x14); 23 (x55); 8 (x85); 4, 10, 16 (x120).

Goniomitrium Hook.f. & Wilson

Plants small, to 0,4 cm tall, rhizoidal gemmae present. Leaves crowded, larger above, obovate to spatulate; laminal cells large, 20-25 μm wide, quadrate or rhomboidal, smooth, thin-walled; nerve long-excurrent. Seta 0,3-0,5 mm long; capsule emergent, operculate, turbinate, with broad mouth; peristome absent;

calyptra mitriform, bearing 8 radial pleats; spores ovoid to elliptical, 40-55 µm, reddish-brown (fig. 13, 5-10)

G. seroi Casas

Forms small patches on soil in brushwood and in sandstone crevices. Very rare, in the east and southeast of the Peninsula. Esp.

Physcomitrella Bruch & Schimp.

Plants light green or yellowish, to 0,5 cm tall. Leaves 2-2.5 mm, lanceolate, ovate-lanceolate, or obovate, acute, denticulate in the upper half or less; cells rhomboidal or rectangular, thin-walled, often narrower at margin. Seta short, about 0,2 mm long; capsule cleistocarpous, immersed, globose, bluntly apiculate, with thin-walled exothecial cells, wholly surrounded by perichaetial leaves; calyptra very small, conic-mitriform; spores spinose.

1 Nerve extending to at most 2/3 leaf length **P. readeri** (Müll.Hal.) I.G.Stone & G.A.M.Scott

* **Physcomitrium readeri** Müll.Hal., **Physcomitridium readeri** (Müll.Hal.) G.Roth

Solitary to gregarious plants on mud or on the drawdown. Scattered in the north and northeast of the Peninsula. Esp, Prt.

1 Nerve extending to leaf apex (fig. 13, 11-12) **P. patens** (Hedw.) Bruch & Schimp.

* **Physcomitrium patens** (Hedw.) Mitt.

Solitary to gregarious plants on damp soil in places subject to flooding. Scattered in the north and northeast of the Peninsula. Esp, Prt.

Physcomitrium (Brid.) Brid.

Plants to 0,5 cm tall. Leaves ovate-lanceolate, oblong-lanceolate or spatulate, acuminate, margin toothed above; laminal cells 25-28 µm long, rectangular, thin-walled, marginal somewhat narrower; nerve ending near the apex. Seta 5-15 mm; capsule globose to pyriform, narrowed at mouth, with short distinct neck, exothecial cells irregular, quadrate, hexagonal or short rectangular, thin walled; lid apiculate or rostellate; peristome absent; calyptra mitriform; spores spinose (fig. 13, 13-16) **P. pyriforme** (Hedw.) Bruch & Schimp.

Forms small turfs or scattered stem on moist, usually acidic soils in cultivated fields and on stream banks, in the northern half of the Peninsula. Esp, Prt.

Pyramidula Brid.

Plants pale green, small, about 0,5 cm tall. Leaves ovate or oblong-ovate; nerve excurrent. Seta 1-1,5 mm long; capsule exerted, operculate, ovoid or pyriform, with short neck, irregularly sulcate when dry and empty;

peristome lacking; calyptra cucullate, inflated, 4-angled; spores ovoid to elliptical, 50-60 µm (fig. 13, 17-19)

P. tetragona (Brid.) Brid.

Solitary plants or forming patches on temporarily moist soil in fields of several southern Iberian localities. Esp, Prt.

Fam. Gigaspermaceae

Gigaspermum Lindb.

Plants small, pale green or glaucous, branches short, 2,5-5(-8) mm high, erect, arising from a leafless, branching, yellowish subterranean rhizome. Leaves distant, concave, orbicular, abruptly apiculate; laminal cells hexagonal, lax, smooth, 20-30 µm wide; nerve lacking. Perichaetial leaves large, concealing sporophyte. Seta very short; capsule immersed, turbinate; peristome lacking; spores reddish brown, to 130 µm (fig. 13, 20-21)

G. mouretii Corb.

Forms loose turfs on dry rocky soils, in the lowlands in the south of the Peninsula, Mallorca and Pithyusic Islands. Esp, Bl.

Oedipodiella Dixon

Plants small, branches erect, 0,3-0,5 cm high, arising from a leafless, branching, yellowish subterranean rhizome. Leaves crowded above, obovate to spatulate, apex rounded, abruptly apiculate, margin entire; laminal cells rounded or hexagonal, smooth, 25-30 µm wide; nerve excurrent. Gemmae lenticular, produced at stem apex and borne in a rosette of upper leaves. Sterile (fig. 13, 22-24)

O. australis (Wager & Dixon) Dixon

Scattered or loosely caespitose, on small ledges and in rock and wall crevices, in the lowlands and montane areas of the east of the Peninsula. Esp.

O. Grimmiales

Fam. Grimmiaceae

Coscinodon Spreng.

Leaves lanceolate, keeled above, longitudinally plicate or not, margin entire, upper leaves with long or short, smooth or slightly denticulate hyaline point, flat at base, nerve percurrent to shortly excurrent; lamina

unistratose or bistratose; median cells quadrate, smooth, basal cells rectangular. Seta straight, capsule immersed to emergent, peristome with 16 perforated teeth, calyptra campanulate, enveloping capsule, plicate; columella persistent, not attached to lid.

- 1 Leaves strongly plicate, usually to near base (fig. 14, 1-4) **C. cribrosus** (Hedw.) Spruce
Leaves ovate-lanceolate, lamina bistratose, partially bistratose at apex, longitudinally plicate on both sides of nerve, margin incurved in upper half; basal cells towards nerve rectangular, slightly differentiated from the rest of basal cells. Forms dense turfs, 0,5-1 cm high, on exposed, granitic or schistose rocks in montane areas and high mountains, mainly in the northeast and southwest of the Peninsula. Esp, Prt, And.
When sterile may be confused with *Grimmia caespiticia* since both species have plicate leaves, but the latter has prominent laminal cells and the peristome teeth not perforated or slightly so.

- 1 Leaves shallowly plicate in mid-leaf **C. monchiquensis** R.D.Porley, Ochyra & Ignatova
Plants small, 0,2-0,5 cm high. Leaves ovate-lanceolate, lamina bistratose, occasionally 3-stratose near apex, margin slightly recurved, occasionally plane. Forms dense cushions or mats on magmatic rock in the Serra de Monchique, southwest of the Peninsula. Prt.

Grimmia Hedw.

Plants small to robust, mostly forming cushions or turfs, whitish above, dark below. Leaves usually with hyaline point, upper lamina 1-3-stratose; upper cells rounded or quadrate, papillose or not, basal cells linear to rectangular, cells towards nerve often nodulose. Seta short or long, straight or curved; capsule immersed to exerted, ovoid, oblong-ovoid or ellipsoidal, symmetrical, rarely gibbous at base, smooth or striate; calyptra mitriform or cucullate; columella persistent; peristome teeth 16, entire or divided, rarely peristome lacking. Species saxicolous, mostly on acidic rocks, rarely on basic substrata.

- 1 Leaves with ciliate hyaline point (fig. 14, 5-6) **G. horrida** J.Muñoz & H.Hespanhol
* **Coscinodon horridus** (J. Muñoz & Hespanhol) Hugonnot, R.D. Porley & Ignatov
Plants to 0,6 cm tall. Leaves strongly keeled in the upper part, margin bistratose, of 2-4 marginal rows of cells. Forms dense, dark-green to blackish cushions on dry, acidic rocks in montane areas and high mountains. Only in the northwestern part of the Peninsula. Esp, Prt.

- 1 Leaves with smooth or dentate hyaline point or muticous **2**
- 2 Basal cells at margin oblate (fig. 16, 10-11) **G. laevigata** (Brid.) Brid.
Plants rigid, dull. Leaves triangular, cordate to ovate, apex plane, hyaline point long, denticulate; upper lamina bistratose, basal cells with thickened transverse walls. Seta long, straight; capsule emergent or exerted, ovoid,

smooth. Forms dense, fragile cushions, whitish above, dark below, to 2 cm high, on dry, exposed, acidic rocks or rock ledges, in the lowlands and montane areas, rarely in high mountains. Widespread throughout the Peninsula and in Menorca. Esp, Prt, And, Bl.

2 Basal cells at margin isodiametric to shortly rectangular

3

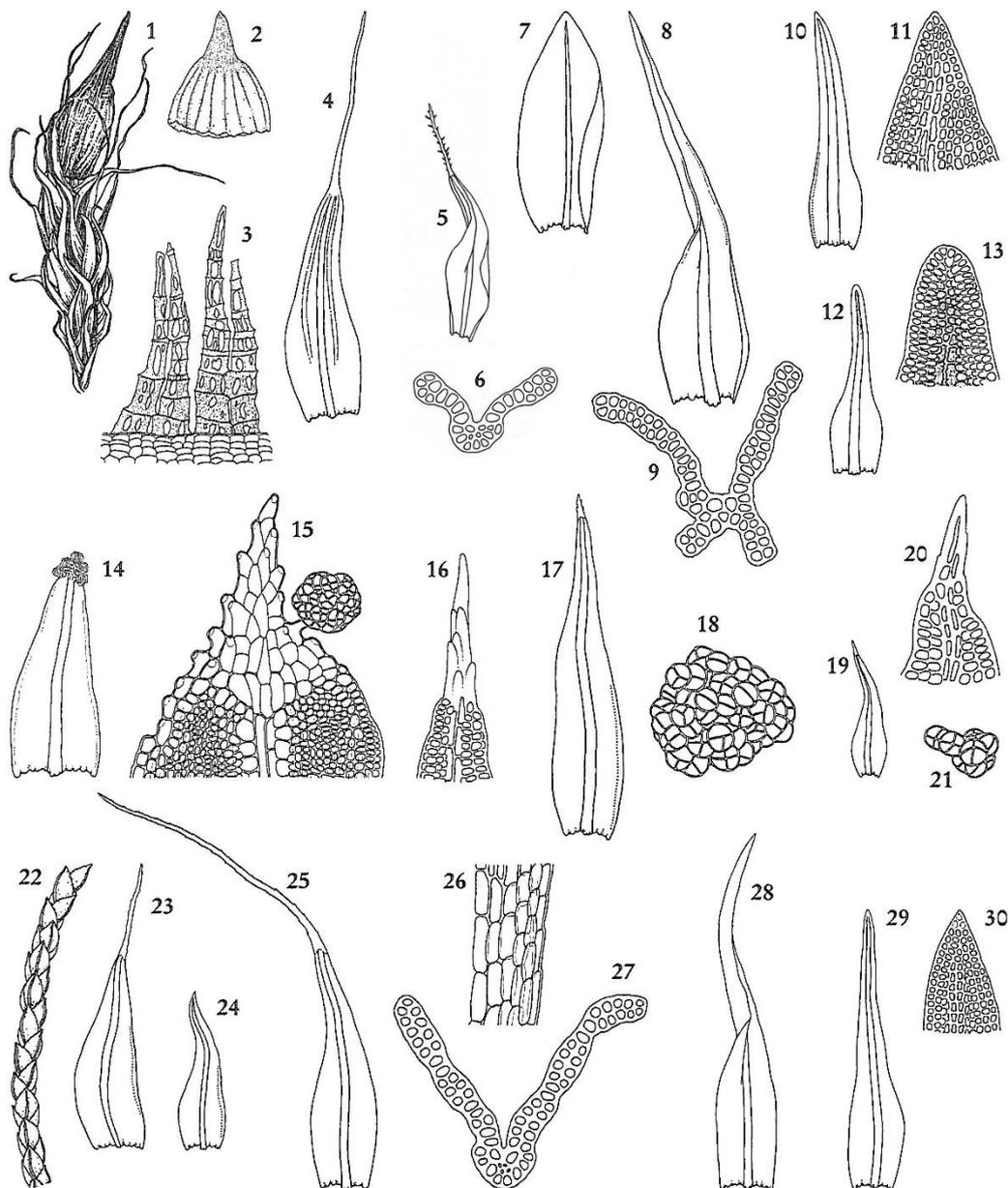


FIGURE 14. 1-4, *Coscinodon cribrerosus*: 1, habit when dry; 2, calyptra; 3, peristome; 4, leaf. 5-6, *G. horrida*: 5, leaf; 6, leaf section. 7, *Grimmia mollis*, leaf. 8-9, *G. ramondii*: 8, leaf; 9, leaf section. 10-11, *G. atrata*: 10, leaf; 11, leaf apex. 12-13, *G. unicolor*: 12, leaf; 13, leaf apex. 14-16, *G. anomala*: 14, leaf with gemmae; 15, leaf apex with gemma; 16, leaf apex. 17-18, *G. hartmanii*: 17, leaf; 18, gemma. 19-21, *G. torquata*: 19, leaf; 20, leaf apex; 21, gemma. 22-24, *G. funalis*: 22, innovation; 23, leaf of female plant; 24, leaf of male plant. 25-27, *G. arenaria*: 25, leaf; 26, basal cells; 27, leaf section. 28, *G. incurva*, leaf. 29-30, *G. elongata*: 29, leaf; 30, leaf apex. 1, 2 (x12); 4, 5, 7 8, 10, 12, 14, 17, 19, 22, 23, 24, 25, 28, 29 (x18); 3 (x100); 15, 16, 18, 21 (x130); 6, 9, 11, 13, 20, 26, 27, 30 (x160).

- 3 Leaves broadly ovate, strongly concave; plants growing by streams (fig. 14, 7) **G. mollis** Bruch & Schimp.
- Hydrogrimmia mollis** (Bruch & Schimp.) Loeske
- Leaf apex obtuse or acute, margin entire, plane; laminal cells quadrate, smooth, basal cells shortly rectangular, wider, smooth; nerve long, to near apex. Forms lax or dense, dark green to blackish cushions, 2-3 cm high, on damp, siliceous rocks, in the high mountains of the Pyrenees and Sierra Nevada. Esp, And.
- 3 Leaves linear, lanceolate, ovate or obovate, slightly concave; plants not growing by streams **4**
- 4 Laminal cells with scattered, large papillae (fig. 15, 17-19) **G. elatior** Bruch ex Bals.-Criv. & De Not.
- Leaves 2-3,5 mm long, bistratose, margin 3-4-stratose in the upper part, recurved on one side, hyaline point to 2mm, less than 1/2 length of lamina, smooth or nearly so, occasionally lacking; median cells 10-20 µm long, basal cells towards nerve rectangular, nodulose, thick-walled; nerve prominent on back, irregular in cross section. Seta long, curved; capsule pale yellow; peristome reddish. Forms loose, rigid, brownish green to dark green turfs, to 8 cm high, on sheltered, acidic rocks, in high mountains, in the north of the Peninsula, mainly in the Pyrenees. Esp, And.
- 4 Laminal cells smooth or with slightly differentiated, small papillae, occasionally pseudopapillose **5**
- 5 Capsule asymmetrical, with ventricose base **6**
- 5 Capsule symmetrical at base or sterile plants **8**
- 6 Leaves spatulate to obovate; calyptra cucullate (fig. 16, 8-9) **G. crinita** Brid.
- Laminal basal cells at margin isodiametric to rectangular, thin-walled. Lid conical; peristome orange; spores 10-14 µm. Forms dense, whitish cushions, to 1 cm high, on exposed calcareous rocks, walls or mortar of walls, in the lowlands, mainly in the north and east of the Peninsula and in Mallorca. Esp, Bl.
- When sterile, it is hard to distinguish from *G. capillata*.
- 6 Leaves lanceolate, ovate-lanceolate or oblong; calyptra mitrate **7**
- 7 Peristome lacking **G. anodon** Bruch & Schimp.
- Plants to 2 cm tall. Leaves oblong-ovate to oblong-lanceolate, hyaline point to 1,5 mm long, denticulate, upper lamina unistratose or partially bistratose, margin bistratose, nerve with 2 cells on ventral side. Perichaetial leaves similar in shape to vegetative leaves. Seta sigmoid; capsule gibbous at base; spores 8-11 µm. Forms dense, soft, whitish cushions, dark green to brownish below, calcareous rocks, rarely on schists or granitic rocks, in montane areas and high mountains. Widespread throughout the Peninsula. Esp, And.

7 Peristome well developed, rarely rudimentary (fig. 16, 14)

G. crinitoleucophaea Cardot

G. poecilostoma Cardot & Sébille

Median cells of lamina 8-12 μm long. Perichaetial leaves strongly differentiated from vegetative leaves. Seta sigmoid; capsule ovoid, yellow; peristome teeth orange, strongly perforated; spores 10-12 μm . Forms dense dark green to blackish cushions, to 2 cm high, on exposed, acidic rocks, in montane areas and high mountains. Scattered in the Peninsula. Esp, And.

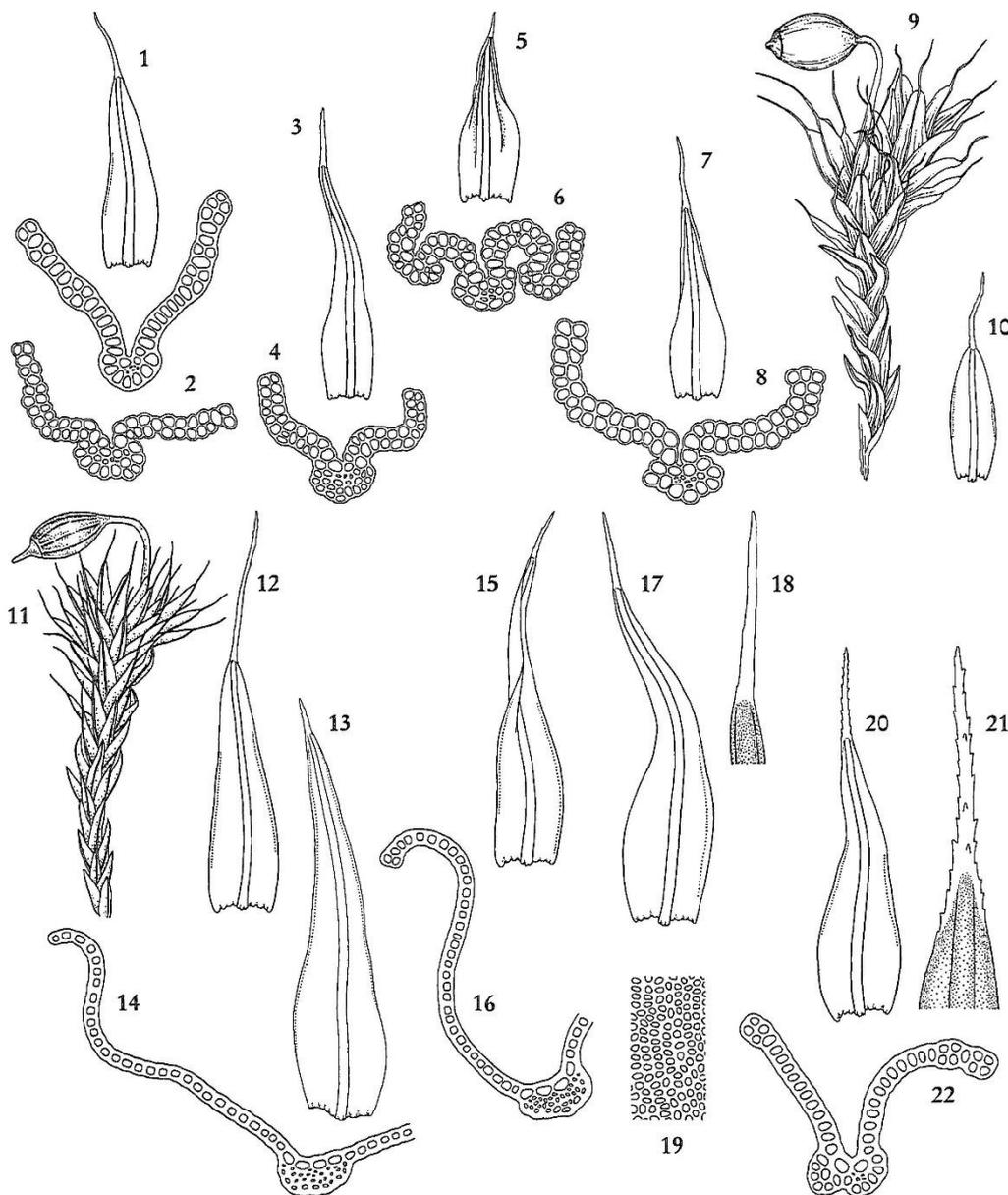


FIGURE 15. 1-2, *Grimmia reflexidens*: 1, leaf; 2, leaf sections. 3-4, *G. montana*: 3, leaf; 4, leaf section. 5-6, *G. caespiticia*: 5, leaf; 6, leaf section. 7-8, *G. alpestris*: 7, leaf; 8, leaf section. 9-10, *G. orbicularis*: 9, habit; 10, leaf. 11-12, *G. pulvinata*: 11, habit; 12, leaf. 13-14, *G. dissimulata*: 13, leaf; 14, leaf section. 15-16, *G. trichophylla*: 15, leaf; 16, leaf section. 17-19, *G. elatior*: 17, leaf; 18, leaf apex; 19, upper cells of leaf. 20-22, *G. muehlenbeckii*: 20, leaf; 21, leaf apex; 22, leaf section. 9, 11 (x8); 1, 3, 5, 7, 10, 12, 13, 15, 17, 20 (x18); 18, 21 (x45); 2, 4, 6, 8, 14, 16, 19, 22 (x160).

- 8 Leaf cells at basal margin thin-walled 9
- 8 Leaf cells at basal margin with the transverse walls thickened 14
- 9 Leaf margin plane towards apex (fig. 14, 25-27) **G. arenaria** Hampe
 Leaves spirally twisted to flexuose when dry, lanceolate, acute, hyaline point to 2,8 mm long, denticulate or dentate, plane; laminal cells smooth. Autoicous. Seta to 2 mm long, curved; capsule emergent; calyptra mitriform. Forms dense, dark green to black cushions to 1,5 cm high, on acidic rocks, in the montane areas. Very rare, in the Pyrenees. Esp, And.
- 9 Leaf margin totally or partially recurved or at least recurved on one side 10
- 10 Leaves crisped when dry; perichaetial leaves with hyaline point to 1 mm long (fig. 14, 28) **G. incurva** Schwägr.
 Leaves muticous, linear-lanceolate, base oblong, erect when dry; basal cells towards nerve thick-walled, nodulose. Seta slightly curved; capsule exerted, straight. Forms dense, fragile, dark green cushions, to 4 cm high, on acidic, wet rocks in high mountains. Very rare, in the Pyrenees. Esp, And.
- 10 Leaves straight or slightly flexuose when dry; perichaetial leaves with hyaline point to 0,3 mm long, occasionally muticous 11
- 11 Plants dark green, nearly blackish; nerve occupying most of upper part of leaf; leaf tips fragile (fig. 14, 28) **G. incurva** Schwägr.
 Leaves muticous, linear-lanceolate, base oblong, erect when dry; basal cells towards nerve thick-walled, nodulose. Seta slightly curved; capsule exerted, straight. Forms dense, fragile, dark green cushions, to 4 cm high, on acidic, wet rocks in high mountains. Very rare, in the Pyrenees. Esp, And.
- 11 Plants olive green, brownish, rusty brown or blackish brown; nerve not occupying most of upper part of leaf; leaf tips not fragile (fig. 14, 29-30) **G. elongata** Kaulf.
 Leaves appressed, lanceolate, straight. Seta straight. Forms dense, fragile brownish red cushions, to 4 cm high, on exposed, acidic rocks, in high mountains. Very rare, in the Pyrenees. Esp, And.
- 12 Leaves strongly crisped when dry (fig. 14, 19-21) **G. torquata** Drumm.
 Leaves oblong-lanceolate, hyaline point smooth, short or very short, at least present in upper leaves. Gemmae pluricellular, forming pedicellate clusters in the axils of upper leaves. Forms dense, fragile, to 5 cm high, brownish to orange cushions, dark green to blackish. Grows on acidic, shaded rocks and in wet, sheltered rock crevices, in

montane areas and high mountains. Scattered in the Peninsula, mainly in the Pyrenees, Spanish Central Range, Cantabrian Mountains and Sierra Nevada. Esp, Prt, And.

- 12 Leaves not crisped when dry 13
- 13 Plants with gemmae at leaf apex 14
- 13 Plants without gemmae or gemmae not developed at leaf apex 15
- 14 Gemmae green, light green, yellowish or pale orange; nerve not sulcate on dorsal side; stem with central strand (fig. 14, 14-16) **G. anomala** Hampe ex Schimp.
Leaves erect, less than 3 mm long, broadly ovate-lanceolate, apex acuminate, truncate in propaguliferous leaves; lamina unistratose, bistratose at margins, laminal cells dense striate, papillose-like owing to cuticular thickened walls; basal cells with straight walls. Forms dense to loose, dull green turfs, to 4 cm high, on more or less exposed, acidic rocks, in montane areas. Rare, in the north and centre of the Peninsula. Esp, And.
- 14 Gemmae orange or reddish; nerve sulcate on dorsal side; stem without central strand (fig. 14, 17-18) **G. hartmanii** Schimp.
Plants 8-10 cm tall. Leaves erecto-patent to falcate-secund, to 3 mm long, lanceolate, acuminate, ending in a short hyaline point; laminal cells with sinuose walls. Forms loose turfs on exposed, acidic, more or less wet rocks, from the lowlands to the high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 15 Leaves without hyaline point 16
- 15 Leaves, at least perichaetial leaves, with hyaline or yellowish point 18
- 16 Leaf margin plane (fig. 14, 12-13) **G. unicolor** Hook.
Leaves ovate-lanceolate, concave, with broad and sheathing base, not carinate, sigmoid in lateral view, erect and rigid when dry; upper half of lamina 2-4-stratose, with very obscure cells, 7 µm wide, basal cells beside nerve with nearly or totally straight walls. Seta long, straight; capsule exerted. Forms loose, dark brown to blackish cushions, to 5 cm high, on acidic rocks in the high mountains. Very rare, in the Pyrenees. Esp, And.
- 16 Leaf margin at least partially recurved or recurved on one side 17
- 17 Leaf apex acuminate; nerve on dorsal side usually with one deep furrow flanked by 2 wings (fig. 14, 8-9) **G. ramondii** (Lam. & DC.) Margad.
Dryptodon patens (Hedw.) Brid.

Plants robust, 10 cm long or longer, often with curved branches. Leaves dark green, flexuose when dry, long, lanceolate, carinate, with broad base, apex acute, rarely with hyaline point, margin bistratose, recurved; lamina unistratose or partially bistratose, laminal cells irregularly quadrate, basal cells linear, nodulose, smooth; nerve stout, prominent, ending below apex. Seta long, curved; capsule elliptical, striate. Forms loose, dark green turfs, blackish below, on vertical, shady, wet, granitic rocks, in montane areas and high mountains, mainly in the northern half of the Peninsula. Esp, Prt, And.

- 17 Leaf apex obtuse; nerve without wings on dorsal side (fig. 14, 10-11) **G. atrata** Miel. ex Hornsch.
Leaves lanceolate, obtuse, carinate at apex, flexuose or upper leaves twisted when dry, lamina unistratose or partially bistratose, margin bistratose, recurved on one side; median cells 9 µm wide; basal cells beside nerve nodulose, alar group 2-3-stratose, of inflated cells. Seta straight; capsule exerted, symmetrical. Forms compact, dark green to blackish or ferruginous cushions, to 5,5 cm high, on acidic rocks, in the high mountains in the Pyrenees. Esp, And.
- 18 Nerve weakly differentiated, slightly prominent dorsally **19**
- 18 Nerve differentiated, strongly prominent dorsally **21**
- 19 Basal cells towards nerve rectangular, 4-8:1, with nodulose walls; perichaetial leaves similar to stem leaves; seta longer than capsule (fig. 16, 12) **G. ovalis** (Hedw.) Lindb.
Upper lamina 2-4(-5)-stratose. Capsule straight; calyptra cucullate. Forms loose, dark green to blackish cushions, to 5 cm high, on exposed rocks, in montane areas and high mountains, in the northern half of the Peninsula, very rare in the southeast. Esp, Prt, And.
Depauperate specimens may be confused with *G. tergestina*.
- 19 Basal cells towards nerve isodiametric to shortly rectangular, 1,5-3,5:1, with non-nodulose walls; perichaetial leaves hyaline, transparent; seta shorter than capsule **20**
- 20 Seta straight; capsule symmetrical at base; plants growing on calcareous rocks (fig. 16, 13)
G. tergestina Tomm. ex Bruch & Schimp.
Median cells of lamina 6-12 µm wide. Capsule yellow; peristome teeth reddish yellow, strongly perforated; spores 8-10 µm. Forms dense, whitish green cushions, 5 cm high, on exposed, basic rocks, in montane areas. Scattered throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 20 Seta sigmoid; capsule gibbous at base; plants growing on calcareous or acidic rocks (fig. 16, 14)
G. crinitoleucophaea Cardot
G. poecilostoma Cardot & Sébille

Median cells of lamina 8-12 μm long. Perichaetial leaves strongly differentiated from vegetative leaves. Seta sigmoid; capsule ovoid, yellow; peristome teeth orange, strongly perforated; spores 10-12 μm . Forms dense dark green to blackish cushions, to 2 cm high, on exposed, acidic rocks, in montane areas and high mountains. Very rare in the Pyrenees and in the northeast of the Peninsula. Esp, And.

21 Nerve on dorsal side with one deep furrow, with angulate or winged dorsal projections, or irregularly triangular in cross section 22

21 Nerve semicircular or angulate in cross section 25

22 Nerve with 2 layers of guide cells towards base; lamina 2-4 stratosed; cells bulging, irregularly projecting on both sides, scattered papillose, occasionally smooth (fig. 15, 17-19)

G. elatior Bruch ex Bals.-Criv. & De Not.

Leaves 2-3,5 mm long, bistratose, margin 3-4-stratose in the upper part, recurved on one side, hyaline point to 2 mm, less than 1/2 length of lamina, smooth or nearly so, occasionally lacking; median cells 10-20 μm long, basal cells towards nerve rectangular, nodulose, thick-walled; nerve prominent on back, irregular in cross section. Seta long, curved; capsule pale yellow; peristome reddish. Forms loose, rigid, brownish green to dark green turfs, to 8 cm high, on sheltered, acidic rocks, in high mountains, in the northern half of the Peninsula, mainly in the Pyrenees. Esp, And.

22 Nerve with 1 layer of guide cells towards base; lamina unistratose or irregularly bistratose; cells not bulging or papillose 23

23 Nerve with 2 guide cells on ventral side; stem with central strand (fig. 15, 20-22)

G. muehlenbeckii Schimp.

Leaves to 2 mm long, lanceolate, with partially bistratose apex, margin recurved on one or both sides at middle, hyaline point short, cylindrical, denticulate, plane. Gemmae often present, 30-60 μm wide, pluricellular, shortly pedicellate, on dorsal base of upper leaves. Capsule ovoid, glossy, yellowish or dark brown, smooth; peristome teeth orange. Forms dense, olive green to blackish cushions, to 2 cm high, on exposed, acidic rocks, in montane areas and high mountains in the Pyrenees. Esp, And.

23 Nerve with 2-6 guide cells on ventral side; stem without central strand 24

24 Leaves without hyaline point, sometimes with a few yellowish cells at apex; without gemmae (fig. 14, 8-9)

G. ramondii (Lam. & DC.) Margad.

Dryptodon patens (Hedw.) Brid.

Plants robust, 10 cm long or longer, often with curved branches. Leaves dark green, flexuose when dry, long, lanceolate, carinate, with broad base, apex acute, rarely with hyaline point, margin bistratose, recurved; lamina

unistratose or partially bistratose, laminal cells irregularly quadrate, basal cells linear, nodulose, smooth; nerve stout, prominent, ending below apex. Seta long, curved; capsule elliptical, striate. Forms loose, dark green turfs, blackish below, on vertical, shady, wet, granitic rocks, in montane areas and high mountains, mainly in the northern half of the Peninsula. Esp, Prt, And.

- 24 Leaves with hyaline point; orange or reddish gemmae at leaf apex (fig. 14, 17-18) **G. hartmanii** Schimp.
Plants 8-10 cm tall. Leaves erecto-patent to falcate-secund, to 3 mm long, lanceolate, acuminate, ending in a short hyaline point; laminal cells with sinuose walls. Forms loose turfs on exposed, acidic, more or less wet rocks, from the lowlands to the high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 25 Leaf margin plane towards apex **26**
- 25 Leaf margin at least partially recurved or recurved on one side **30**
- 26 Laminal cells bulging on both sides **27**
- 26 Laminal cells not bulging or bulging only on one side **29**
- 27 Leaves with strong, longitudinal plicae on both sides of nerve (fig. 15, 5-6) **G. caespiticia** (Brid.) Jur.
Leaves appressed, cucullate, margin plane and entire, apex cucullate, ending in short, to 0,5 mm, hyaline point, plicae usually of cells with small lumina and thickened walls. Seta straight; capsule exerted, ovoid, symmetrical, brownish, with stomata at base; calyptra cucullate. Forms dense, readily disintegrating, glaucous cushions, to 1 cm high, on dry, acidic rocks, in montane areas and high mountains. Scattered in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.
When sterile, this species may be confused with *Coscinodon cribrosus*, but the latter has smooth cells.
- 27 Leaves not plicate or with faint plicae **28**
- 28 Dioicous; capsule fusiform; capsule and peristome brownish, without stomata at base of capsule; exothecial cells thick-walled (>3 µm) (fig. 15, 7-8) **G. alpestris** (F.Weber & D.Mohr) Schleich.
Leaves patent to spreading when wet, appressed when dry, ovate, appressed when dry, apex cucullate, upper margin plane, hyaline point to 1,5 mm long, cylindrical, smooth or slightly denticulate; lamina 2(-3)-stratose, basal cells at margin quadrate to rectangular. Capsule attenuate at base; lid short, straight, obtuse; calyptra cucullate. Dioicous. Forms compact, glaucous to green cushions on dry, acidic rocks, in montane areas and high mountains. Scattered in the north of the Peninsula and in Sierra Nevada. Esp, And.

- 28 Autoicous; capsule ovoid; capsule straw-coloured, the colour clearly different to peristome, with stomata at base of capsule; exothecial cells thin-walled ($<3 \mu\text{m}$) (fig. 15, 1-2) **G. reflexidens** Müll.Hal.
G. sessitana De Not
 Leaves patent to spreading, ovate to lanceolate, appressed when dry, ending in hyaline point, to 1,5 mm, cylindrical, smooth or with obtuse teeth; upper lamina bistratose, longitudinally plicae weak or lacking, basal cells shortly rectangular, with thickened transverse walls at margins. Seta straight or slightly curved. Forms loose or dense, yellowish green to brown cushions, to 1 cm high, on dry, humid or periodically wet, acidic rocks, in high mountains, in northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.
- 29 Leaves patent or spreading when moist, not sigmoid in lateral view; capsule straw-coloured, the colour clearly different to peristome, with stomata at base (fig. 15, 1-2) **G. reflexidens** Müll.Hal.
G. sessitana De Not
 Leaves patent to spreading, ovate to lanceolate, appressed when dry, ending in hyaline point, to 1,5 mm, cylindrical, smooth or with obtuse teeth; upper lamina bistratose, longitudinally plicae weak or lacking, basal cells shortly rectangular, with thickened transverse walls at margins. Seta straight or slightly curved. Forms loose or dense, yellowish green to brown cushions, to 1 cm high, on dry, humid or periodically wet, acidic rocks, in high mountains, in northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.
- 29 Leaves with basal part appressed when moist, upper part spreading with apex curved toward stem, sigmoid in lateral view; capsule and peristome brownish, without stomata at base (fig. 15, 3-4) **G. montana** Bruch & Schimp.
 Leaves erect, sigmoid in lateral view, appressed, flexuose when dry, acuminate, margin plane, hyaline point 1,5 mm long, cylindrical, with obtuse or acute teeth. Seta 2-4 mm long; peristome teeth 50-90 μm wide at base. Forms dense, olive green cushions on dry, acidic rocks, in montane areas and high mountains. Widespread throughout the Peninsula. Esp, Prt, And.
- 30 Cross section of nerve reniform, with 2-6 guide cells on ventral side **31**
- 30 Cross section of nerve semicircular, with 2 guide cells on ventral side **35**
- 31 Stem ascending; plants dioicous **32**
- 31 Stem erect or ascending and plants autoicous **34**
- 32 Basal paracostal cells longly rectangular (fig. 14, 8-9) **G. ramondii** (Lam. & DC.) Margad.
Drytodon patens (Hedw.) Brid.

Plants robust, 10 cm long or longer, often with curved branches. Leaves dark green, flexuose when dry, long, lanceolate, carinate, with broad base, apex acute, rarely with hyaline point, margin bistratose, recurved; lamina unistratose or partially bistratose, laminal cells irregularly quadrate, basal cells linear, nodulose, smooth; nerve stout, prominent, ending below apex. Seta long, curved; capsule elliptical, striate. Forms loose, dark green turfs, blackish below, on vertical, shady, wet, granitic rocks, in montane areas and high mountains, mainly in the northern half of the Peninsula. Esp, Prt, And.

32 Basal paracostal cells shortly rectangular

33

33 Nerve reniform in cross section, with dorsal nerve contour regularly convex; leaves spreading to squarrose when moist, margin plane towards apex (leaves flatten easily in preparation); stem with central strand (fig. 16, 1-3)

G. lisae De Not.

Leaves to 5 mm, apex acute, carinate, bistratose at margins, hyaline point stout, denticulate; median cells quadrate or rounded, thick-walled, not sinuose, cells towards base quadrate to shortly rectangular, 1-3 times as long as wide, with thick and straight walls. Gemmae pluricellular, shortly pedicellate, in the axils of upper leaves. Capsule ellipsoidal, brown or yellow; peristome teeth orange. Forms dense or loose, blackish brown cushions, 2-3 cm high, on acidic rocks in very moist and shaded sites, rare at base of trees, in the lowlands and montane areas. Widespread throughout the Peninsula. Esp, Prt, Bl.

33 Nerve semicircular in cross section, irregularly sulcate or with ribs, with dorsal nerve contour irregular; leaves patent or somewhat secund when moist, strongly keeled towards apex (leaves remain folded longitudinally along nerve in preparation); stem without central strand (fig. 14, 17-18)

G. hartmanii Schimp.

Plants 8-10 cm tall. Leaves erecto-patent to falcate-secund, to 3 mm long, lanceolate, acuminate, ending in a short hyaline point; laminal cells with sinuose walls. Forms loose turfs on exposed, acidic, more or less wet rocks, from the lowlands to the high mountains, in the northern half of the Peninsula. Esp, Prt, And.

34 Perigonia axillary, below perichaetium; seta curved; capsule ribbed; hair point of upper leaves patent or spreading, with many sharp teeth (fig. 16, 4-6)

G. decipiens (Schultz) Lindb.

Leaves 2,5-3 mm long, margin recurved on both sides, hyaline point more to 2,5 mm, cylindrical at base; upper lamina partially bistratose, paracostal basal cells with thick and nodulose walls, shorter and with thickened transverse walls at margins. Autoicous. Seta long, flexuose, twisted when dry. Forms loose, whitish, cushions, yellowish to dark green below, to 7 cm high, on exposed, acidic rocks, in montane areas and high mountains. Widespread throughout the Peninsula, mainly in the northern half. Esp, Prt, And.

34 Perigonia terminal; seta straight; capsule smooth; hair point of upper leaves erect, slightly dentate (fig. 16, 7)

G. longirostris Hook.

G. affinis Hornsch.

Leaves ovate-lanceolate, rigid, lamina 2-3-bistratose, recurved on one side, hyaline hair point occasionally lacking; basal cells towards margin isodiametric to rectangular, with thickened transverse walls. Autoicous. Forms compact, rounded, yellowish green to dark green or ferrugineous to blackish cushions, to 6 cm high, on dry, exposed, non-calcareous rocks, in montane areas and high mountains. Scattered in the north of the Peninsula. Esp, And.

35 Leaves lingulate or elliptical, when hair point lacking leaves different from leaves with hair point, apex more or less cucullate 36

35 Leaves ovate or lanceolate, when hair point lacking leaves similar to leaves with hair point 38

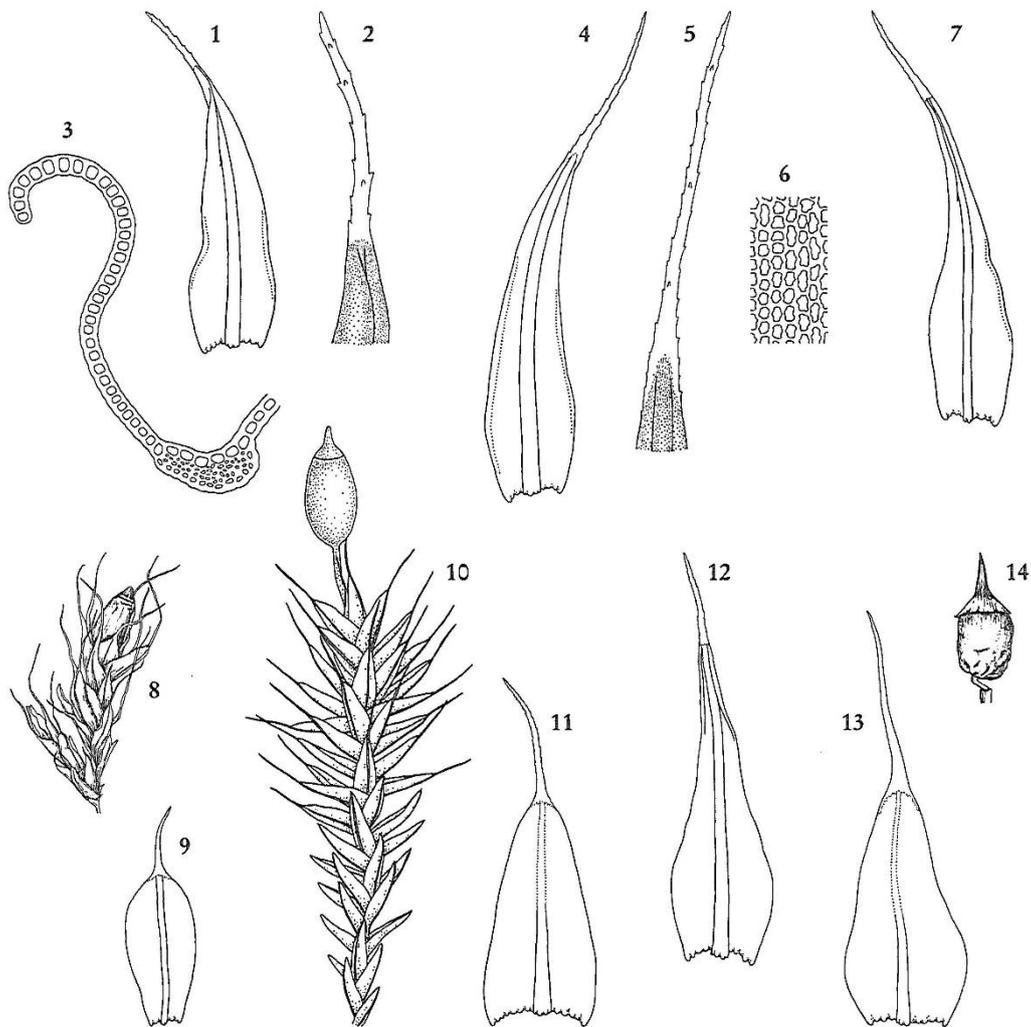


FIGURE 16. 1-3, *Grimmia lisae*: 1, leaf; 2, leaf apex; 3, leaf section. 4-6, *G. decipiens*: 4, leaf; 5, leaf apex; 6, upper cells of leaf. 7, *G. longirostris*, leaf. 8-9, *G. crinita*: 8, habit; 9, leaf. 10-11, *G. laevigata*: 10, habit; 11, leaf. 12, *G. ovalis*, leaf. 13, *G. tergestina*, leaf. 14, *G. crinitoleucophaea*, capsule. 8, 10 (x8); 14 (x10); 1, 4, 7, 9, 11, 12, 13 (x18); 2, 5 (x45); 3, 6 (x160).

36 Seta to 1 mm long, straight; capsule immersed

G. capillata De Not.

G. mesopotamica Schiffn.

Leaves cucullate, straight and appressed when dry; basal cells at margin rectangular. Lid conical to mamillate; calyptra mitriform; peristome teeth orange; spores about 12-14 μm . Forms dense, yellowish green to olive green cushions on mortar of walls and banks with gypsiferous soil. Very rare in the east and southeast of the Peninsula, scattered in Mallorca. Esp, Bl.

- 36 Seta more than 1,5 mm long, curved; capsule exerted 37
- 37 Perigonia axillary, below perichaetium; calyptra mitrate (fig. 15, 11-12) **G. pulvinata** (Hedw.) Sm.
Median cells of lamina 6-14 μm long, basal cells towards nerve shortly rectangular, with thin and straight walls, 1-2:1 at margins. Perigonial leaves strongly modified, hyaline or orange. Capsule striate when dry, yellowish; lid rostrate to rostellate; peristome teeth orange. Forms whitish cushions, 1-5 cm high, on mortar walls and exposed, acidic or basic rocks, in the lowlands and montane areas, rarely in high mountains. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 37 Perigonia terminal; calyptra cucullate (fig. 15, 9-10) **G. orbicularis** Bruch ex Wilson
Leaves abruptly narrowed into hyaline point; median cells of lamina 9-18 μm long, basal cells towards nerve longly rectangular, thick-walled, nodulose, 1,5-8:1 at margins. Seta 1,5-3 mm long, curved; capsule inclined, exerted, ovoid, striate; lid mamillate; peristome teeth perforated, irregularly divided at apex, orange. Forms whitish green cushions, to 4 cm high, on calcareous soils and mortar of walls, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 38 Leaves when dry clearly arranged in spiral rows around stem; flagelliform shoots with differentiated leaves (fig. 14, 22-24) **G. funalis** (Schwägr.) Bruch & Schimp.
Stem with narrow, central strand. Leaves ovate-lanceolate, asymmetrical, flexuose, hyaline point absent in male plants; basal cells longly rectangular, thick-walled, sinuose; nerve faint below. Seta curved; capsule exerted, striate when dry. Dioicous. Forms dense, fragile, green-olive cushions, blackish below, 1-5 cm high, on vertical, dry or wet, acidic rocks, in montane areas and high mountains in the north of the Peninsula and in Sierra Nevada. Esp, And.
- 38 Leaves when dry not arranged in spiral rows around stem; flagelliform shoots without differentiated leaves 39
- 39 Lamina bistratose in upper 2/3, 2-3(4)-stratose at margins, gemmae lacking (fig. 15, 1-2) **G. reflexidens** Müll.Hal.
G. sessitana De Not.
Leaves patent to spreading, ovate to lanceolate, appressed when dry, ending in hyaline point, to 1,5 mm, cylindrical, smooth or with obtuse teeth; upper lamina bistratose, longitudinally plicae weak or lacking, basal cells shortly rectangular, with thickened transverse walls at margins. Seta straight or slightly curved. Forms loose or dense,

yellowish green to brown cushions, to 1 cm high, on dry, humid or periodically wet, acidic rocks, in high mountains, in northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

- 39 Lamina unistratose or partially bistratose in upper 2/3, rarely almost uniformly bistratose, margins bistratose; gemmae formed on laminal cells, liberation causing breakdown of leaves

40

- 40 Nerve in cross section towards base of leaf with 2 layers of guide cells, 1-3 lower ones smaller than the ventral surface cells; basal paracostal cells smooth or slightly nodulose; basal marginal cells longly rectangular (2-5:1) (fig. 15, 15-16)

G. trichophylla Grev.

G. britannica A.J.E. Sm.

Hyaline point straight to flexuose, cylindrical at base; median cells of lamina with thick and sinuose walls, basal cells 2-5 times as long as wide, with thin, smooth or nodulose walls; nerve in leaf base with guide cells arranged in two layers, 2 cells in the outer layer and 1-3 smaller cells in the inner layer. Sessile gemmae present on back of lamina, seldom on the nerve. Capsule oblong, dull, yellow; peristome teeth orange yellow. Forms loose, easily disintegrating cushions, yellowish above, blackish below, to 3 cm high, on sheltered, usually siliceous rocks, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

Extremely variable species, when sterile is hard to distinguish from *G. muehlenbeckii* and *G. dissimulata*.

- 40 Nerve in cross section towards base with a single layer of guide cells; basal paracostal cells usually clearly nodulose; basal marginal cells isodiametric or shortly rectangular (1-3:1)

41

- 41 Basal paracostal cells longly rectangular (3-7:1), with walls as thick as or more than lumen, forming a differentiated yellowish area

G. meridionalis (Müll. Hal.) E.Maier

Leaves patent to spreading, squarrose at apex, appressed when dry, with acute to acuminate apex, margin recurved on one side or plane; nerve in leaf base with 2 guide cells arranged in 1 ventral layer, elliptical in cross section (with its major axes v-shaped) toward leaf base. Forms compact yellowish green cushions to 3 cm, on exposed, acidic rocks in montane areas. Scattered in the Peninsula. Esp, Prt.

- 41 Basal paracostal cells rectangular (2-5:1), with walls not as thick as lumen, not forming a differentiated area (fig. 15, 13-14)

G. dissimulata E.Maier

Leaves spreading or erecto-patent, erect when dry, with acuminate apex, margin recurved when wet; nerve in leaf base with 2 guide cells arranged in 1 ventral layer, rounded in cross section toward leaf base. Forms compact yellowish green cushions or extensive tufts to 3 cm, on usually acidic or calcareous rocks in the lowlands and montane areas. Scattered in the Peninsula. Esp, Prt, Bl.

This species may be confused with *G. lisae*, but that species differs in its nerve in the leaf base having 6 guide cells.

Racomitrium Brid.

Plants fairly robust. Stem erect or procumbent, mostly densely, shortly branched. In some species, all or only the upper leaves are elongated in a long, hyaline point; laminal cells sinuose, basal cells sinuose-nodulose. Capsule ovoid or cylindrical, straight, smooth. Mainly growing on siliceous rocks, rarely on calcareous rocks and soils.

1 Lamina totally or partially bistratose in upper part 2

1 Lamina unistratose 4

2 Lamina bistratose; leaf ovate to elliptical with acute to obtuse apex (fig. 17, 19-20)

R. hespericum Sérgio, J. Muñoz & Ochyra

Plants green or olivaceous. Nerve 140-180 μm wide at base, 6-10 cells wide on the ventral side. Spores 18-22 μm . Forms \pm dense, rigid tufts to 7 cm high on wet rocks or granitic rocks in flowing waters, in montane areas and high mountains, in the north, western and central part of the Peninsula. Esp, Prt.

2 Lamina bistratose or partially bistratose; leaves lanceolate or ovate lanceolate, with acuminate apex 3

3 Leaf apex with hyaline point; nerve 2-stratose in the central part (fig. 17, 7)

R. lusitanicum Ochyra & Sérgio

Leaves rigid, straight or slightly falcate, hair point to 0,5 mm long, rarely longer, not dentate or nearly so; leaf margin 2-4-stratose of 4-15 rows of cells; nerve 4-6 cells wide on the ventral side, plane or slightly convex on dorsal side. Capsule cylindrical elongate, 2-3 mm long; spores 12-16(-20) μm . Plants green or blackish, forming \pm loose, prostrate tufts, to 2-4 cm long, on wet or periodically wet, acidic, usually vertical, rocks, in montane areas and high mountains, in the northwestern part of the Peninsula. Esp, Prt.

3 Leaf apex without hyaline point; nerve 3-4-stratose in the central part (fig. 17, 23-24)

R. lamprocarpum (Müll.Hal.) A. Jaeger

Plants yellowish green to almost black; stem rigid, with ascending tips, 3-10 cm long, branched from base. Leaves straight, falcate, lanceolate, with reflexed apex; margin 2-4-stratose of 4-15 rows of cells. Spores 20-30 μm . Grows on wet, usually granitic, rocks in streams, in montane areas, in the northwest of the Peninsula. Esp, Prt.

4 Leaf apex with hyaline point 5

4 Leaf apex without hyaline point 14

5 Hyaline point papillose

6

5 Hyaline point not papillose

8

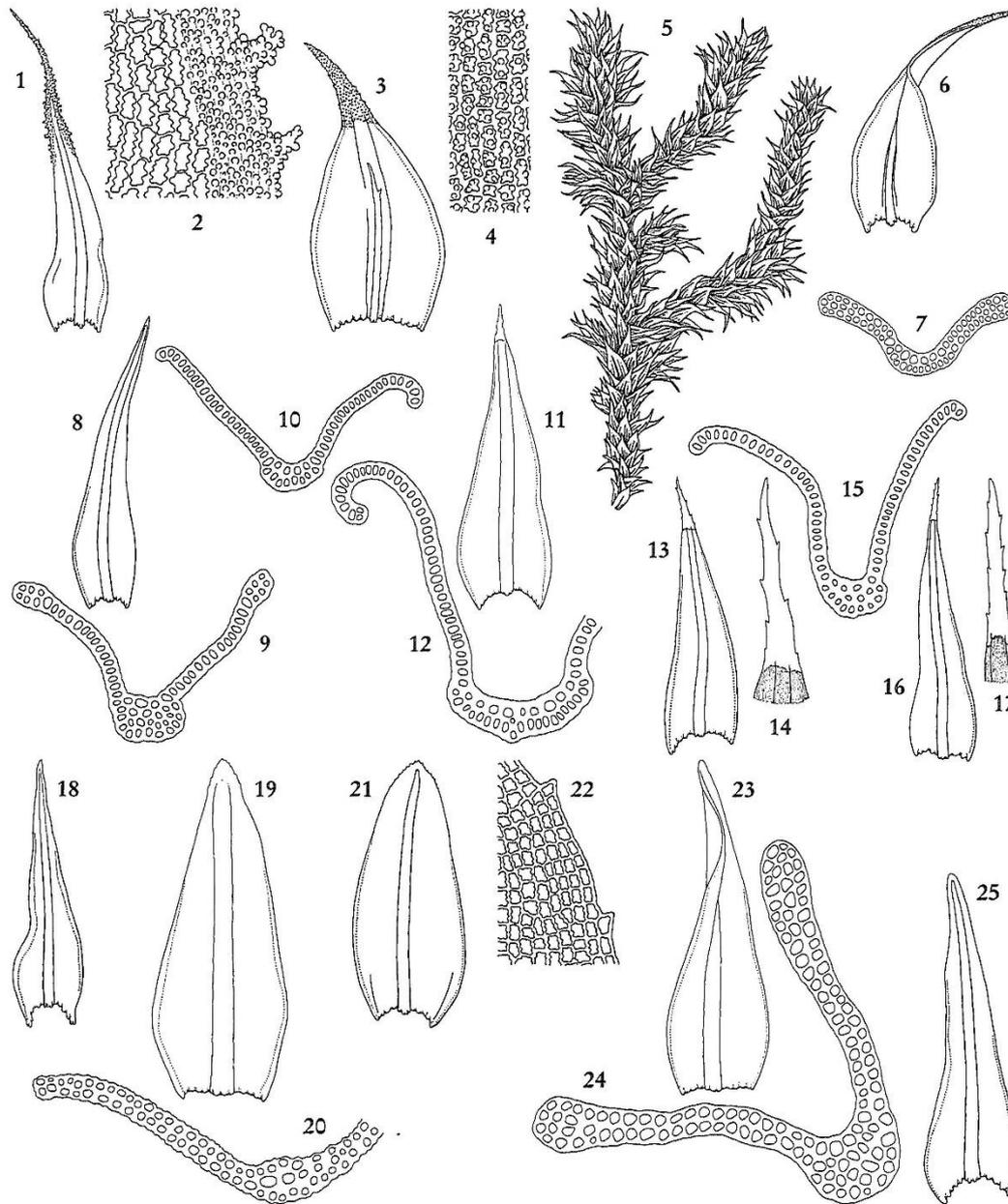


FIGURE 17. 1-2, *Racomitrium lanuginosum*: 1, leaf; 2, upper cells. 3-4, *R. canescens*: 3, leaf; 4, median cells. 5-6, *R. elongatum*: 5, habit; 6, leaf. 7, *R. lusitanicum*, leaf section. 8-9, *R. macounii* subsp. *alpinum*: 8, leaf; 9, leaf section. 10, *R. heterostichum*, leaf section. 11-12, *R. obtusum*: 11, leaf; 12, leaf section. 13-15, *R. affine*: 13, leaf; 14, leaf apex; 15, leaf section. 16-17, *R. sudeticum*: 16, leaf; 17, leaf apex. 18, *R. fasciculare*, leaf. 19-20, *R. hespericum*: 19, leaf; 20, leaf section. 21-22, *R. aciculare*: 21, leaf; 22, upper cells. 23-24, *R. lamprocarpum*: 23, leaf; 24, leaf section. 25, *R. aquaticum*, leaf. 5 (x1,6); 1, 3, 6, 8, 11, 13, 16, 18, 19, 21, 23, 25 (x16); 14, 17 (x60); 7, 9, 10, 12, 15, 20, 24 (x160); 2, 4, 22 (x230).

- 6 Laminal cells of leaves smooth (fig. 17, 1-2) **R. lanuginosum** (Hedw.) Brid.
Stem to 15 cm long or more, densely branched. Leaves lanceolate, keeled, long, narrow, hyaline point long, decurrent, strongly papillose and with coarse, deep teeth at margin; nerve stout, long. Forms patches or lax cushions on acidic rocks in montane areas, in the northern and western halves of the Peninsula. Esp, Prt, And.
- 6 Laminal cells of leaves papillose **7**
- 7 Leaves non- or slightly carinate; nerve bifurcate, not extending half way up (fig. 17, 3-4) **R. canescens** (Hedw.) Brid.
Plants robust, brown at base, grey or whitish above. Stem 3-7 cm long or more. Leaves concave, widely ovate to ovate-lanceolate, hyaline point wide, flat at base, often dentate or spinulose, non- or slightly decurrent; laminal cells with high papillae, marginal cells near base longer than wide, with non-sinuose walls. Forms lax tufts on rock ledges and dry, exposed, sandy, usually acidic soils, in montane areas and high mountains, mainly in the northeastern part of the Peninsula. Esp, And.
- 7 Leaves carinate; nerve reaching apex or nearly so (fig. 17, 5-6) **R. elongatum** Ehrh. ex Frisvoll
Plants robust, greenish. Stem 3-5 cm long or more. Leaves lanceolate to ovate-lanceolate, hyaline point long, flat at base, slender, often strongly denticulate, decurrent; marginal cells near base wider than long, with sinuose walls. Forms lax tufts on rocks and exposed, sandy soils, usually on acidic substrata, in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 8 Leaf margin 2-3(4)-stratose of 2-4 rows of cells **9**
- 8 Leaf margin 1-2-stratose of 1(2) row of cells **10**
- 9 Leaves contorted when dry, dull olive green; hyaline point spinulose, straight, short, usually less than 100 µm long **R. macounii** Kindb. subsp. **macounii**
Forms lax tufts, to 6 cm high, on exposed, acidic rocks, periodically wet by thaw water, in high mountains. Scattered in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.
- 9 Leaves straight when dry, glossy brownish red; hyaline point dentate or spinulose, reflexed, to 200 µm long (fig. 17, 8-9) **R. macounii** Kindb. subsp. **alpinum** (E.Lawton) Frisvoll
Forms loose cushions, to 8 cm high, on acidic rocks in streams, in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 10 Basal marginal cells not sinuose, forming a pellucid, 1(-2)-rows border of 10-25 cells **R. microcarpon** (Hedw.) Brid.

Plants dull olive green, to 3 cm long, prostrate, subpinnate branched. Leaves lanceolate to ovate-lanceolate, hyaline point flattened, to 1 mm long, narrow at the insertion with chlorophyllose cells; margin recurved; nerve rectangular or sometimes slightly reniform in cross section, 2-3-stratose in the leaf median part, 2 cells wide on ventral side; central basal cells strongly incrassate, with straight and porose walls. Perichaetial leaves similar to stem leaves. Capsule oblong. Forms dense tufts attached to substrate, on granitic rocks. Only one locality above 900 m in the centre of the Peninsula. Esp.

- 10 Basal marginal cells sinuose, not forming a border or forming a border of less than 10 cells 11
- 11 Leaf apex with cylindrical hyaline point; margin recurved to 1/3-3/4 the leaf length on one side, recurved in the basal third or in the central part on the other side; nerve reniform in cross section (fig. 17, 16-17)
R. sudeticum (Funk) Bruch & Schimp.
Plants green or olive green, blackish below, to 5 cm long, prostrate, slightly branched. Leaves lanceolate or narrowly lanceolate, hyaline point to 0,5 mm long, sometimes mucous, margin recurved; nerve 2-3-stratose in the leaf median part, 2-4 cells wide on the ventral side. Perichaetial leaves similar to stem leaves. Capsule sub-globose to cylindrical. Forms dense tufts or cushions on wet, acidic, often inclined rocks, in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 11 Leaf apex with hyaline point flattened at base; margin recurved or revolute on both sides; nerve not reniform in cross section 12
- 12 Nerve in the middle of leaf semicircular in cross section, 3-stratose, 2-4 cells wide on the ventral side (fig. 17, 13-15)
R. affine (F.Weber & D.Mohr) Lindb.
Plants dark green, olive green or brownish, to 8 cm long, irregularly branched. Leaves lanceolate to ovate-lanceolate, hyaline point non- or slightly decurrent, 0,5-1 mm long, denticulate, narrow at the insertion with chlorophyllose cells; nerve, near base, flattened on ventral side. Perichaetial leaves similar to stem leaves. Capsule oblong. Forms ± dense tufts strongly attached to substrate, on wet or periodically wet vertical rocks, from the lowlands to high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 12 Nerve in the middle of leaf rectangular or curved and with parallel sides in cross section, 2-stratose, 4-8 cells wide on the ventral side 13
- 13 Hyaline point not or only slightly flexuose, usually less than 0,5 mm long, narrow at the insertion with chlorophyllose cells (fig. 17, 11-12)
R. obtusum (Brid.) Brid.
Plants dark green, olive green or brownish, to 5 cm long, subpinnate. Leaves with hyaline point and leaves mucous on the same plant, margin widely recurved to revolute, unistratose, occasionally with bistratose spots. Capsule

oblong. Forms dense tufts strongly attached to substrate, on dry, exposed, acidic rocks, in the northwestern part of the Peninsula. Esp, Prt, And.

- 13 Hyaline point flexuose, usually more than 0,5 mm long, with a wide at the insertion with chlorophyllose cells (fig. 17, 10) **R. heterostichum** (Hedw.) Brid.

Plants green or olive green, fairly robust, to 5 cm long, procumbent, densely branched. Leaf margin narrowly or widely recurved, unistratose, rarely with bistratose spots, hyaline point to 1,5 mm long, denticulate; lamina unistratose, rarely with 2-stratose spots in the marginal row. Capsule oblong. Forms dense, yellowish green to greyish tufts on dry, exposed, acidic usually vertical rocks, in montane areas, in the northern half of the Peninsula, although rarer in the northeast and southwest. Esp, Prt, And.

Grows in drier and more exposed sites than *R. affine*.

- 14 Laminal cells longly rectangular in the upper part of leaf, 20-30 μm long; leaf apex acute to obtuse (fig. 17, 18) **R. fasciculare** (Hedw.) Brid.

Stem to 10 cm long, procumbent, with numerous fasciculate branches. Leaves linear-lanceolate to lanceolate. Forms dense, dark green or brownish tufts on shaded, siliceous rocks, in montane areas and high mountains, in the north of the Peninsula and in Sierra Nevada. Esp.

- 14 Laminal cells quadrate or shortly rectangular in the upper part of leaf, 5-20 μm long; leaf apex rounded **15**

- 15 Leaf apex dentate (fig. 17, 21-22) **R. aciculare** (Hedw.) Brid.

Stem ascending or decumbent, usually 3-4 cm long, occasionally to 10 cm long. Leaves ovate or ovate-lanceolate with obtuse to rounded apex, nerve 70-120 μm wide at base, 4-7 cells wide on the ventral side. Spores to 13-23 μm . Forms cushions or loose tufts on disintegrating granitic rocks in flowing waters, from the lowlands to high mountains, in the northern and western halves of the Peninsula and in Sierra Nevada. Esp, Prt, And.

- 15 Leaf apex entire (fig. 17, 25) **R. aquaticum** (Brid. ex Schrad.) Brid.

Plants yellowish green; stem procumbent, with ascending tips, to 10 cm long or more, sparsely branched. Leaves straight, lanceolate, with acute apex. Spores 14-20 μm . Grows on wet, mostly granitic, rocks in streams, in montane areas and high mountains, mainly in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

Schistidium Bruch & Schimp.

Plants brownish green, olive-green to blackish. Stem 0,5 to 12-15 cm high, simple or branched. Leaves ovate-lanceolate to ovate-triangular, straight or falciform, mostly ending in a hyaline point; lamina unistratose, bistratose or with bistratose spots, cells rounded to oblong, smooth or papillose, sometimes with sinuose, thick

walls. Capsule globose to cylindrical, immersed among perichaetial leaves and covered totally or partially by them, exothecial cells isodiametric, oblong or irregular, with or without stomata; lid apiculate to rostrate, coming off attached to columella; peristome teeth 16, perforated or not, orange to brownish red, in some species peristome lacking.

- | | | |
|---|--|--|
| 1 | Leaves without hyaline point | 2 |
| 1 | At least upper leaves with hyaline point | 5 |
| 2 | Leaf lamina unistratose (fig. 18, 1-3)
Laminal rounded-quadrate, cells thick-walled, ± sinuose. Exothecial cells isodiametric, with groups of oblate cells intercalated, stomata lacking. Forms turfs on acidic substrata by streams in montane areas and high mountains, in the northern half of the Peninsula and Sierra Nevada. Esp, And. | S. agassizii Sull. & Lesq. |
| 2 | Leaf lamina totally or partially bistratose | 3 |
| 3 | Leaf apex obtuse; capsule orange, yellow or light brown, cyathiform, without stomata; peristome short or rudimentary (fig. 18, 4-6)
Plants small, jet black. Leaves imbricate, ovate-triangular, slightly keeled, straight, sometimes with smooth or slightly denticulate point; nerve percurrent. Exothecial cells mostly rectangular, usually mixed with isodiametric cells. Grows on dry, calcareous rocks in montane areas of the Peninsula. Esp. | S. atrofusum (Schimp.) Limpr. |
| 3 | Leaf apex acute or acuminate; capsule reddish to dark brown, shortly cylindrical to globose, with stomata; peristome well developed | 4 |
| 4 | Leaves ovate-triangular to ovate-lanceolate, with acute apex; nerve excurrent in short apiculus (fig. 18, 7-10)
Plants medium-sized to robust, dull, olive green to blackish. Capsule sub-globose, exothecial cells isodiametric polygonal. Forms tufts on calcareous or siliceous rocks by streams in montane areas and high mountains, rarer in the lowlands, in the northern half of the Peninsula and Sierra Nevada. Esp, Prt, And. | S. rivulare (Brid.) Podp. |
| 4 | Leaves lanceolate, with acuminate apex; nerve stout, percurrent, excurrent only in the upper leaves (fig. 18, 11-14)
Plants medium-sized, dull dark green to black. Leaves falcate-secund. Capsule sub-globose to shortly cylindrical. Forms submerged or semi-submerged tufts on siliceous rocks by high mountain streams in Sierra Nevada. Esp. | S. occidentale (E.Lawton) S.P.Churchill |
| 5 | Laminal cells papillose, at least on dorsal side; exothecial cells mostly isodiametric | 6 |

5 Laminal cells smooth on dorsal side (leaf margin and dorsal side of nerve may be papillose); exothecial cells oblong or isodiametric 8

6 Leaf lamina bistratose; upper and median cells rounded or ovate, 6-9 µm wide, wall cells slightly sinuose or not; hyaline point rigid; perichaetial leaves elliptical, wider than stem leaves (fig. 18, 15-18)

S. pruinatum (Wilson ex Schimp.) G. Roth

Leaves imbricate, oblong to ovate-oblong, straight, hyaline point spinulose at base, more distantly spinulose in the upper part; laminal cells with broad papillae on both sides. Capsule oblong; peristome teeth reddish, perforated with narrow slits in the upper half. Forms olive green turfs on exposed, calcareous or siliceous rocks, in the Pyrenees and Basque Mountains. Esp, And.

6 Leaf lamina unistratose, rarely with bistratose apex; upper and median cells oblong, 8-11 µm wide, wall cells sinuose; hyaline point weak, flexuose; perichaetial leaves lanceolate, similar to stem leaves 7

7 Leaves from ovate base abruptly narrowed in long, narrow acumen, arranged in spiral rows (fig. 18, 19-21)

S. strictum (Turner) Loeske ex Martensson

Hyaline point 0-0,6 mm long, thin, narrow, ± flexuose, not or shortly decurrent. Capsule sub-globose to ovoid, reddish; peristome teeth red, entire or with small perforations in the upper part. Forms tufts on siliceous rocks in wet forests, in high mountains in the eastern Pyrenees. Esp.

7 Leaves gradually narrowed from base, not arranged in spiral rows (fig. 18, 22-24) **S. papillosum** Culm.
Leaves falcate-secund, hyaline point 0,1-1,25 mm long, thin, flexuose, decurrent spinulose in the lower part, nearly smooth in the upper part. Capsule oblong-cylindrical; peristome teeth reddish, gradually narrowed in fine point, entire or with small perforations. Forms small to large, reddish or olivaceous tufts, blackish brown below, on calcareous or granitic rocks, in montane areas and high mountains, in the north of the Peninsula, common in the Pyrenees. Esp, And.

8 Peristome lacking (fig. 18, 25-27) **S. flaccidum** (De Not.) Ochyra
Leaves erect, imbricate, ovate-lanceolate, acute, hyaline point flattened, slightly or non-decurrent, with distant, fine, acute or obtuse teeth; lamina usually unistratose. Perichaetial leaves wider than stem leaves. Capsule yellowish to light brown, hemispherical, widely cyathiform to ovoid; lid with short and obtuse beak. Grows on acidic rocks in montane areas of the Peninsula. Esp, Prt.

8 Peristome well developed 9

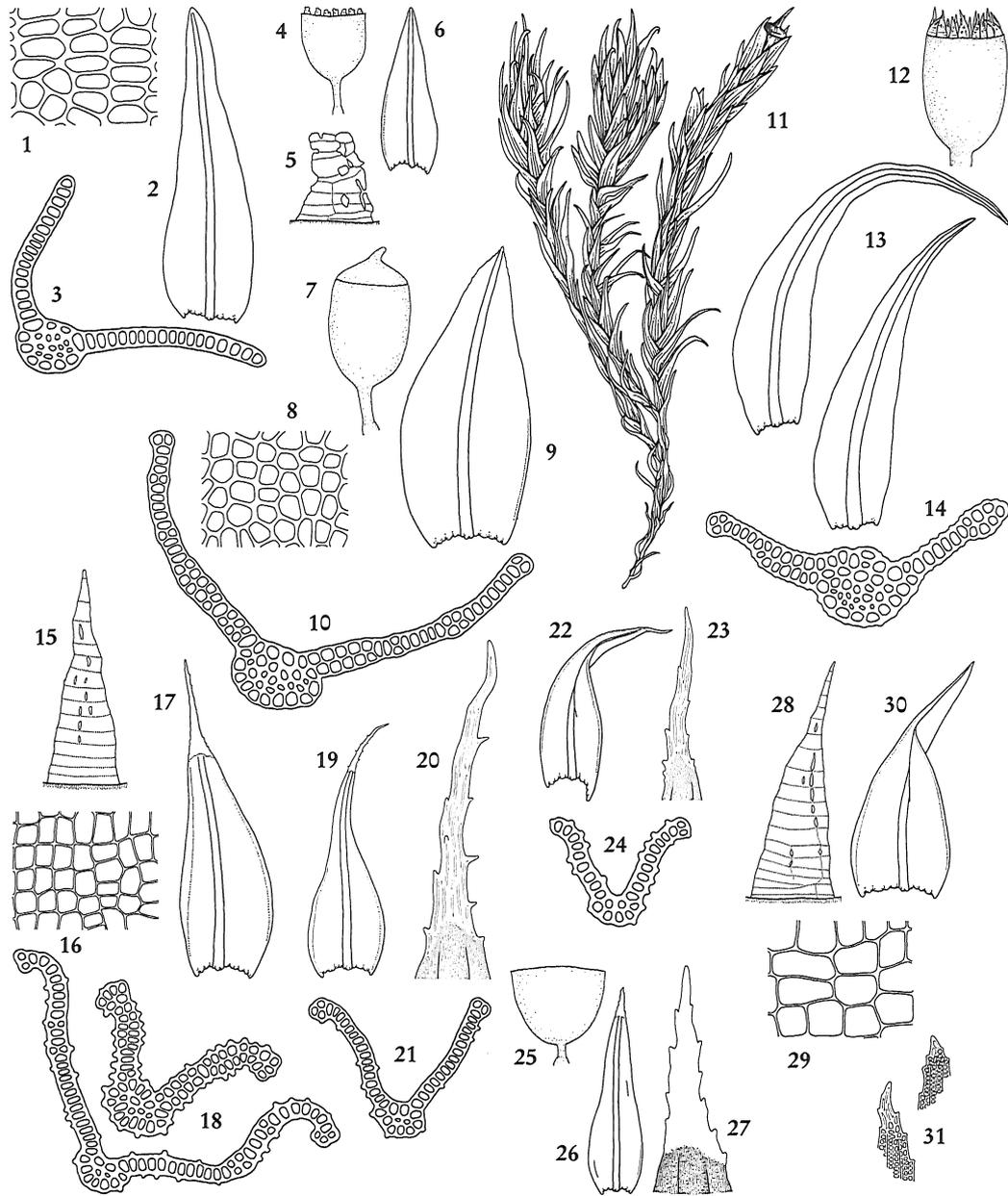


FIGURE 18. 1-3, *Schistidium agassizii*: 1, exothelial cells; 2, leaf; 3, leaf section. 4-6, *S. atrofuscum*: 4, capsule; 5, peristome tooth; 6, leaf. 7-10, *S. rivulare*: 7, capsule; 8, exothelial cells; 9, leaf; 10, leaf section. 11-14, *S. occidentale*: 11, habit; 12, capsule; 13, leaves; 14, leaf section. 15-18, *S. pruinosum*: 15, peristome tooth; 16, exothelial cells; 17, leaf; 18, leaf sections. 19-21, *S. strictum*: 19, leaf; 20, leaf apex; 21, leaf section. 22-24, *S. papillosum*: 22, leaf; 23, leaf apex; 24, leaf section. 25-27, *S. flaccidum*: 25, capsule; 26, leaf; 27, leaf apex. 28-31, *S. apocarpum*: 28, peristome tooth; 29, exothelial cells; 30, leaf; 31, leaf apices. 11 (x4); 4, 7, 12, 25 (x10); 2, 6, 9, 13, 17, 19, 22, 26, 30 (x16); 5, 15, 20, 23, 27, 28, 31 (x100); 1, 3, 8, 10, 14, 16, 18, 21, 24, 29 (x160).

- | | | |
|---|--|----|
| 9 | Exothelial cells mostly isodiametric or oblate | 10 |
| 9 | Exothelial cells mostly oblong | 14 |

- 10 Leaf margin of upper leaves denticulate near apex (fig. 18, 28-31)

S. apocarpum (Hedw.) Bruch & Schimp.

Stem without central strand or poorly developed. Leaves ovate-lanceolate, sometimes falcate-secund, keeled, with hyaline point short or long, decurrent or not, spinulose, margin recurved and bistratose. Perichaetial leaves 3-3,8 mm long. Capsule oblong-cylindrical, with 4-8(-12) stomata; peristome teeth reddish, ending in long point, in the upper 2/3 with ovate perforations in vertical rows. Forms loose or dense, olivaceous or light brown tufts on siliceous or calcareous rocks, usually by streams, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

- 10 Leaf margin entire

11

- 11 Basal marginal cells of leaf longly rectangular, differentiated from basal cells **S. frigidum** H.H.Blom

Stem without central strand or poorly developed. Leaves ovate-lanceolate, keeled, with cylindrical, decurrent hyaline point with recurved margins. On wet, siliceous rocks. And.

- 11 Basal marginal cells of leaf quadrate, oblate or shortly rectangular, differentiated or not from basal cells

12

- 12 Leaves with a very short hyaline point, to 0,15 mm long, dentate; perichaetial leaves 1,4-2,0 mm long (fig. 19, 1-4)

S. dupretii (Thér.) W.A.Weber

Stem with central strand. Leaves ovate-lanceolate, keeled; hyaline point erect to patent, to 0,15 mm long, denticulate-spinulose, non- or slightly decurrent; lamina usually unistratose, occasionally bistratose in 1-2 marginal rows; median cells of lamina isodiametric to oblong, slightly to strongly sinuose. Capsule brownish red, oblong-cylindrical, finely striate in the lower part when empty, exothecial cells irregular in shape and size, with trigones and up to 6 stomata; peristome teeth squarrose, entire or perforated. Plants fine, small, dull, brownish to olivaceous, blackish at base. Grows on exposed, usually dry and calcareous rocks, in montane areas and high mountains. Rare, in the Pyrenees, León Mountains and Basque Mountains. Esp, Prt.

- 12 Leaves with hyaline point usually more than 0,15 mm long, spinulose; perichaetial leaves 2-3 mm long

13

- 13 Basal cells of leaf rectangular, 5-7 μm wide; leaves with hyaline point to 0,30 mm long

S. convergens J.Guerra & M.J.Cano

Stem with central strand. Leaves ovate to ovate-triangular; hyaline point straight, not decurrent, slightly spinulose, with short, erecto to erecto-patent spinulae; lamina unistratose to bistratose in spots or irregularly bistratose; median cells of lamina isodiametric, oblate or oblong, sinuose; basal marginal cells with slightly thickened transverse walls. Capsule brownish to reddish brown, oblong-cylindrical, slightly urceolate with age, exothecial cells irregular in shape

and size, quadrate to shortly rectangular or oblate, with 2-4(-5) stomata; peristome teeth straight, entire or perforated. Plants small, olivaceous, brownish at base. Grows on exposed, dry, siliceous rocks, in montane areas and high mountains. Rare, in Sierra Nevada and Sierra de Filabres. Esp.

- 13 Basal cells of leaf shortly rectangular, 10-12 μm wide; leaves with hyaline point to 0,85 mm long

S. marginale H.H.Blom, Bednarek-Ochyra & Ochyra

Stem with central strand. Leaves ovate to ovate-triangular; hyaline point straight, not decurrent, spinulose, with short, erecto to erecto-patent spinulae; lamina unistratose with a few bistratose spots and strips, 2-4-stratose in 2-4 marginal rows; median cells of lamina isodiametric, oblate or shortly oblong, weakly to distinctly sinuose; basal marginal cells with thickened transverse walls. Capsule greyish brown to yellowish brown, oblong-cylindrical, exothecial cells irregular in shape and size, quadrate to oblong or oblate, with 4-6 stomata; peristome teeth erect to erecto-patent, entire or perforated. Plants small, dull, olivaceous or brownish, brownish below. Grows on exposed, dry, granitic rocks, in high mountains. Very rare, in the Pyrenees. Esp.

- 14 Lamina usually unistratose; laminal cells mostly elongated and sinuose (fig. 19, 5-8)

S. robustum (Nees & Hornsch.) H.H.Blom

Plants medium-sized, olivaceous to light brown. Leaves imbricate, ovate-lanceolate; hyaline point long and spinulose, widely decurrent. Capsule oblong, narrow, light brown, exothecial cells irregular in shape and size, with irregularly thickened longitudinal walls. Forms tufts on dry or periodically wet, exposed calcareous rocks, in montane areas and high mountains in the northern part of the Peninsula. Esp.

- 14 Lamina partially bistratose; laminal cells mostly isodiametric and slightly sinuose 15

- 15 Hyaline point flattened; plants olivaceous (fig. 19, 9-12) **S. confertum** (Funck) Bruch & Schimp.

Plants small, with a greasy lustre, olivaceous, grey or light brown. Leaves small, ovate-lanceolate, acute, hyaline point short, not decurrent, with strong, patent to squarrose spinulae. Capsule ovoid, orange yellow, exothecial cells predominantly oblong, with groups of oblate cells, with 3-8 stomata; peristome teeth orange, strongly perforated. Forms dense turfs on dry, exposed, siliceous rocks in montane areas and high mountains, in the north of the Peninsula and in Sierra Nevada. Esp, Prt, And, Bl.

- 15 Hyaline point circular in cross section; plants olivaceous, brown, jet black or blackish 16

- 16 Plants jet black, glossy; leaves muticous or with very short hyaline point 17

- 16 Plants olivaceous, brown to blackish, \pm dull; leaves with \pm long hyaline point 18

- 17 Perichaetial leaves widely elliptical, often covering the whole capsule; peristome teeth short, \pm rudimentary and truncate (fig. 18, 4-6) **S. atrofusum** (Schimp.) Limpr.

Plants small, jet black. Leaves ovate-triangular, slightly keeled, imbricate, straight, sometimes with smooth or slightly denticulate point; lamina partially bistratose; nerve percurrent. Capsule oblong-cylindrical or cyathiform, orange, without stomata, exothecial cells mostly rectangular, usually mixed with isodiametric cells. Grows on dry, exposed, calcareous rocks, in montane areas of the Peninsula. Esp.



FIGURE 19. 1-4, *Schistidium dupretii*: 1, capsule; 2, exothecial cells; 3, leaf; 4, leaf apex. 5-8, *S. robustum*: 5, exothecial cells; 6, leaf; 7, leaf apex; 8, leaf section. 9-12, *S. confertum*: 9, capsule; 10, peristome tooth; 11, exothecial cells; 12, leaf. 13-18, *S. helveticum*: 13, capsule; 14, peristome tooth; 15, exothecial cells; 16, leaf; 17, leaf apex; 18, leaf section. 19-25, *S. crassipilum*: 19, habit; 20, capsule; 21, peristome tooth; 22, exothecial cells; 23, leaf; 24, leaf apex; 25, leaf section. 26-30, *S. brunnescens* subsp. *griseum*: 26, peristome tooth; 27, exothecial cells; 28, leaf; 29, leaf apex; 30, leaf section. 31-34, *S. brunnescens* subsp. *brunnescens*: 31, capsule; 32, leaf; 33, leaf apex; 34, leaf section. 35-39, *S. elegantulum* subsp. *elegantulum*: 35, peristome tooth; 36, exothecial cells; 37, leaf; 38, leaf apex; 39, nerve section. 40, *S. elegantulum* subsp. *wilsonii*, nerve section. 19 (x4); 1, 9, 13, 20, 31 (x10); 3, 6, 12, 16, 23, 28, 32, 37 (x16); 4, 7, 10, 14, 17, 21, 24, 26, 29, 33, 35, 38 (x100); 2, 5, 8, 11, 15, 18, 22, 25, 27, 30, 34, 36, 39, 40 (x160).

- 17 Perichaetial leaves lanceolate, not covering the whole capsule; peristome teeth long, well developed (fig. 19, 13-18) **S. helveticum** (Schkuhr) Deguchi
S. singarense (Schiffn.) Laz.
Leaves imbricate, ovate-triangular, lamina irregularly bistratose. Capsule oblong-cylindrical, yellow or orange to brownish, without stomata; peristome teeth reddish orange, strongly perforated to cribose. Grows on dry or wet, calcareous rocks in the lowlands and montane areas. Common in the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 18 Leaf margin of upper leaves denticulate in the upper part (fig. 19, 19-25) **S. crassipilum** H.H.Blom
Leaves erect to patent, ovate-lanceolate, lamina unistratose or with bistratose spots; upper cells \pm isodiametric, not or slightly sinuose. Capsule oblong-cylindrical, orange or brownish red, stomata 0-4(-6); peristome teeth gradually tapered in narrow and obtuse apex, reddish. Grows on exposed or shaded rocks, common in montane areas, rarer in the lowlands. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 18 Leaf margin entire **19**
- 19 Exothecial cells narrowly oblong, with curved walls **20**
- 19 Exothecial cells oblong with straight walls, mixed with isodiametric cells **22**
- 20 Perichaetial leaves 1,5-2,8 mm long (fig. 19, 31-34) **S. brunnescens** Limpr. subsp. **brunnescens**
Leaves oblong, ovate or ovate-triangular, without longitudinal ridge-like striae short, lamina unistratose to irregularly bistratose, margin bistratose, nerve 38-60 μ m wide in the central part. Capsule widely ovoid, finely striate, yellow or orange, without stomata; peristome teeth ending in a blunt apex, strongly perforated. Grows on dry, exposed, calcareous rocks, in montane areas and high mountains, in the Peninsula and in Mallorca. Esp, Prt, Bl.
- 20 Perichaetial leaves 2,5-3,5 mm long **21**
- 21 Leaf lamina regular or irregularly 2-4-stratose above, mainly in the margin (fig. 19, 26-30)
S. brunnescens Limpr. subsp. **griseum** (Nees & Hornsch.) H.H.Blom
Leaves ovate-lanceolate to ovate-triangular, usually with longitudinal ridge-like striae, margin plane or recurved in mid-leaf on one or more rarely on both sides, nerve 58-90 μ m wide in the central part. Capsule oblong, orange to brownish red, stomata absent; peristome teeth ending in an acute or blunt apex, entire or slightly perforated. Grows on calcareous rocks in montane areas and high mountains, in the Pyrenees, Basque Mountains and Cantabrian Mountains. Esp.
- 21 Leaf lamina unistratose, with bistratose spots **S. memnonium** J.Guerra

Leaves ovate to ovate-triangular, without longitudinal ridge-like striae, margin recurved from near base to apex on both sides, very rarely almost plane in one side, nerve 50-65 μm wide in the central part. Capsule oblong to oblong-cylindrical, brown to reddish brown, stomata absent; peristome teeth ending in an acute apex, perforated. Grows on calcareous rocks in more or less open forests, from the lowlands to high mountains. Scattered in the south and centre of the Peninsula. Esp.

- 22 Exothecial cells very variable in shape and size; peristome teeth strongly perforated or cribose (fig. 19, 13-18)

S. helveticum (Schkuhr) Deguchi

S. singarense (Schiffn.) Laz.

Leaves imbricate, ovate-triangular, lamina irregularly bistratose. Leaves and dorsal nerve glossy, hyaline point broad, with obtuse teeth. Capsule oblong-cylindrical, yellow to brownish, without stomata; peristome teeth reddish orange. Grows on dry or wet, calcareous rocks in the lowlands and montane areas. Common in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 22 Exothecial cells similar in shape and size; peristome teeth entire or slightly perforated 23

- 23 Hyaline point broad and flattened in the lower part, erecto-patent, \pm decurrent (fig. 19, 19-25)

S. crassipilum H.H.Blom

Leaves erect to patent, ovate-lanceolate, lamina unistratose or with bistratose spots; upper cells \pm isodiametric, not or slightly sinuose. Capsule oblong-cylindrical, orange or brownish red, stomata 0-4(-6); peristome teeth gradually tapered in narrow and obtuse apex, reddish. Grows on exposed or shaded rocks, common in montane areas, rarer in the lowlands. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 23 Hyaline point circular in cross section, not flattened in the lower part, erect, not decurrent 24

- 24 Hyaline point narrow, weak, slightly spinulose; peristome teeth orange to reddish, erect to erecto-patent; nerve 55-78 μm wide in the lower part, 4-5-stratose (fig. 19, 35-39)

S. elegantulum H.H.Blom subsp. **elegantulum**

Leaves ovate lanceolate, acuminate; hair point straight, often yellowish at base. Capsule oblong, orange yellow, with 6-8 stomata; peristome teeth orange, densely papillose in upper part, entire or with narrow slits. Forms tufts on rocks in pinewoods and oakwoods, in the lowlands and montane areas, in the north of the Peninsula and in Mallorca. Esp, Bl.

- 24 Hyaline point stout, finely and densely spinulose; peristome teeth red, erect or patent to squarrose; nerve 75-88 μm wide in the lower part, 5-7-stratose (fig. 19, 40)

S. elegantulum H.H.Blom subsp. **wilsonii** H.H.Blom

Leaves similar to those to subsp. *elegantulum*. Capsule oblong-cylindrical, orange to light brown, stomata 8-16, often rudimentary. Forms tufts on dry, exposed, calcareous rocks, in the lowlands, in the northeastern part of the Peninsula and in Mallorca, scattered in Portugal. Esp, Prt, Bl.

Fam. Ptychomitriaceae

Campylostelium Bruch & Schimp.

Plants very small, rarely up to 0,5 cm tall, gregarious. Leaves crisped when dry, linear or linear-lanceolate, apex acute or rounded, margin entire; cells small, quadrate, rectangular at base; nerve percurrent. Seta twisted when dry, curved, cygneous or flexuose when moist; capsule emergent or exerted, ellipsoidal, straight, smooth or rugose when dry; lid longly rostrate; peristome teeth 16, entire or slightly divided; calyptra mitriform, lobate.

1 Capsule emergent, gibbous at base (fig. 20, 1-2)

C. pitardii (Corb.) E.Maier

Grimmia pitardii Corb.

Leaves linear, acute, margin plane or recurved on one side; lamina unistratose, basal cells hyaline, longly rectangular, upper cells rounded or quadrate, 6-8 μ m; nerve percurrent or excurrent. Autoicous. Seta sigmoid; capsule emergent, widely ellipsoidal, smooth, brownish red; peristome teeth perforated, yellow. Forms glossy dark brown cushions, on open, basic soils in the lowlands near coastal areas. Frequent in the eastern half of the Peninsula and in Mallorca and Pithyusic Islands, very rare in the west of the Peninsula. Esp, Prt, Bl.

1 Capsule exerted, symmetrical

2

2 Seta straight when wet (fig. 20, 3)

C. strictum Solms

Grows on shaded, acidic rocks in the lowlands and montane areas. Distributed in the west of the Peninsula. Esp, Prt.

2 Seta flexuose or cygneous when wet (fig. 20, 4-5)

C. saxicola (F.Weber & D.Mohr) Bruch & Schimp.

Capsule narrowly ellipsoidal. Forms patches on shaded, acidic rocks in the lowlands and montane areas. Very rare, only in the north of the Peninsula. Esp.

Ptychomitrium Fürnr.

Plants small to robust. Stem simple or branched. Leaves patent, crisped when dry, lanceolate, flexuose, apex dentate or entire, plicate or not at base, margin plane or recurved at base; lamina bistratose at apex, laminal cells

quadrate, smooth, thick-walled, basal cells linear or rectangular; nerve stout, percurrent. Perigonium bud-like, below perichaetium. Capsule exerted, ovoid to cylindrical, slightly striate, rugose when dry; peristome teeth 16, divided to half way or more (32 teeth), papillose; calyptra mitriform, plicate.

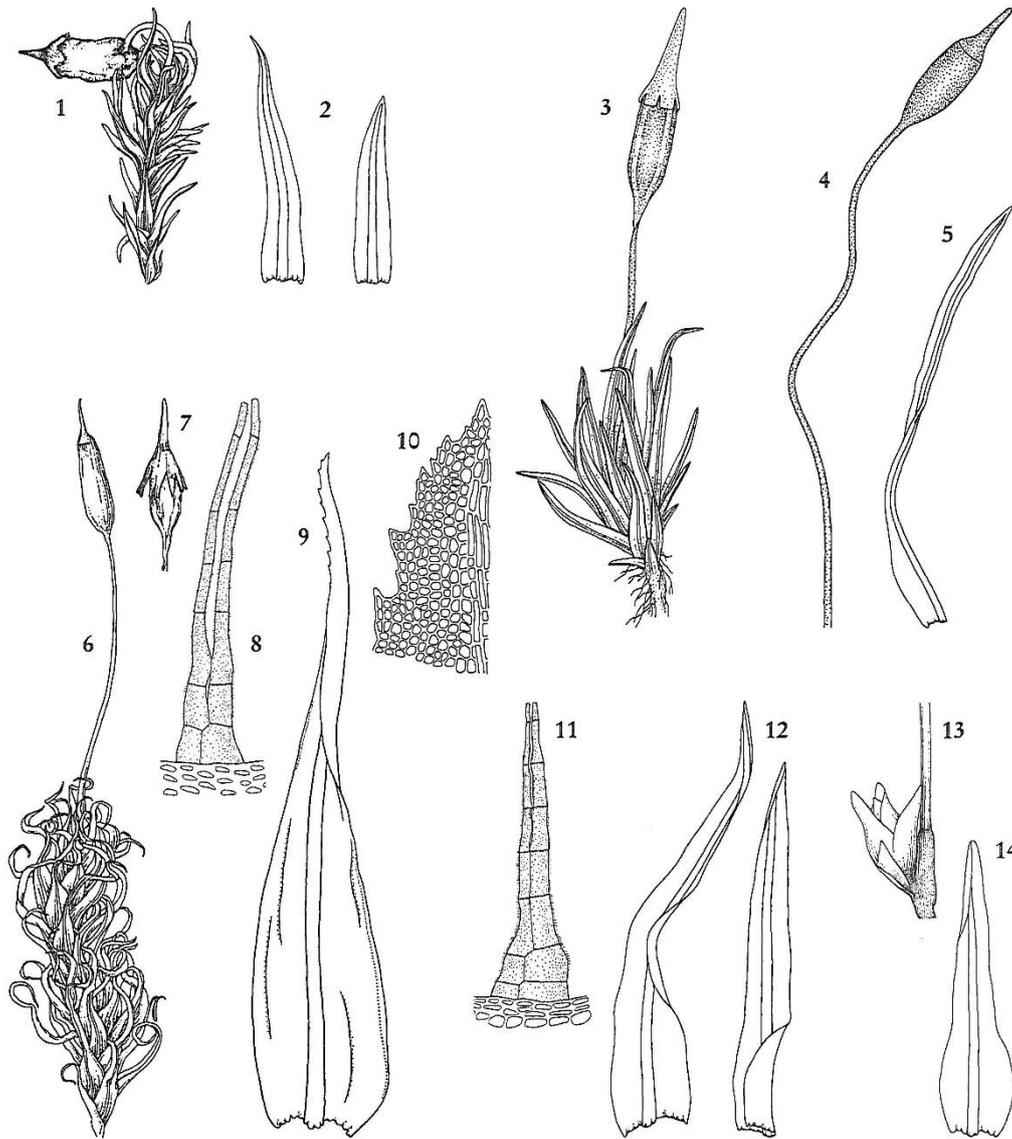


FIGURE 20. 1-2, *Campylostelium pitardii*: 1, habit; 2, leaves. 3, *C. strictum*, habit. 4-5, *C. saxicola*: 4, capsule and seta; 5, leaf. 6-10, *Ptychomitrium polyphyllum*: 6, habit when dry; 7, capsule; 8, peristome tooth; 9, leaf; 10, apical cells. 11-12, *P. nigrescens*: 11, peristome tooth; 12, leaves. 13-14, *P. incurvum*: 13, perigonium; 14, leaf. 6, 7 (x6); 1, 3, 4 (x14); 2, 5, 9, 12, 13, 14 (x18); 10 (x100); 8, 11 (x160).

1 Plants robust, to 5 cm tall; leaves with dentate apex, plicate at base (fig. 20, 6-10)

***P. polyphyllum* (Dicks. ex Sw.) Bruch & Schimp.**

Plants to 4 cm tall. Stem densely branched. Leaves strongly crisped, lanceolate, acuminate; basal cells with strongly thickened longitudinal walls. Peristome teeth deeply bifid. Forms dark green to blackish cushions on exposed,

siliceous rocks in montane areas, in the north and northwestern part of the Peninsula, rare in the southwest. Esp, Prt, And.

- 1 Plants small, to 2 cm tall; leaves with entire margin, not plicate at base 2
- 2 Plants to 2 cm tall; leaf apex acute, flat (fig. 20, 11-12) **P. nigrescens** (Kunze) Wijk & Margad.
Stem branched. Leaves patent, crisped when dry, linear-lanceolate. Capsule elliptical; peristome teeth with medial, narrow perforations. Forms dense, green turfs, blackish below, on eruptive rocks, in the southwest of the Peninsula. Prt.
- 2 Plants to 0,5 cm tall; leaf apex obtuse, cucullate (fig. 20, 13-14) **P. incurvum** (Schwägr.) Spruce
Stem simple. Leaves erect to patent, with cucullate apex, incurved toward stem. Capsule ovoid. Forms brownish green to blackish turfs on siliceous rocks, in montane areas, in the western Pyrenees. Figures are from Basse Pyrénées (France) specimen. Esp (Extinct).

Fam. Seligeriaceae

Blindia Bruch & Schimp.

Leaves spreading, sometimes secund, concave, lanceolate, straight, wide at base and gradually narrowed into long subula; laminal cells narrowly rectangular, smooth, alar cells differentiated, orange to reddish; nerve excurrent, without stereids. Capsule pyriform, smooth; lid rostrate; peristome teeth 16, usually perforated (fig. 21, 1-3)

B. acuta (Hedw.) Bruch & Schimp.

Forms glossy, dark green to blackish compact turfs, to 4 cm tall, on seeping acidic rocks or by springs and streams, in montane areas and high mountains of the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

Brachydontium Fürnr.

Plants very small, 1-3 mm tall. Leaves ovate-lanceolate, longly tapering to subula; margin entire; nerve excurrent; upper cells quadrate, basal cells rectangular. Seta flexuose when dry; capsule ovoid or ellipsoidal, striate; peristome of 16 short, hyaline, finely papillose teeth; calyptra mitriform (fig. 21, 4)

B. trichodes (F. Weber) Milde

Forms small patches dull green or yellow brown on damp, shaded acidic or basic rocks. Very rare in north and northwest of the Peninsula, from the lowlands to the montane areas. Esp, Prt (Extinct).

Seligeria Bruch & Schimp.

Plants very small, usually of a few millimetres, mostly growing on damp, shaded, basic rocks, common on ceilings of caves. Leaves linear to lanceolate; laminal cells quadrate, rhomboidal or rectangular to ovoid. Seta straight or curved; capsule exserted, straight, ellipsoidal or pyriform, often turbinate when mature; peristome present or lacking, when present with 16, sometimes truncate teeth; calyptra cucullate.

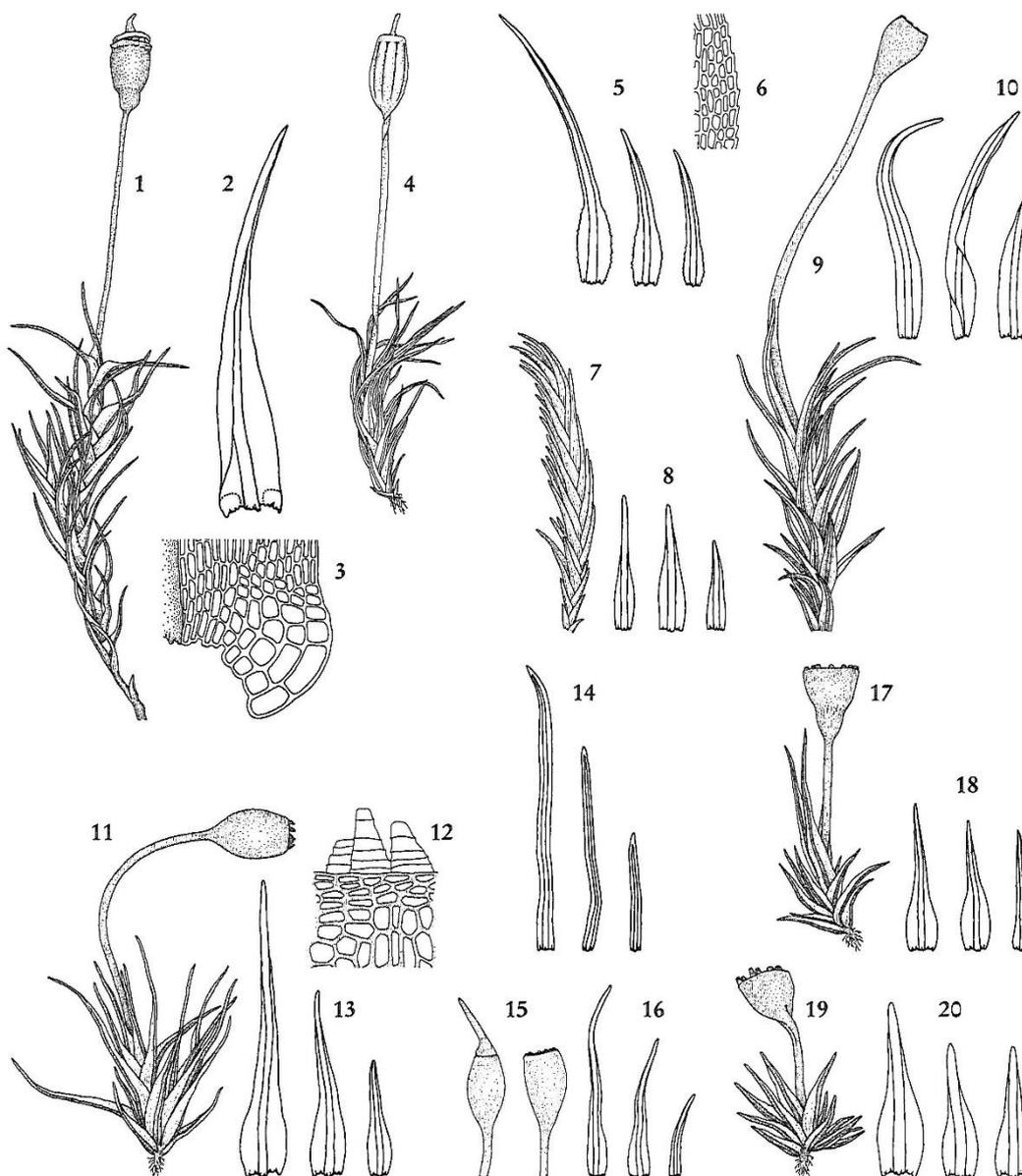


FIGURE 21. 1-3, *Blindia acuta*: 1, habit; 2, leaf; 3, alar cells. 4, *Brachydontium trichodes*, habit. 5-6, *Seligeria donniana*: 5, leaves; 6, marginal cells. 7-8, *S. patula*: 7, habit; 8, leaves. 9-10, *S. trifaria*: 9, habit; 10, leaves. 11-13, *S. recurvata*: 11, habit; 12, peristome; 13, leaves. 14, *S. pusilla*, leaves. 15-16, *S. calycina*: 15, capsules; 16, leaves. 17-18, *S. acutifolia*: 17, habit; 18, leaves. 19-20, *S. calcarea*: 19, habit; 20, leaves. 1 (x7,5); 4, 7, 9, 11, 15, 17, 19 (x15); 2, 5, 8, 10, 13, 14, 16, 18, 20 (x25); 3, 6, 12 (x150).

- 1 Peristome lacking; leaf margin denticulate at base (fig. 21, 5-6) **S. donniana** (Sm.) Müll.Hal.
Plants dark green. Leaf nerve excurrent. Perichaetial leaves much shorter than seta. Seta straight. Grows on shaded, calcareous rocks, from the lowlands to high mountains, in the northern and eastern part of the Peninsula. Esp, And.
- 1 Peristome present; leaf margin entire or nearly so **2**
- 2 Leaves arranged in three rows **3**
- 2 Leaves arranged in more than three rows; nerve 3-stratose or pluristratose **4**
- 3 Plants to 0,25 cm tall; spores 16-17 μm , smooth (fig. 21, 7-8) **S. patula** (Lindb.) I.Hagen
Plants light green. Leaves lanceolate-subulate; nerve 2-3-stratose, nerve cells on ventral side 6-9 μm wide, 4-6 μm wide on dorsal side. Capsule turbinate. Grows on wet, calcareous rocks in caves. Very localized in the Basque Mountains. Esp.
- 3 Plants to 0,50 cm tall; spores 21-30 μm , papillose (fig. 21, 9-10) **S. trifaria** (Brid.) Lindb.
Plants greenish brown. Leaf nerve bistratose; nerve cells on ventral side 8-11 μm wide, 6-8 μm wide on dorsal side. Grows on wet, calcareous rocks. Scattered in the northern half of the Peninsula. Esp.
- 4 Seta curved, straight when dry (fig. 21, 11-13) **S. recurvata** (Hedw.) Bruch & Schimp.
* **Blindiadelphus recurvatus** (Hedw.) Fedosov & Ignatov
Plants dark green. Leaves with longly excurrent nerve. Perichaetial leaves sheathing, longer than stem leaves. Capsule ellipsoidal, turbinate when dry. Grows on calcareous or siliceous, shaded rocks, from the lowlands to high mountains, in northern part of the Peninsula. Esp, And.
- 4 Seta always straight **5**
- 5 Leaves linear, acuminate; nerve not excurrent (fig. 21, 14) **S. pusilla** (Hedw.) Bruch & Schimp.
Plants light green. Lamina visible to apex; upper cells rectangular. Perichaetial leaves similar to vegetative leaves, shorter than seta. Forms loose or dense turfs on shaded, calcareous rocks, from the lowlands to high mountains. Scattered in the Peninsula and Mallorca. Esp, And, Prt, Bl.
- 5 Leaves lanceolate, subulate; nerve excurrent **6**
- 6 Capsule ellipsoidal, longly attenuate at base, narrowed at mouth when empty (fig. 21, 15-16) **S. calycina** Mitt. ex. Lindb.

Leaves linear-lanceolate, gradually tapered, subulate. Perichaetial leaves longer than vegetative leaves. Grows on shaded, calcareous rocks, in the lowlands. Very rare, in the west of the Peninsula. Prt.

- 6 Capsule turbinate, shortly attenuate at base, with wide mouth when empty 7
- 7 Perichaetial leaves much longer than stem leaves, usually reaching the capsule base; than seta; apical cells of nerve rectangular on ventral side, 3 or more times as long as wide (fig. 21, 17-18) **S. acutifolia** Lindb. Plants light green. Laminal cells rectangular. Perichaetial leaves lanceolate, acute to subulate, with ovate, sheathing base, more than half length of seta. Spores 10-11 μm . Grows on wet, shaded, calcareous rocks, from the lowlands to high mountains. Scattered in the Peninsula. Esp, Prt.
- 7 Perichaetial leaves similar to vegetative leaves, much shorter than seta; apical cells of nerve oblong on ventral side, to 3 times as long as wide (fig. 21, 19-20) **S. calcarea** (Hedw.) Bruch & Schimp. Plants rigid, dark green. Leaves abruptly tapered; laminal cells ovate, laminal cells shortly oblong. Spores 12-17 μm . Grows on wet, shaded, calcareous rocks, in montane areas and high mountains, in the east and north of the Peninsula. Esp.

O. Archidiales

Fam. Archidiaceae

Archidium Brid.

Plants 0,4-1 cm high, mostly perennial, stem innovating from below perichaetial. Leaves lanceolate to triangular, apex finely denticulate; median cells rhomboidal to linear, basal cells rectangular, alar cells quadrate or shortly rectangular; nerve percurrent to excurrent. Perichaetial leaves larger than stem leaves, with sheathing base. Capsule immersed, globose, indehiscent, pellucid; spores 16-20, angulate, 180-225 μm (fig. 22, 1)

A. alternifolium (Hedw.) Mitt.

Forms lax or dense turfs on very moist, temporarily waterlogged soils, by lakes, streams or in hollows. Scattered in the Peninsula and Menorca. Esp, Prt, Bl.

O. Dicranales

Fam. Fissidentaceae

Fissidens Hedw.

Plants a few millimetres to 12 cm long. Stem simple or slightly branched. Leaves distichous, consisting of 3 parts: conduplicate part or sheathing lamina, apical lamina and dorsal lamina (fig. 15, 6), with unistratose or pluristratose margin; laminal cells \pm hexagonal in upper part, border of narrow, elongated cells in some species; nerve ending below apex to excurrent in short apiculus. Sporophyte lateral or terminal. Capsule straight or inclined, symmetrical or asymmetrical; peristome single, reddish to brownish, teeth divided to middle or with short and truncate teeth.

Due to the high number of sterile specimens in our territory, it is sometimes really difficult to separate the different species, especially when the gametophytic characters are very variable as in *F. viridulus* and *F. pusillus*.

- 1 Leaves with the conduplicate part 1/4-1/3 of leaf length (fig. 22, 2-3) **F. fontanus** (Bach.Pyl.) Steud.

Octodiceras fontanum (Bach.Pyl.) Lindb.

Plants large, soft, 6-12 cm length, mostly branched. Leaves distant, linear, with obtuse apex, margin entire; 1 row of marginal cells differentiated, 8 μ m wide, smaller than median cells, cells towards nerve 15-25 μ m wide; nerve ending below apex. Sporophyte lateral, on axillary branches. Seta short; capsule ovoid; peristome imperfect, with short and truncate teeth. Forms dark patches on submerged rocks in quiet or slow-flowing waters, in the lowlands and montane areas. Scattered localities in the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

- 1 Leaves with the conduplicate part 1/2 of leaf length **2**

- 2 Leaves with border of narrow, elongated cells (limbidium), at least in some lamina part **3**

- 2 Leaves without border of narrow, elongated cells **15**

- 3 Leaves gradually narrowed into acuminate apex; cells twice as long as wide (fig. 22, 9)

F. curvatus Hornsch.

F. algarvicus Solms

Plants small to 0,5 cm long. Leaves narrowly lanceolate. Grows on wet slopes and rocks in the lowlands and montane areas. Scattered localities mainly in the northeastern and southwestern part of the Peninsula. Esp, Prt.

- 3 Leaves abruptly narrowed into acute, obtuse or apiculate apex; cells as long as wide **4**

- 4 Leaf laminal cells small, usually not longer than 9 μ m and not wider than 6 μ m **5**

- 4 Leaf laminal cells usually larger 6
- 5 Dorsal lamina usually extending to the leaf base; leaves oblong to ovate-oblong; median laminal cells distinctly protuberant on both sides (fig. 22, 4-7) **F. crispus** Mont.
F. limbatus Sull.
- Plants 0,3-1 cm long, with 6-15 leaf pairs. Leaves crisped when dry, 0,7-3 x 0,2-0,6 mm, apex obtuse, apiculate, border of 2-3 rows of linear cells, usually confluent with nerve at leaf apex; conduplicate part with intralaminar limbidium at base; laminal cells 6-9 x 4-6 μ m. Capsule inclined; spores 10-20 μ m. Species very variable. Grows on shaded, wet rocks and sandy or loamy, rarely damp soils, in the lowlands and montane areas. Widespread in the Peninsula, Mallorca and Menorca. Esp, Prt, Bl.
- 5 Dorsal lamina not reaching leaf base; leaves widely elliptic; median laminal cells not or only slightly protuberant (fig. 22, 8) **F. ovatifolius** R.Ruthe
- Plants to 1,5 cm long, with 6-15 leaf pairs. Leaves with obtuse to broadly acute apex, often apiculate, border nearly reaching apex, of 2-4 rows linear cells; cells 4-7 x 3-6 μ m; nerve ending near apex. Capsule slightly inclined; spores 12-13 μ m. Grows on soils and in wet rock crevices, rarely on rocks, from the lowlands to high mountains. Scattered in the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.
- 6 Leaf border not reaching the apex 7
- 6 Leaf border reaching the apex 12
- 7 Margin of conduplicate part bistratose or pluristratose 8
- 7 Margin of conduplicate part unistratose 10
- 8 Conduplicate part narrow at base, with intralaminar limbidium (row of quadrate chlorophyllose cells outside border of linear cells); laminal cells 12-18 μ m long (fig. 22, 10-12) **F. crassipes** Wilson ex Bruch & Schimp.
- Plants to 4 cm long. Leaves oblong-lanceolate, 1,5-2,2 mm long, with acute apex; nerve ending below apex. Forms turfs on wet or \pm submerged rocks and by streams, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.
- 8 Conduplicate part wide at base, without intralaminar limbidium; laminal cells to 12 μ m long 9

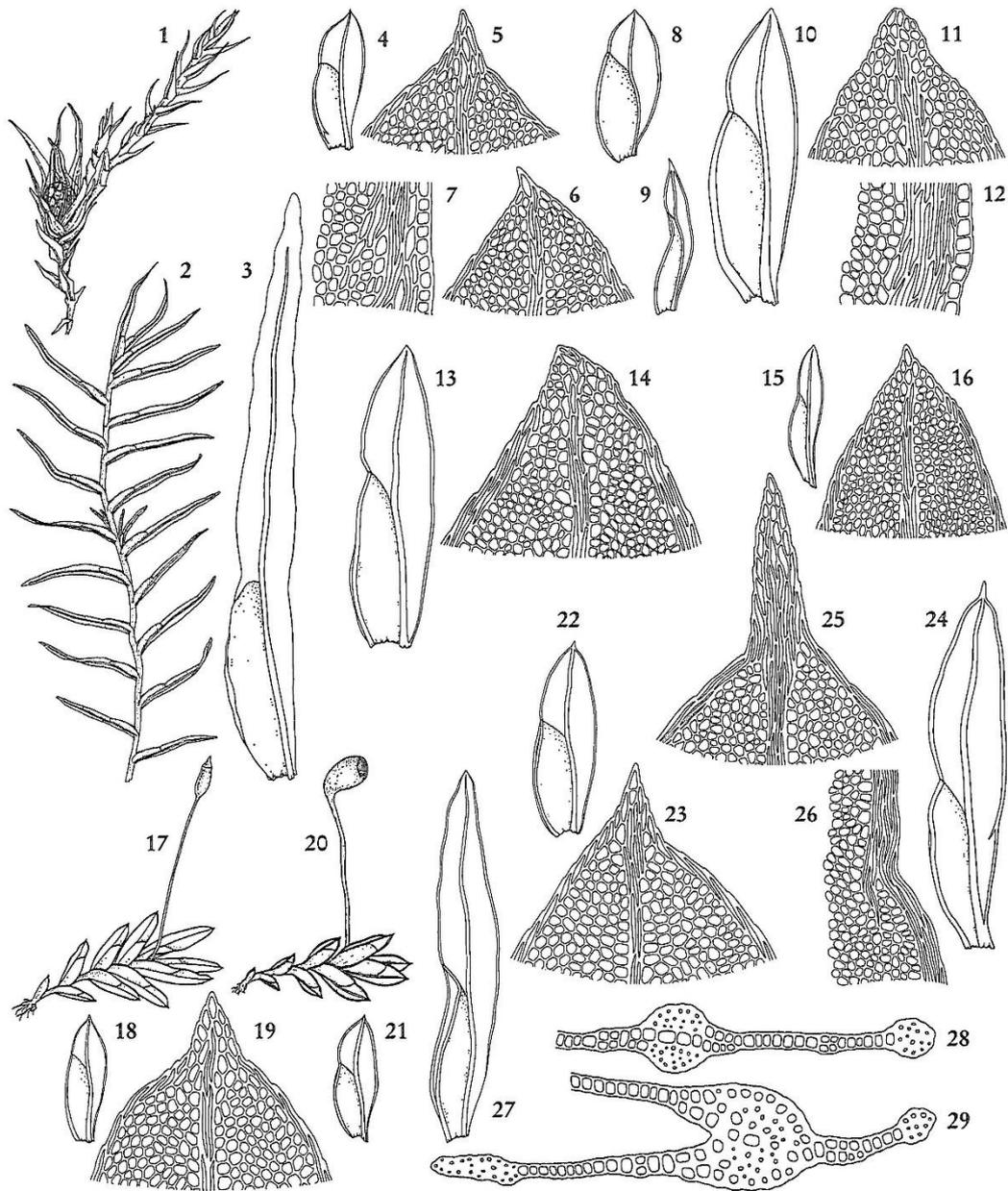


FIGURE 22. 1, *Archidium alternifolium*, habit. 2-3, *Fissidens fontanus*: 2, habit; 3, leaf. 4-7, *F. crispus*: 4, leaf; 5, leaf apex; 6, leaf apex, small plant; 7, basal margin of sheathing lamina. 8, *F. ovatifolius*, leaf. 9, *F. curvatus*, leaf. 10-12, *F. crassipes*: 10, leaf; 11, leaf apex; 12, basal margin of conduplicate part. 13-14, *F. rufulus*: 13, leaf; 14, leaf apex. 15-16, *F. pusillus*: 15, leaf; 16, leaf apex. 17-19, *F. viridulus* var. *viridulus*: 17, habit; 18, leaf; 19, leaf apex. 20-21, *F. incurvus*: 20, habit; 21, leaf. 22-23, *F. bryoides* var. *bryoides*: 22, leaf; 23, leaf apex. 24-26, *F. rivularis*: 24, leaf; 25, leaf apex; 26, margin in the middle of the dorsal lamina. 27-29, *F. jansenii*: 27, leaf; 28, leaf section in the upper part; 29, section in the middle of leaf. 2 (x3); 17, 20 (x5); 1 (x8); 3, 4, 8, 9, 10, 13, 15, 18, 21, 22, 24, 27 (x16); 5, 6, 7, 11, 12, 14, 16, 19, 23, 25, 26, 28, 29 (x160).

9 Leaves narrowly oblong, 2,5-3,5 mm long (fig. 22, 27-29)

F. jansenii Sérgio & Pursell

Plants 0,8-1,1 cm long. Leaf border 3-5 (8) cells thick; laminal cells 6-10 µm wide. Rheophilous, growing on vertical rocks at the edge of waterfalls or in rock crevices in stream, only in Serra da Estrela. Prt.

- 9 Leaves oblong-lanceolate to lingulate, 1,5-2,3 mm long (fig. 22, 13-14) **F. rufulus** Bruch & Schimp.
Plants 0,5-3,5 cm long, branched; rhizoids reddish brown, in the leaf axils. Leaf apex acute; nerve ending near apex. Forms loose turfs on wet or submerged calcareous rocks and soils, from the lowlands to high mountains. Scattered in the Peninsula. Esp.
- 10 Perichaetial much longer than vegetative leaves **F. gracilifolius** Brugg.-Nann. & Nyholm
F. viridulus (Sw.) Wahlenb. var. **tenuifolius** (Boulay) A.J.E. Sm.
Plants 0,2-0,4 cm long, with 3-5 leaf pairs. Leaves ending in sharp point; median cells of dorsal lamina 6-11 μm wide. Seta yellow; capsule erect or slightly inclined. Forms lax turfs on wet or moist basic rocks, mostly non-hydrophilous, in the north of the Peninsula. Esp.
- 10 Perichaetial leaves similar to vegetative leaves **11**
- 11 Plants saxicolous, with 5-8(-10) leaf pairs (fig. 22, 15-16) **F. pusillus** (Wilson) Milde.
Plants 0,5 cm long. Leaves lanceolate to narrowly elliptical, apex broadly acute or obtuse and apiculate; median cells of dorsal lamina lax, 5-10 μm wide. Seta yellow; capsule nearly straight or oblique; spores 10-18 μm . Grows on wet or submerged siliceous rocks, from the lowlands to high mountains. Scattered in the Peninsula and in Menorca. Esp, Prt, Bl.
- 11 Plants terricolous, with 4-8 leaf pairs (fig. 22, 17-19)
F. viridulus (Sw. ex anon.) Wahlenb. var. **viridulus**
F. bambergeri Milde
Plants to 0,6 cm long, with 4-10 leaf pairs. Leaves with obtuse, apiculate apex and border more or less developed. Capsule symmetrical, straight, oblong. Grows on wet, shaded soils, slopes, walls and in rock crevices mainly in the lowlands. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 12 Cells in the middle of the dorsal lamina 12-18 μm wide; border; perichaetial leaves narrower than vegetative leaves **F. monguillonii** Thér.
Plants 0,5-1,5 cm long. Leaves oblong to elliptic, acute, mucronate, border of dorsal lamina 5-8 μm wide, 2-3-stratose. Forms loose, dark green turfs by streams and in river-beds with slow-flowing waters, in the lowlands and montane areas. Scattered localities in the northern half of the Peninsula, very rare in the south. Esp, Prt.
- 12 Cells in the middle of the dorsal lamina to 12 μm wide; perichaetial leaves similar to vegetative leaves **13**
- 13 Border of dorsal lamina more than 20 μm wide at middle, yellow to brownish red (fig. 22, 24-26)
F. rivularis (Spruce) Schimp.

Plants 0,5-1,5 cm long. Leaves lanceolate to narrowly elliptic, with acute apex, mostly longly mucronate or apiculate, nerve excurrent; laminal cells 7-10 μm wide, border of dorsal lamina 20-30(-35) μm wide. Antheridia in axillary buds. Grows on moist soils and rocks by streams, in the northern half of the Peninsula. Esp, Prt, Bl.

- 13 Border of dorsal lamina up to 15 μm wide at middle, colourless **14**
- 14 Capsule asymmetrical, inclined to horizontal (fig. 22, 20-21) **F. incurvus** Starke ex Röhl.
F. viridulus (Sw. ex anon.) Wahlenb. var. **incurvus** (Starke ex Röhl.) Waldh.
 Plants to 0,5 cm long, with 5-10 leaf pairs. Leaves with short apiculus, dorsal lamina border unistratose, 7-15 μm wide, hyaline; cells 8-10 μm wide. Antheridia terminal, in dwarf male plants. Grows on wet slopes and soils in the lowlands. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 14 Capsule symmetrical, straight **F. bryoides** Hedw.
 var. **bryoides**: Plants to 1 cm long, with up to 15 leaf pairs; rhizoids brownish. Leaves elliptical to oblong-lanceolate, apex acute. Antheridia in axillary bud-like perigonia. Seta brownish; capsule erect. Grows on clayey soils and wet slopes, on acid or basic substrata, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, And, Bl. (fig. 22, 22-23)
 var. **caespitans** Schimp.: Plants 0,5-2 cm long, with up to 25 leaf pairs; rhizoids reddish-purple. Leaves oblong to lanceolate, apex acute. Antheridia in axillary bud-like perigonia. Capsules inclined, rarely erect. Forms turfs on wet, acidic soils and rocks and by streams, in the lowlands and montane areas. Scattered in the north and west of the Peninsula. Esp, Prt.
 var. **gymnandrus** (Buse) R. Ruthe (= * **F. gymnandrus** Büse): Plants to 7 cm long, with up to 15 leaf pairs; rhizoids brownish. Leaves oblong-lanceolate to oblong-lingulate, apex acute to shortly acuminate. Antheridia solitary, naked, under perichaetial leaves. Grows on calcareous walls, in montane areas. Very rare, in the north. Esp.
- 15 Plants to 0,4 cm long **16**
- 15 Plants mostly more than 1 cm long; leaf margin entire, denticulate or dentate; nerve ending near apex or excurrent **17**
- 16 Stem with 2-4(5) leaf pairs; nerve straight **F. exilis** Hedw.
 Leaf laminal cells 8-12 μm wide, smooth; nerve ending near apex. Perichaetial leaves much longer than vegetative leaves. Grows on wet rocks. Scattered localities in the northern part and west of the Peninsula. Esp, Prt.
- 16 Stem with 5-16(18) leaf pairs; nerve with distinct bent at about half way up leaf **F. celticus** Patton
 Leaf laminal cells 12-15 μm wide, smooth; nerve percurrent to shortly excurrent. Perichaetial leaves slightly longer than vegetative leaves. Grows on rocky slopes near streams in montane areas. Very rare, in the Peninsula. Esp, Prt.

17 Leaf margin entire towards apex; lamina regularly pluristratose (fig. 23, 1) **F. grandifrons** Brid.
 Plants robust, to 10 cm or more, dark green to blackish. Leaves rigid, oblong-lanceolate, nearly linear, apex obtuse; pluristratose. Grows on basic rocks in waterfalls or submerged, from the lowlands to high mountains. Widespread in the northern half and east of the Peninsula. Esp, Prt (extinct), And.

17 Leaf margin denticulate, dentate or crenulate towards apex; lamina unistratose or irregularly pluristratose

18

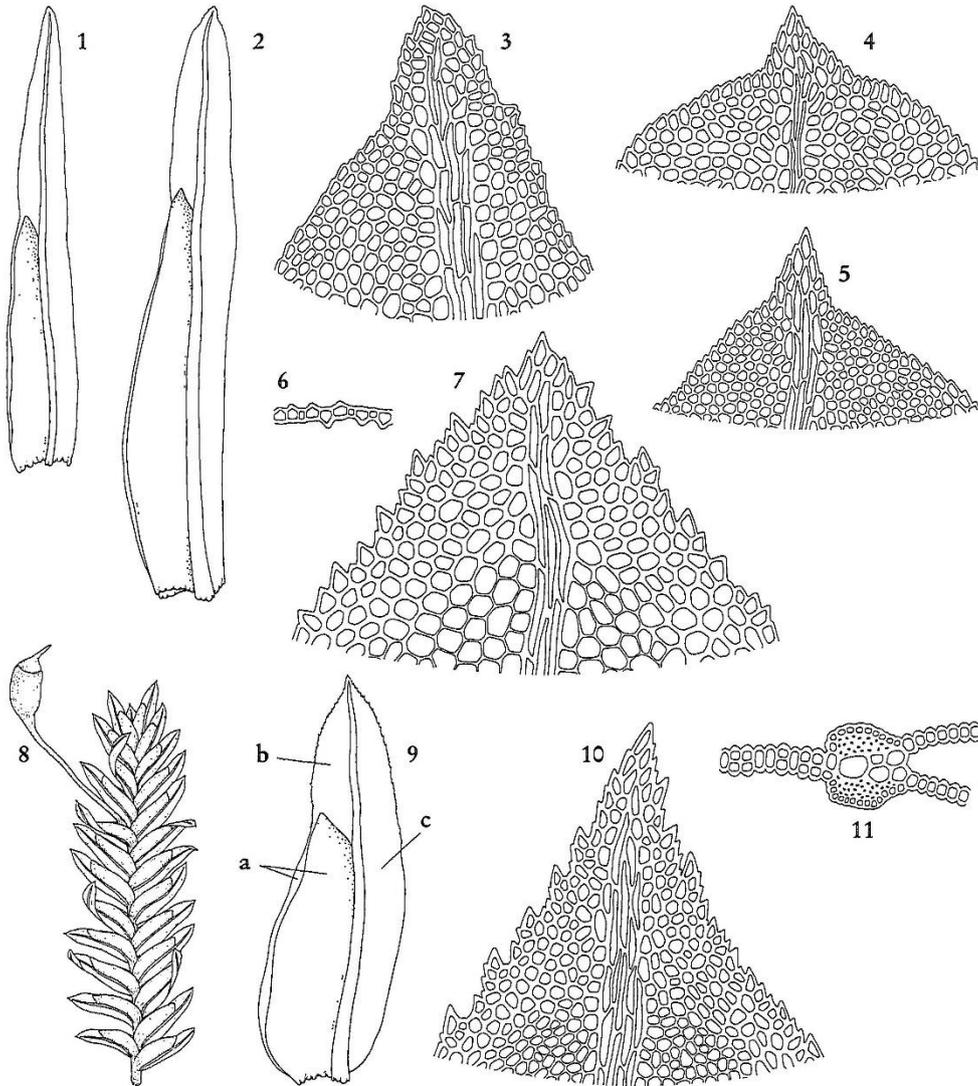


FIGURE 23. 1, *Fissidens grandifrons*, leaf. 2-3, *F. polyphyllus*: 2, leaf; 3, leaf apex. 4, *F. osmundoides*, leaf apex. 5, *F. taxifolius*, leaf apex. 6, *F. serrulatus*, lamina section. 7, *F. adianthoides*, leaf apex. 8-11, *F. dubius*: 8, habit; 9, leaf: (a) conduplicate part, (b) apical lamina, (c) dorsal lamina; 10, leaf apex; 11, nerve section. 8 (x3); 1, 2, 9 (x16); 3, 4, 5, 6, 7, 10, 11 (x160).

18 Leaves with marginal cells not differentiated or with 1 row of paler marginal cells

19

- 18 Leaves with 2-5 rows of paler marginal cells 21
- 19 Plants 5-20 cm long; leaves longly and narrowly lingulate-lanceolate (fig. 23, 2-3)
F. polyphyllus Wilson ex Bruch & Schimp.
 Leaves with single marginal row of smaller, but not pale cells, margin entire, finely and obscurely denticulate towards apex with irregular teeth; laminal cells smooth. Grows on wet or submerged rocks, in the lowlands and montane areas. In the north and western part of the Peninsula. Esp, Prt.
- 19 Plants to 4 cm long; leaves oblong-lingulate or oblong-lanceolate 20
- 20 Leaves short, wide, oblong-lingulate, obtuse or apiculate; nerve ending below apex; upper cells 10-14(-18) μm wide; sporophyte terminal (fig. 23, 4) **F. osmundoides** Hedw.
 Plants 1-2(4) cm long. Leaves with a single row of smaller marginal cells, margin regularly and finely serrulate. Seta purplish. Grows on rocks and slopes by streams from the lowlands to high mountains. Widespread in the northern part and west of the Peninsula. Esp, Prt, And.
- 20 Leaves long, oblong-lanceolate, broadly acute; nerve stout, excurrent in mucro; upper cells 6-9 μm wide; sporophyte lateral (fig. 23, 5) **F. taxifolius** Hedw.
 Plants 0,5-2,5(4) cm long. Leaves sometimes with 1 row of slightly paler marginal cells, margin regularly and finely serrulate. Grows on moist, shaded slopes in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 21 Upper cells of leaf conically mamillose (fig. 23, 6) **F. serrulatus** Brid.
 Plants 1-5 cm long, light green. Leaves strongly dentate with irregular teeth in the upper part, finely denticulate below; cells 10-15 μm wide, marginal cells thick-walled. Sporophyte terminal. Grows on stream margins and damp soils and rocks, in the lowlands and montane areas. Widespread in the north and west of the Peninsula. Esp, Prt.
- 21 Upper cells of leaf bulging but not mamillose 22
- 22 Upper cells of lamina hexagonal, 12-20 μm wide; dorsal lamina unistratose; 2-4 rows of marginal cells forming a pale, slightly distinct band (fig. 23, 7) **F. adianthoides** Hedw.
 Plants to 3,5 cm long. Leaf margin sharply and irregularly dentate in upper part, teeth unicellular. Sporophyte lateral. Grows on seeping rocks and damp soil by streams in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 22 Upper cells of lamina rounded, 6-12 μm wide; dorsal lamina irregularly bistratose; 4-5 rows of marginal cells forming a pale, strongly distinct band (fig. 23, 8-11) **F. dubius** P.Beauv.

F. cristatus Wilson ex Mitt.

Plants 1,5-3 cm long. Margin irregularly dentate towards apex, teeth sometimes composed of more than one cell. Sporophyte lateral. Grows on calcareous slopes, in calcareous rock crevices and at tree bases, in the lowlands and montane areas. Widespread in the northern part of the Peninsula and in Mallorca and Menorca, rarer in the south of the Peninsula. Esp, Prt, And, Bl.

Fam. Ditrichaceae

Ceratodon Brid.

Plants small to medium-size. Leaves erect, curved or twisted when dry, erecto-patent to spreading when moist, lanceolate to ovate, lamina unistratose, apex obtuse to acuminate, margin recurved, entire or denticulate in upper part; median cells \pm quadrate, smooth, basal cells rectangular; nerve stout, percurrent to excurrent in arista. Seta yellowish to reddish; capsule cylindrical, sulcate when dry, mostly strumose, annulus of large cells; peristome brownish red, teeth 16, divided to base, papillose and often with a paler border; lid conic to longly conic.

- 1 Plants 0,5-2 cm tall; nerve percurrent to more or less excurrent; leaf margin irregularly dentate near apex (fig. 24, 1-5) **C. purpureus** (Hedw.) Brid.

Plant yellowish green to reddish brown or purple. Leaves not forming a comal tuft, lanceolate to ovate lanceolate; nerve 60-100 μ m wide at base. Capsule inclined to horizontal, dark reddish to purple, usually curved, strongly sulcate when dry, strumose. Forms dense, green or reddish turfs on exposed soils. Widespread in montane areas and high mountains of the Peninsula. Esp, Prt, And.

- 1 Plants 0.2-0,7 cm tall; nerve excurrent in arista; leaf margin entire

C. amazonum Nieto-Lugilde, O.Werner, S.F.McDaniel & Ros

Plant yellowish green or yellowish. Leaves sometimes forming a comal tuft, ovate; nerve 45-90 μ m wide at base, excurrent in arista to 600 μ m long. Sterile plants. Forms dense turfs on exposed, acidic or calcareous soils in montane areas and high mountains. Rare, in the southeastern part of the Peninsula. Esp.

Cheilothela Broth.

Plants to 2 cm tall. Leaves erecto-patent, rigid, lanceolate, gradually tapering, appressed when dry, margin plane, crenulate; lamina bistratose, median cells more or less isodiametric, 7-10 μm wide, strongly papillose, basal cells rectangular, smooth; nerve broad, excurrent (fig. 24, 6-7) **C. chloropus** (Brid.) Broth.

Forms dense, green to brownish turfs on basic soils and in rock crevices, in the lowlands. Widespread throughout the Peninsula and in Mallorca and Menorca, sporadic in the northwest and northeast. Esp, Prt, Bl.

Distichium Bruch & Schimp.

Leaves distichous, basal part broad and sheathing, abruptly narrowed into long and papillose subula; nerve excurrent. Capsule cylindrical or ovoid, straight or inclined; peristome teeth 16, divided to near.

- 1 Plants glossy; capsule cylindrical, straight or slightly inclined; spores 12-22 μm (fig. 24, 8-9)

D. capillaceum (Hedw.) Bruch & Schimp.

Leaf subula rigid and reflexed; laminal cells rectangular, basal cells narrower; nerve excurrent. Forms dark green turfs in calcareous rock crevices. Common in montane areas and high mountains of the Peninsula, rarer in Mallorca. Esp, And, Bl.

- 1 Plants dull; capsule ovoid, inclined; spores 30-50 μm

D. inclinatum (Hedw.) Bruch & Schimp.

Leaf subula erect and flexuose. Similar to *D. capillaceum*, it is hard to differentiate when the plant has no sporophytes, in montane areas. Grows in calcareous rock crevices, in the Pyrenees, Basque Mountains and Sierra Nevada. Rare. Esp, And.

Ditrichum Hampe

Plants small to medium-sized. Stem unbranched to slightly branched, tomentose or not. Leaves lanceolate from broad base, apex acute to obtuse, gradually or abruptly tapered into long, channelled subula, margin plane or narrowly recurved, entire or denticulate near apex; laminal cells rhomboidal or rectangular, smooth, basal cells rectangular to linear, margin or upper lamina bistratose in some species; nerve broad, percurrent or excurrent. Rhizoidal gemmae frequent. Perichaetial leaves subulate, with broad and sheathing base. Capsule cylindrical, sometimes striate when dry; peristome teeth divided to base.

- 1 Upper leaves squarrose (fig. 24, 10-11)

D. cylindricum (Hedw.) Grout

* **Trichodon cylindricus** (Hedw.) Schimp.

Rhizoids light brown. Leaves with sheathing base, abruptly tapered into long, flexuose, denticulate subula composed of nerve. Rhizoidal gemmae tricellular, brown. Dioicous. Forms turfs to 0,4 cm high by roadsides, in small ditches and on wet, shaded soils. Occasional in the northeast and west of the Peninsula, very localized in the south. Esp, Prt.

- | | | |
|---|---|---------------------------|
| 1 | Upper leaves erect to patent | 2 |
| 2 | Stem 2-12 cm high | 3 |
| 2 | Stem up to 2 cm high | 4 |
| 3 | Stem with dense, brown tomentum; leaves ovate-lanceolate, abruptly tapered into subula; nerve distinct, excurrent; cells on dorsal surface of nerve longer than adjacent laminal cells (fig. 24, 12) | |
| | D. flexicaule (Schwägr.) Hampe | |
| | * Flexitrichum flexicaule (Schwägr.) Ignatov & Fedosov | |
| | Basal cells towards nerve short, not sinuose, without pores. Forms dense to compact, dark green turfs, to 3 cm high on rocks and calcareous rocks in montane areas and high mountains in the northeast of the Peninsula and in Mallorca. Esp, And, Bl. | |
| 3 | Stem with scarce tomentum or tomentum absent; leaves ovate-lanceolate, gradually tapered into long subula; nerve faint, excurrent; cells on dorsal surface of nerve shorter than adjacent laminal cells (fig. 24, 13-14) | |
| | D. gracile (Mitt.) Kuntze | |
| | * Flexitrichum gracile (Mitt.) Ignatov & Fedosov | |
| | Basal cells towards nerve long, sinuose, porose. Forms dense, light green or golden turfs, to 12 cm high, on calcareous rocks and soils in montane areas and high mountains in the northern half of the Peninsula and in Mallorca. Esp, Prt, And, Bl. | |
| 4 | Leaves abruptly tapered into long subula composed of nerve (fig. 24, 15) | D. subulatum Hampe |
| | Upper and perichaetial leaves falciform, margin plane; nerve longly excurrent. Paroicous. Forms very lax, light green turfs, to 0,6 cm high, on rocky slopes. Scattered from the lowlands to montane areas throughout the Peninsula and in Menorca. Esp, Prt, Bl. | |
| 4 | Leaves gradually narrowed into acute or obtuse apex or ± long subula, often composed of nerve | 5 |

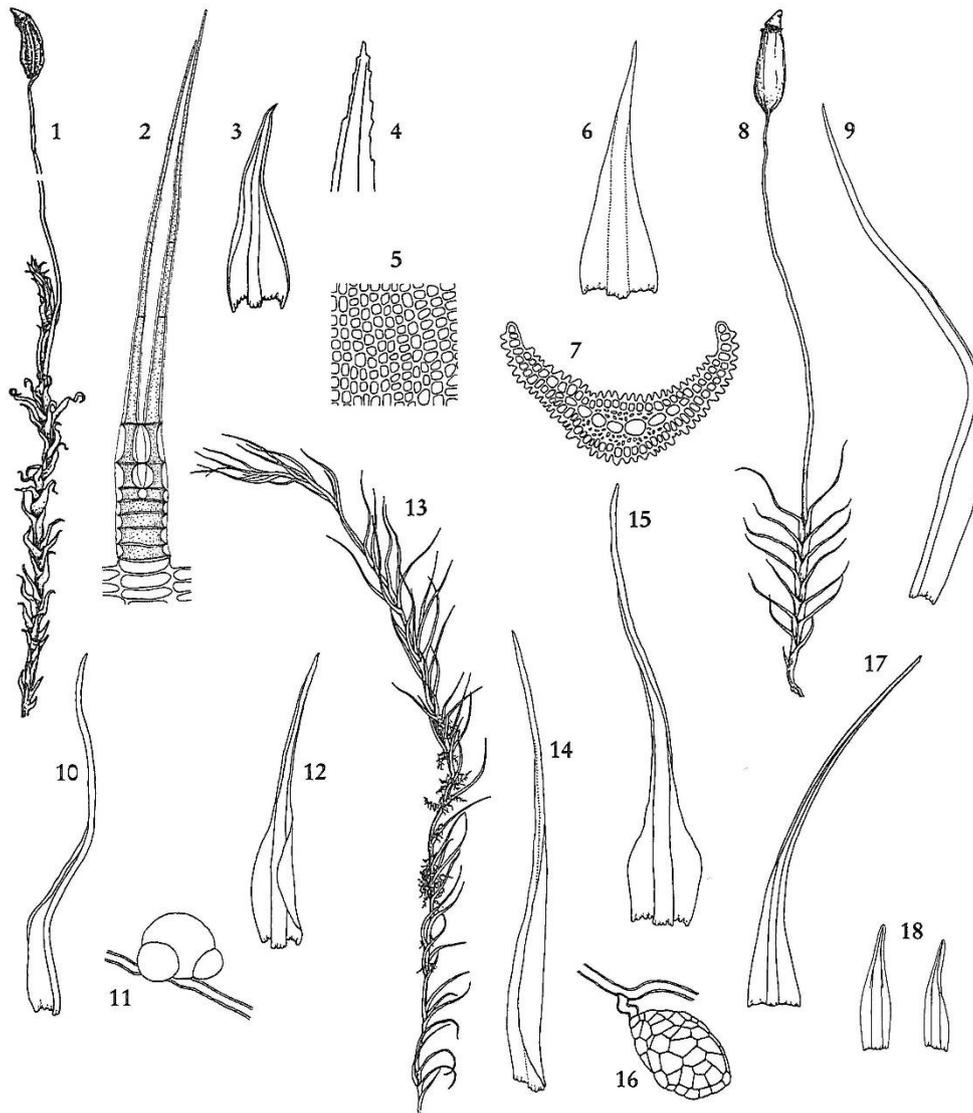


FIGURE 24. 1-5, *Ceratodon purpureus*: 1, habit; 2, peristome tooth; 3, leaf on dorsal side; 4, leaf apex on ventral side; 5, median cells. 6-7, *Cheilothela chloropus*: 6, leaf; 7, leaf section. 8-9, *Distichium capillaceum*: 8, habit; 9, leaf. 10-11, *Ditrichum cylindricum*: 10, leaf; 11, rhizoidal gemma. 12, *D. flexicaule*, leaf. 13-14, *D. gracile*: 13, habit; 14, leaf. 15, *D. subulatum*, leaf. 16, *D. pusillum*, rhizoidal gemma. 17, *D. heteromallum*, leaf. 18, *D. lineare*, leaves. 13 (x3); 1 (x4); 8 (x6); 3, 6, 9, 10, 12, 14, 15, 17, 18 (x20); 4, 11, 16 (x100); 2, 5, 7 (x160).

- 5 Leaves tapering into long, acuminate subula, erecto-patent, ± secund base 6
- 5 Leaves with tapering into short, acute or obtuse subula, erect to appressed, straight 7
- 6 Leaf basal cells narrowly rectangular to linear, 40-65 µm long (fig. 24, 17)

D. heteromallum (Hedw.) E. Britton

Plants to 1 cm tall; rhizoids brownish. Leaves erecto-patent, channelled, often secund, margin plane, entire; nerve occupying the subula, excurrent in dentate point. Sporophyte common; dioicous; seta not glossy, red, at least at base.

Forms lax, glossy, yellowish green turfs on damp soils in montane areas in the north and northwest of the Peninsula. Esp, Prt, And.

- 6 Leaf basal cells rectangular, 10-24 μm long **D. zonatum** (Brid.) Kindb.
Plants 0,3-5 cm tall. Sporophyte unknown. In Alpine metalliferous seepage area. And.

- 7 Leaves appressed, with obtuse, concave, denticulate apex, margin entire, \pm recurved (fig. 24, 18)
D. lineare (Sw.) Lindb.
Plants to 0,8 cm. Leaves channelled, margin partially bistratose; nerve broad at base. Grows on damp, rocky soils in montane areas. Rare in the northwest of the Peninsula. Esp.

- 7 Leaves erecto-patent, with acuminate, channelled apex, margin denticulate, recurved (fig. 24, 16)
D. pusillum (Hedw.) Hampe
Leaves lanceolate, channelled in upper part; lamina occasionally bistratose; nerve percurrent or slightly excurrent. Often with brown, pyriform, rhizoidal gemmae up to 125 μm wide. Dioicous. Grows on wet soils and slopes from montane areas to high mountains in the northern half of the Peninsula. Esp.

Pleuroidium Rabenh.

Plants small, to 1 cm tall, unbranched. Leaves lanceolate; laminal cells smooth, rectangular or linear; nerve percurrent or excurrent in long subula. Perichaetial leaves broad at base, longer than stem leaves. Capsule indehiscent, ovoid, apiculate, immersed.

- 1 Perichaetial leaves gradually tapering into narrow subula; antheridia axillary, naked; spores 24-28 μm , strongly papillose (fig. 25, 1-2) **P. acuminatum** Lindb.
Plants light green. Forms small turfs on slopes and wet, exposed ledges, from the lowlands to high mountains. Scattered in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 1 Perichaetial leaves abruptly tapering into long, narrow subula; antheridia axillary, covered by perigonal leaves; spores 28-30 μm , finely papillose (fig. 25, 3) **P. subulatum** (Hedw.) Rabenh.
Plants green to yellowish green, forming lax turfs. Very similar to *P. acuminatum* and growing in the same habitat. Widespread throughout the Peninsula. Esp, Prt.

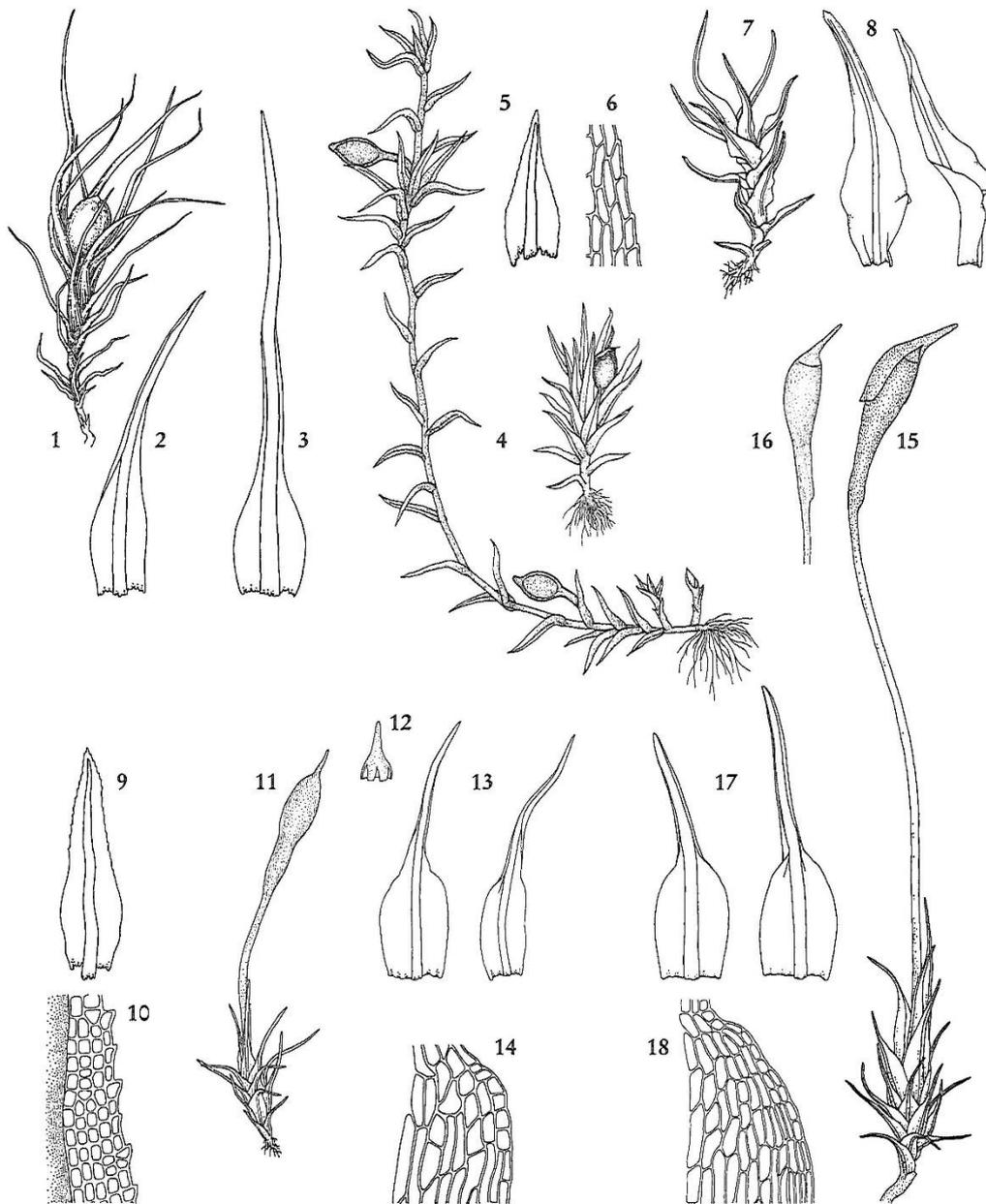


FIGURE 25. 1-2, *Pleuridium acuminatum*: 1, habit; 2, leaf. 3, *P. subulatum*, leaf. 4-6, *Pseudephemerum nitidum*: 4, habits; 5, leaf; 6, marginal cells. 7-8, *Rhamphidium purpuratum*: 7, habit; 8, leaves. 9-10, *Saelania glaucescens*: 9, leaf; 10, median cells. 11-14, *Bruchia vogesiaca*: 11, habit; 12, calyptra; 13, leaves; 14, laminal cells. 15-18, *Trematodon ambiguus*: 15, habit; 16, capsule; 17, leaves; 18, laminal cells. 1, 4, 7, 11, 12, 15, 16 (x9); 2, 3, 5, 8, 9, 13, 17 (x25); 6, 10, 14, 18 (x160).

Pseudephemerum (Lindb.) I. Hagen

Stem straight, simple or branched, innovating from below perichaetia. Rhizoids hyaline or pale brownish, sometimes with bright yellow or pale orange gemmae. Leaves erect, lanceolate to ovate-lanceolate, gradually tapering, acute, margin plane and denticulate at the apex; laminal cells rectangular, 9-13 μm wide, thin-walled; nerve thin, faint, percurrent. Lower leaves smaller. Seta short, hyaline, terminal but becoming lateral due to

later stem growth; capsule immersed, ovoid, shortly pointed and indehiscent (fig. 25, 4-6)

P. nitidum (Hedw.) Loeske

Forms loose, glossy pale green or brownish turfs to 2(5) cm high or brownish patches to 0,25 cm high, on damp, open, acidic, clayey soils, often beside pools or periodically waterlogged hollows, often with *Isoetes*, mainly in the northeast and southwest of the Peninsula. Esp, Prt.

Rhamphidium Mitt.

Plants to 1,6 cm tall, yellowish green. Leaves erect, squarrose when moist, distant, lanceolate, sheathing, abruptly or gradually narrowed into channelled subula, squarrose when dry, margin \pm undulate, entire but often with small teeth at apex; basal cells rectangular, elongated, 60-75 x 8-9 μ m, median cells abruptly becoming quadrate, ovate or rounded, smaller, 7-8 μ m wide, cells towards nerve gradually smaller; nerve percurrent (fig. 25, 7-8)

R. purpuratum Mitt.

Forms loose, green turfs, reddish below, on wet rocks by a waterway, in the west of the Peninsula. Prt.

Saelania Lindb.

Plants to 3 cm tall. Leaves linear-lanceolate, pruinose, giving a characteristic glaucous cast to the plant, margin plane and dentate; median cells quadrate, smooth, basal cells rectangular; nerve thin, percurrent or excurrent in upper leaves. Capsule straight, cylindrical, longitudinally striate; peristome teeth papillose, divided to base (fig. 25, 9-10)

S. glaucescens (Hedw.) Broth.

Forms turfs in crevices and on basic rock ledges from the lowlands to high mountains, in the north of the Peninsula. Esp, And.

Fam. Bruchiaceae

Bruchia Schwägr.

Plants very small. Stem to 0,6 cm high. Basal leaves small, gradually increasing in size above, upper leaves long and flexuose, gradually to abruptly tapering into long subula from an ovate base; cells 2-3 times as long as wide, smooth. Seta to 10 mm long, straight, flexuose; capsule cylindrical or pyriform, neck slender, 1/3-1/2 of the capsule length, indehiscent; calyptra mitriform. Protonema persistent, producing pluricellular gemmae (fig. 25, 11-14)

B. vogesiaca Nestl. ex Schwägr.

Forms small, lax, yellowish green turfs on slopes and in clearings in peaty heath lands, in montane areas, in the western part of the Peninsula. Esp, Prt.

Trematodon Michx.

Plants small. Stem 0,4-0,7 cm high. Leaves erecto-patent, abruptly narrowed to subula, apex obtuse and dentate, sheathing base oblong, 1/2 of the leaf length; basal cells rectangular, shorter above; nerve stout, occupying nearly the whole subula. Seta yellow, to about 2 cm long; capsule exserted, slightly curved, strumose, neck about same length as urn, dehiscent; peristome well developed; calyptra cucullate (fig. 25, 15-18)

T. ambiguus (Hedw.) Hornsch.

Grows on very humid soils and on the banks of streams, at high altitudes in the Central Pyrenees. Esp.

Fam. Rhabdoweisiaceae

Amphidium Schimp.

Stem branched. Leaves linear-lanceolate, acute or acuminate, flexuose or contorted when dry, margin entire or denticulate, plane or recurved at base; upper laminal cells quadrate or rounded, strongly papillose, basal cells rectangular to linear, finely papillose or smooth; nerve percurrent. Capsule emergent to exserted, pyriform, striate, annulus persistent; peristome lacking; calyptra cucullate, smooth.

- 1 Upper laminal cells rounded, 8-11 μm , obscure, strongly papillose, with large, rounded papillae; basal cells hyaline, smooth, thin-walled; capsule emergent; autoicous (fig. 26, 1-2)

A. lapponicum (Hedw.) Schimp.

Plants to 3 cm tall, pale green to dark green. Leaves contorted; margin plane or slightly recurved at base. Forms dense turfs in acidic rock crevices, in the high mountains of the Pyrenees and Sierra Nevada. Esp, And.

- 1 Upper laminal cells irregularly quadrate, 5-9 μm , slightly papillose; basal cells yellowish, thick-walled, finely papillose-striate, with elliptical to linear papillae; capsule exserted; dioicous (fig. 26, 3-5)

A. mougeotii (Schimp.) Schimp.

Plants to 6 cm tall, yellowish green, with rhizoids in old parts. Leaves flexuose or contorted; margin recurved at base. Sterile. Forms turfs in wet, siliceous rock crevices, from the lowlands to high mountains. Scattered throughout the Peninsula. Esp, Prt, And.

Arctoa Bruch & Schimp.

Plants 1-2 cm tall. Leaves straight to falciform, often secund, lanceolate with broad base, abruptly tapering into long, plane, entire or slightly denticulate subula; median cells narrowly rectangular, shorter at margin, basal cells narrowly elongated, alar cells differentiated, rectangular; nerve without stereids. Seta short, thick, yellow; capsule exserted, straight and symmetrical, widely ovoid, longitudinally sulcate when dry; peristome teeth reddish, divergent or spreading when dry (fig. 26, 6-8)

A. fulvella (Dicks.) Bruch & Schimp.

Plants branched, forming green turfs, dark brown below, on ledges and in wet acidic rock crevices, in high mountains of the Pyrenees. Esp, And.

This species may be confused with *Kiaeria starkei* because it lacks stereids in nerve, but the leaves of the latter are not abruptly tapering and the capsule is curved and slightly strumose.

Cynodontium Bruch & Schimp.

Plants up to 2,5 cm tall, branched, forming cushions. Leaves linear-lanceolate, margin recurved or plane, bistratose, rarely unistratose, crenulate or irregularly dentate above; upper lamina cells quadrate, smooth or mamilllose. Capsule exserted, straight or curved, \pm striate or smooth, strumose or not, annulus present; lid rostrate; peristome teeth 16, divided to the middle or beyond, sometimes rudimentary; calyptra cucullate.

- 1 Lamina partially bistratose above; leaf margin bistratose; capsule smooth or slightly striate when dry; peristome irregular, with teeth less than 200 μm long (fig. 26, 9-11)

C. bruntonii (Sm.) Bruch & Schimp.

Leaves linear-lanceolate, margin recurved to about 1/2 way up leaf, crenulate above. Upper laminal cells mamilllose on both sides of leaf; median cells quadrate or shortly rectangular, basal cells rectangular, enlarged towards nerve. Seta straight; peristome teeth divided in irregularly developed, fragile branches. Grows in acidic rock crevices or at base of trees, from the lowlands to the high mountains throughout the Peninsula. Esp, Prt, And.

- 1 Lamina unistratose above; leaf margin uni- or bistratose; capsule striate when dry; peristome well developed, with teeth more than 200 μm long

2

- 2 Median laminal cells smooth; leaf margin unistratose

C. jeneri (Schimp.) E. Britton

Plants to 0,6-0,8 cm tall, light green or olive green. Leaf linear-lanceolate, acuminate, margin coarsely dentate in upper part, entire below; upper cells quadrate or shortly rectangular, 12-17 μm wide. Capsule striate, not strumose. Grows in acidic rock crevices, over 1800 m, in Serra da Estrela. Prt.

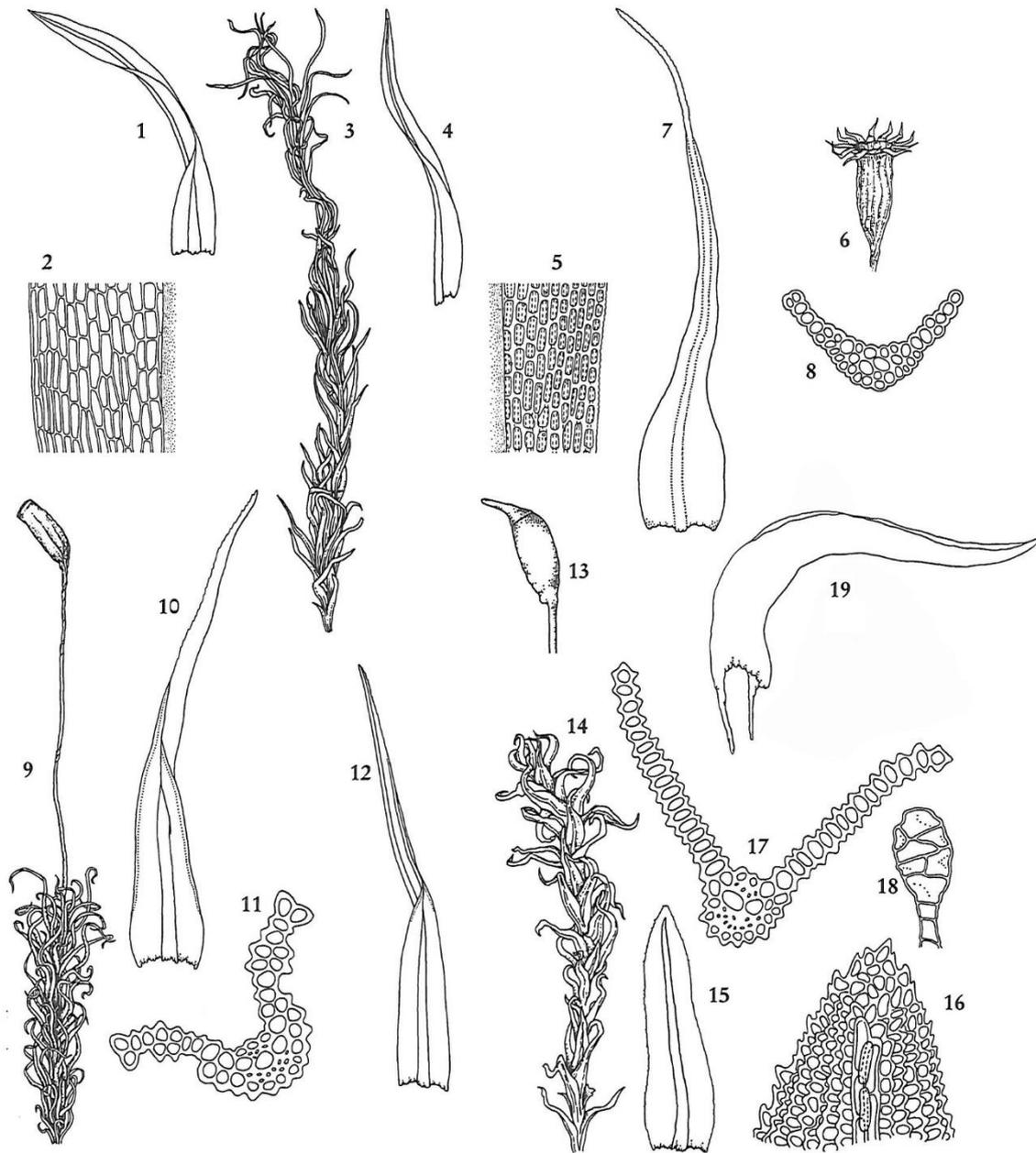


FIGURE 26. 1-2, *Amphidium lapponicum*: 1, leaf; 2, basal cells. 3-5, *A. mougeotii*: 3, habit; 4, leaf; 5, basal cells. 6-8, *Arctoa fulvella*: 6, capsule when dry; 7, leaf; 8, leaf section. 9-11, *C. bruntonii*: 9, habit when dry; 10, leaf; 11, leaf section. 12, *C. polycarpon*, leaf. 13, *C. strumiferum*, capsule. 14-18, *Dichodontium pellucidum*: 14, habit when dry; 15, leaf; 16, leaf apex; 17, leaf section; 18, gemma. 19, *D. palustre*, leaf. 3, 9, 13, 14 (x7); 1, 4, 6, 7, 10, 12, 15, 19 (x20); 2, 5, 8, 11, 16, 17, 18 (x200).

- | | | |
|---|--|---|
| 2 | Median laminal cells mamilllose; leaf margin uni- or bistratose | 3 |
| 3 | Median laminal cells strongly mamilllose, mamillae 4-8 μ m high, evenly distributed on both sides; leaf margin unistratose | <i>C. gracilescens</i> (F.Weber & D.Mohr) Schimp. |

Plants 1,5-2,5 cm tall. Leaves linear-lanceolate, with wide, blunt apex, margin incurved and dentate in upper part, bistratose; upper cells 5-12 μm wide, oval in cross section, mamillose on both sides, basal cells pellucid. Seta curved; capsule striate, not strumose. Grows in rock crevices, in high mountains. Very rare, in the Pyrenees and Serra da Estrela. Esp, Prt.

- 3 Median laminal cells more or less mamillose, mamillae 1-4 μm high, mainly on ventral side; leaf margin bistratose 4

- 4 Capsule straight, symmetrical, not strumose (fig. 26, 12) **C. polycarpon** (Hedw.) Schimp.
Plants 1,2-1,9 cm tall, dark green, tomentose. Perigonial leaves acute. Grows in rock crevices, in coniferous forests, in montane areas and high mountains of the northern part of the Peninsula. Esp, Prt (Extinct), And.

- 4 Capsule curved, asymmetrical, strumose (fig. 26, 13) **C. strumiferum** (Hedw.) Lindb.
Plants dark green. Perigonial leaves sub-acute. Capsule striate when dry. Grows on rocks, in acidic rock crevices and on rotting trunks in coniferous forests, in montane areas and high mountains of the Pyrenees. Esp, And.

Dichodontium Schimp.

Plants to 6 cm tall, forming lax green or yellowish green turfs. Leaves lanceolate to oblong-lanceolate or almost lingulate, with wide base and acute or obtuse apex, incurved when dry, margin \pm dentate; median cells quadrate, mamillose on both sides, basal cells rectangular, smooth; nerve percurrent, narrow, denticulate at back above. Capsule exserted, erect or inclined, ovoid, ellipsoidal or cylindrical, smooth; peristome teeth bifid; calyptra cucullate.

- 1 Leaves squarrose; upper laminal cells rectangular, smooth (fig. 26, 19) **D. palustre** (Dicks.) M.Stech
* **Diobelonella palustris** (Dicks.) Ochyra
Median cells of lamina 9-14 μm wide; nerve 40-50 μm wide near base. Gemmae at stem base, brown, spherical, 200-220 μm wide. Forms loose, green turfs, brown in older parts, on very damp or periodically waterlogged, acidic soils, near springs and streams, in montane areas and high mountains in the north of the Peninsula and in Sierra Nevada. Esp, Prt, And.

- 1 Leaves erecto-patent to reflexed; quadrate to shortly rectangular, mamillose or conic-papillose (fig. 26, 14-18) **D. pellucidum** (Hedw.) Schimp.
Laminal cells pellucid. Sometimes with pluricellular, brown axillary gemmae on branched filaments. Forms dark green turfs on wet rocks and by streams, in montane areas in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

Dicranoweisia Milde

Plants medium-sized, to 2,8 cm tall. Stem \pm branched, radiculose at base. Leaves linear to lanceolate, gradually tapering, channelled, crisped when dry, margin entire, recurved, bistratose; upper cells quadrate or rectangular, pellucid, smooth, 8-14 μ m wide; alar cells not differentiated; nerve narrow, percurrent, with dorsal and ventral stereids. Pluricellular gemmae on leaf frequent. Capsule ellipsoidal or cylindrical exserted, straight, smooth, symmetrical; lid obliquely rostrate; calyptra cucullate; peristome teeth 16, short, entire or split at the apex (fig. 27, 1)

D. cirrata (Hedw.) Lindb.

Forms cushions on acidic rocks, bases of trees and rotting wood, in the lowlands and montane areas. Widespread in the Peninsula. Esp, Prt.

Hymenoloma Dusén

Plants small to medium-sized. Stem \pm branched, radiculose at base and at the axil of basal leaves. Leaves linear lanceolate to ovate-lanceolate, acuminate or subulate, channelled, crisped when dry; upper cells quadrate or shortly rectangular, finely striate; nerve narrow, percurrent, with dorsal and ventral stereids. Capsule exserted, straight, smooth, symmetrical; lid obliquely rostrate; calyptra cucullate; peristome teeth 16, entire or split at the apex

- 1 Plants 1-3 cm tall; leaf margin unistratose; alar cells more or less differentiated (fig. 27, 2-4)

H. crispulum (Hedw.) Ochyra

Dicranoweisia crispula (Hedw.) Milde

Leaves subulate, crisped when dry, linear lanceolate to ovate-lanceolate, longly subulate; alar cells becoming brownish. Capsule ovoid or ellipsoidal. Forms cushions on acidic rocks, occasionally on calcareous rocks or compacted soil, in grasslands and forests, in montane areas. Scattered localities in the northern.

- 1 Plants 0,4-0,8 cm tall; leaf margin partially or totally bistratose in the upper part; alar cells not differentiated (fig. 27, 5-6)

H. mulhaceni (Höhn.) Ochyra

Leaves crisped or incurved when dry, lanceolate, shortly subulate. Capsule ellipsoidal to cylindrical. Forms dark green to blackish cushions in siliceous rocks and rock crevices. Very rare, in Sierra Nevada. Esp.

Kiaeria I. Hagen

Plants medium-sized. Leaves lanceolate, falciform or flexuose, frequently secund, gradually tapering into entire or denticulate subula; apical cells of lamina quadrate or rectangular, median cells quadrate, shortly

rectangular or rhomboidal, basal cells rectangular, elongated, \pm porose, alar cells \pm distinct, brownish; nerve excurrent, without stereids. Seta long; capsule ovoid, \pm strumose, with annulus; peristome teeth 16, divided to the middle.

- 1 Surface of leaf apex smooth or slightly dentate; alar cells sharply distinct, inflated, brownish (fig. 27, 8-10) **K. starkei** (F. Weber & D. Mohr) I. Hagen

Leaves falciform, flexuose. Perigonia just below the perichaetium; capsule slightly curved, ellipsoidal, strumose, striate when dry, annulus of 2-3 rows of fugacious cells. Forms loose, glossy yellowish green turfs in wet, acidic rock crevices, on stony soils and snow-beds, in montane areas and high mountains in the north and west of the Peninsula. Esp, Prt, And.

- 1 Surface of leaf apex papillose; alar cells widened and incrassate but not forming a strongly differentiated group **2**

- 2 Leaves crisped when dry; perigonia terminal or on separate branches or distant and below the perichaetium (fig. 27, 7) **K. blyttii** (Bruch & Schimp.) Broth.

Leaves erect-spreading, flexuose, subulate point strongly papillose, alar cells quadrate to shortly rectangular, usually rather well differentiated. Capsule slightly strumose, ovate-ellipsoidal, not striate when dry, exothecial cells thin-walled, annulus of 3 rows of fugacious cells. Autoicous or polyoicous. Forms dull or dark green turfs on rocks or in rock crevices, near streams, in montane areas and high mountains. Scattered in the northern half of the Peninsula. Esp, Prt.

- 2 Leaves regularly falcate-secund, not crisped when dry; perigonia just below the perichaetium (fig. 27, 11) **K. falcata** (Hedw.) I. Hagen

Leaves strongly falcate subulate point slightly papillose. Capsule straight or slightly curved, \pm strumose, smooth, irregularly furrowed when dry, exothecial cells thick-walled annulus of 3 rows of persistent cells. Grows on wet, granitic rocks, in high mountains. Very rare, in the Central Range. Esp.

Oncophorus (Brid.) Brid.

Plants medium-sized, forming dense turfs. Leaves lanceolate, with sheathing base, twisted when dry, margin bistratose, entire or dentate, at least in the upper part; median and apical cells of lamina quadrate, 6-8 μm , smooth, thin-walled, alar cells differentiated or not; nerve with 2, dorsal and ventral, stereid bands. Capsule oblong, curved, strumose, smooth or more often sulcate when dry, annulus lacking; peristome teeth reddish, divided to the middle, longitudinally striate.



FIGURE 27. 1, *Dicranoweisia cirrata*, leaf. 2-4, *Hymenoloma crispulum*: 2, leaf; 3, laminal cells; 4, leaf section. 5-6, *H. mulahaceni*, 5, leaf; 6, leaf section. 7, *Kiaeria blyttii*, leaf. 8-10, *K. starkei*: 8, habit; 9, leaf; 10, leaf section. 11, *K. falcata*, leaf. 12-14, *Oncophorus virens*: 12, capsule; 13, leaf; 14, leaf section. 15-18, *Rhabdoweisia fugax*: 15, habit when dry; 16, leaf; 17, leaf apex; 18, leaf section. 19, *R. crispata*, leaf apex. 8, 15 (x7); 12 (x10); 1, 2, 5, 7, 9, 11, 13, 16 (x20); 3, 4, 6, 10, 14, 17, 18, 19 (x200).

1 Alar cells often inflated and hyaline, forming a well-differentiated group; leaf margin recurved in the lower half (fig. 27, 12-14) **O. virens** (Hedw.) Brid.

Leaves with sheathing base, attenuate into channelled acumen. Grows on very moist, acidic soils by streams in forests and in wet grasslands, in high mountains of the Pyrenees and Sierra Nevada. Esp, And.

1 Alar cells not differentiated; leaf margin plane **O. wahlenbergii** Brid.

Leaves with broad sheathing base, abruptly tapering into elongated, channelled acumen. Grows on very moist, acidic soils, in high mountains. Very rare, in the Pyrenees. Esp, And.

Rhabdoweisia Bruch & Schimp.

Leaves linear-lanceolate to lingulate, erect-spreading when moist, crisped when dry, apex acute or rounded, margin unistratose, plane or weakly recurved below; median cells sub-quadrate or rounded, smooth or mamilllose, with thickened walls, basal cells rectangular or elongated hexagonal, hyaline; nerve stout, percurrent, with 4-5(-7) guide cells and 2 stereid bands, the dorsal band well developed and the ventral one weakly so. Seta yellow; capsule exserted, small, ovoid or shortly cylindrical, straight, symmetrical, striate when dry; peristome teeth 16, entire, caducous.

- 1 Leaf margin entire or slightly crenulate near apex; peristome teeth smooth (fig. 27, 15-18)

R. fugax (Hedw.) Bruch & Schimp.

Plants 0,5-1 cm tall. Leaves linear-lanceolate, apex acute; upper cells 8-13 μm . Forms compact, yellowish green turfs, discoloured below, on slopes and in wet, acidic rock crevices, in montane areas and high mountains, rarely in the lowlands, mainly in the northern half of the Peninsula. Esp, Prt, And.

- 1 Leaf margin dentate or denticulate above; peristome teeth striate (fig. 27, 19)

R. crispata (Dicks.) Lindb.

Plants 0,3-1,2 cm tall. Leaves lanceolate, apex acute, margin irregularly denticulate at apex; upper laminal cells 10-14 μm wide. Forms dense turfs in wet, acidic rock crevices in montane areas. Scattered in the north of the Peninsula. Esp.

Fam. Schistostegaceae

Schistostega D.Mohr

Plants to 1,5 cm tall. Leaves arranged in 2 ranks, confluent at base, lanceolate, acute to acuminate; laminal cells rhomboidal, more than 15 μm wide, thin-walled; nerve lacking. Capsule exserted, erect, ovoid; peristome lacking. Protonema persistent, emerald green, light-refracting (fig. 28, 1)

S. pennata (Hedw.) F.Weber & D.Mohr

Grows on sandstone, gneiss or granite, in humid and shady places, in caves or mines. Scattered in the northern part of the Peninsula. Esp, Prt.

Fam. Dicranaceae

Dicranella (Müll.Hal.) Schimp.

Plants generally small. Stem simple or slightly branched. Leaves with wide, occasionally sheathing base, abruptly or gradually tapered to apex or to entire or denticulate subula; laminal cells rectangular, elongated, narrow, smooth, alar cells indistinct; nerve with 2 stereid bands, the ventral one with few cells. Some species with rhizoidal gemmae. Seta red or yellow; capsule straight or inclined, symmetrical or asymmetrical, smooth or striate when dry; lid conical or rostrate; peristome single, teeth 16, divided to the middle, commonly with vertical striae and papillose point, basal membrane usually low.

- 1 Leaves spreading to squarrose, with wide, sheathing or semi-sheathing base; seta red 2

- 1 Leaves erect to patent, sometimes falcate-secund; seta reddish or yellow 3

- 2 Leaves ± gradually tapered to denticulate subula with obtuse teeth; leaf base semi-sheathing; capsule smooth, not strumose (fig. 28, 3) **D. schreberiana** (Hedw.) Dixon
Rhizoidal gemmae occasionally present, spherical, orange brown, (90-)100-130 µm. Median laminal cells (8-)10-14 µm wide; nerve 50-100 µm wide; Forms dense, pale yellowish green turfs, brown below, on wet, clayey soils and rocks by streams, in montane areas. Rare, in the northern part of the Peninsula. Esp, And.

- 2 Leaves abruptly tapered to flexuose, entire subula; leaf base sheathing; capsule striate, strumose (fig. 28, 4) **D. grevilleana** (Brid.) Schimp.
Rhizoids with spherical, brown gemmae; median laminal cells 6-12 µm wide; nerve 40-70 µm wide. Forms compact, green turfs on wet, clayey soils, in high mountains of the Pyrenees. Esp, And.

- 3 Nerve ill-defined; leaves bistratose, rarely unistratose near base (fig. 28, 9-10) **D. howei** Renaud & Cardot
Rhizoids brown, often with irregular gemmae having prominent cells. Leaf basal margin plane or narrowly recurved on one side; nerve 1/3 of leaf base width (85-100 µm); exothecial cells elongated, with sinuose walls, longitudinal and transverse walls with similar thickness. Grows usually on exposed soils and stony slopes in the lowlands. Frequent in the eastern half of the Peninsula and in Mallorca, Menorca and Pithyusic islands. Esp, Prt, Bl.

- 3 Nerve well-defined; leaves unistratose 4

- 4 Nerve occupying 1/3 of leaf base 5

- 4 Nerve occupying 1/5 of leaf base width 6
- 5 Leaf margin denticulate above; basal cells 22-50 μm long; urn not strumose (fig. 28, 12-14)
D. heteromalla (Hedw.) Schimp.
 Leaves falcate-secund when dry; nerve excurrent. Seta yellow; capsule brown, inclined, sulcate when dry; lid rostrate; peristome reddish brown, basal membrane yellow. Forms glossy green turfs on slopes, in wet rock crevices and by streams, on acidic substrata in beechwoods, oakwoods and *Quercus ilex* L. forests. Common in montane areas of the Peninsula. Esp, Prt, And.
- 5 Leaf margin entire or finely denticulate at apex at apex; basal cells less than 65-78 μm long; urn strumose (fig. 28, 2)
D. cerviculata (Hedw.) Schimp.
 Leaves flexuose when dry; nerve excurrent. Seta yellowish to brownish; capsule reddish, sulcate when dry. Grows on wet, sandy or peaty soils in montane areas. Esp.
- 6 Plants reddish to reddish brown; margin denticulate (fig. 28, 11) **D. rufescens** (Dicks.) Schimp.
 Rhizoids red-brown in old parts, with reddish or brownish gemmae of 1-3 cells. Leaves straight or falciform; nerve percurrent. Seta red; capsule reddish, straight or slightly inclined, symmetrical, smooth; lid high-conical; peristome basal membrane high, of up to 10 rows of cells. Forms lax, dull reddish to brownish turfs on wet, acidic, clayey or clay-sandy soils, by roadsides or streams in montane areas, in the northern half of the Peninsula. Esp, Prt.
- 6 Plants green to yellowish green; margin entire or slightly denticulate 7
- 7 Leaves gradually narrowed in a short point (fig. 28, 5) **D. staphylina** H.Whitehouse
 Plants pale green or pale brownish. Leaves triangular to lanceolate, erecto-patent to spreading; margin with a few obtuse teeth towards apex; median cells of lamina 10-14 μm wide. Rhizoidal gemmae to 100 μm long, brown. Forms dense turfs on soils near streams. Only one locality in north of the Peninsula. Esp, Prt.
- 7 Leaves tapering in a long point 8

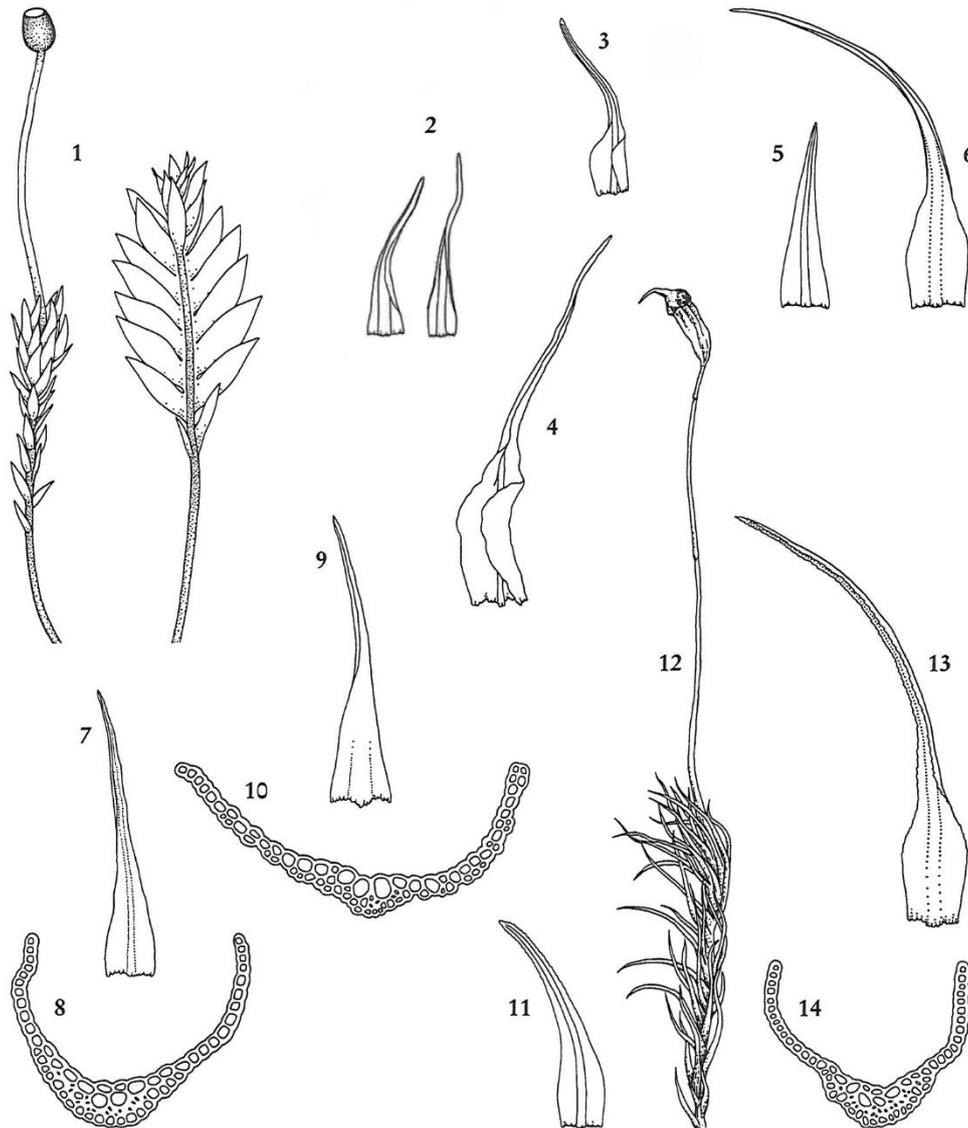


FIGURE 28. 1, *Schistostega pennata*, habit, plants with and without sporophyte. 2, *Dicranella cerviculata*, leaves. 3, *D. schreberiana*, leaf. 4, *D. grevilleana*, leaf. 5, *D. staphylina*, leaf. 6, *D. subulata*, leaf. 7-8, *D. varia*: 7, leaf; 8, leaf section. 9-10, *D. howei*: 9, leaf; 10, leaf section. 11, *D. rufescens*, leaf. 12-14, *D. heteromalla*: 12, habit; 13, leaf; 14, leaf section. 12 (x7); 1 (x15); 2, 3, 4, 5, 6, 7, 9, 11, 13 (x20); 8, 10, 14 (x200).

8 Leaves abruptly narrowed to filiform subula, base sheathing, margin plane; basal cells of lamina 6-10 μm wide; capsule striate when dry (fig. 28, 6) **D. subulata** (Hedw.) Schimp.

Rhizoidal gemmae more than 110 μm long. Forms loose, glossy green turfs on wet, clayey or sandy soils in oakwoods and fir woods in montane areas and high mountains, in the northern part of the Peninsula. Esp, Prt, And.

8 Leaves gradually narrowed to subula, base not sheathing, margin recurved; basal cells of lamina 8-14 μm wide; capsule smooth when dry (fig. 28, 7-8) **D. varia** (Hedw.) Schimp.

Rhizoids pale brown, often with irregular gemmae having prominent cells. Capsule smooth, asymmetrical, curved: exothelial cells elongated, with straight walls, longitudinal walls more thickened than transverse walls, especially at

convex part of capsule. Grows on rocks, soils and slopes by wet, calcareous roads in montane areas. Widespread throughout the Peninsula. Esp, Prt, And.

Dicranum Hedw.

Plants medium-sized to large, generally forming compact, glossy turfs or tufts. Stem tomentose. Leaves straight or falciform, often secund, lanceolate, plane or undulate, mostly with subulate apex and margin \pm dentate; upper cells of lamina quadrate, rectangular to elongate, smooth or mamilliose, thick-walled, occasionally porose, alar cells \pm distinct; nerve percurrent or excurrent or ending below apex, smooth or with longitudinal lamellae at back and 2 stereid bands, rarely without stereids. Capsule erect or inclined, straight or curved, smooth or striate; lid longly rostrate; calyptra cucullate; peristome teeth 16, divided to half way or to 2/3.

- | | | |
|---|---|---|
| 1 | Leaves very fragile, frequently with broken tips | 2 |
| 1 | Leaves not fragile, usually with intact tips | 3 |
| 2 | Nerve with stereids; lamina unistratose; basal laminal cells more than 50 μ m long (fig. 29, 15-16) | |

D. tauricum Sapjegin

Plants small, to 2-3 cm tall. Leaves straight, rigid, apex subulate, very fragile; basal cells of lamina not porose, alar cells yellowish; nerve smooth, longly excurrent. Capsule straight. Grows on rotting stumps, or at tree bases, in montane areas and high mountains, mainly in the northern half of the Peninsula. Esp, Prt, And.

- | | | |
|---|---|--|
| 2 | Nerve without stereids; lamina unistratose or partially bistratose in the upper part; basal laminal cells less than 40 μ m long | |
|---|---|--|

D. viride (Sull & Lesq.) Lindb.

Plants small, to 2-2,5 cm tall. Leaves straight, rigid, apex subulate, very fragile; basal cells of lamina not porose, alar cells yellowish; nerve smooth, excurrent. Capsule straight. Grows on beech. Esp.

- | | | |
|---|---|---|
| 3 | Upper cells of leaf elongated, porose | 4 |
| 3 | Upper cells of leaf quadrate or shortly rectangular, not porose | 9 |

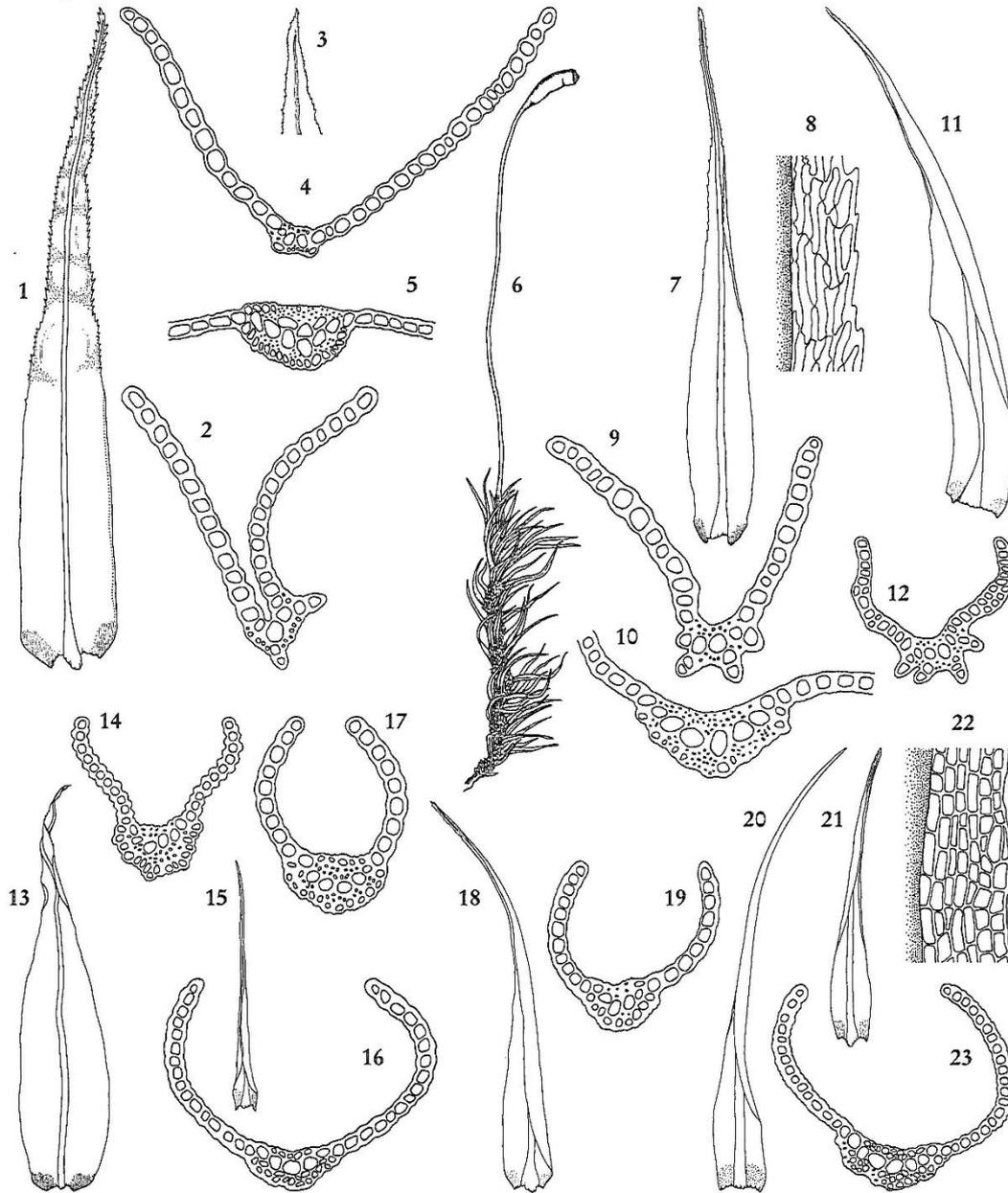


FIGURE 29. 1-2, *Dicranum polysetum*: 1, leaf; 2, leaf section. 3-4, *D. bonjeanii*: 3, leaf apex; 4, leaf section. 5, *D. majus*, nerve section at base. 6-10, *D. scoparium*: 6, habit; 7, leaf; 8, upper cells; 9, section in the middle of leaf; 10, nerve section at base. 11-12, *D. crassifolium*: 11, leaf; 12, leaf section. 13, *D. spurium*, leaf. 14, *D. brevisfolium*, leaf section. 15-16, *D. tauricum*: 15, leaf; 16, leaf section. 17, *D. muehlenbeckii*, leaf section. 18-19, *D. fuscescens*: 18, leaf; 19, leaf section. 20, *D. scottianum*, leaf. 21-23, *D. montanum*: 21, leaf; 22, upper cells; 23, leaf section. 6 (x2); 1, 3, 7, 11, 13, 15, 18, 20, 21 (x10); 2, 4, 5, 8, 9, 10, 12, 14, 16, 17, 19, 22, 23 (x170).

4 Leaves weakly to strongly transversely undulate in the upper part (at least in some leaves) 5

4 Leaves not undulate 7

- 5 Leaves strongly transversely undulate in the upper part; nerve percurrent, with 2(-4) high lamellae at back above (fig. 29, 1-2) **D. polysetum** Sw. ex anon.
Stem robust, strongly tomentose. Leaves 5-11 mm long, straight to falciform, with long and narrow upper part; margin plane, irregularly dentate, recurved at base; alar cells brownish yellow. Fertile plants with (1-)5(-7) sporophytes per perichaetium. Forms large turfs on wet, shaded soils in pinewoods, oakwoods and fir woods in the northern part of the Peninsula. Esp, And.
- 5 Leaves weakly transversely undulate in the upper part; nerve ending below apex, smooth or with 2 short lamellae at back above (fig. 29, 3-4) **D. bonjeanii** De Not.
Stem thin, tomentose. Leaves about 3-7 mm long, straight, with short and wide upper part; margin plane, denticulate; alar cells brownish. Fertile plants with 1(-2) sporophytes per perichaetium. Forms turfs on wet, exposed soils, wet grasslands and peaty soils, in the northern part of the Peninsula. Esp, And.
- 6 Leaves 10-15 mm long; nerve without lamellae but toothed at back above, with 2(-3) rows of central guide cells (fig. 29, 5) **D. majus** Sm.
Leaves falcate-secund, flexuose. Laminal cells rectangular, with thin longitudinal walls. Seta yellow. Grows on damp or humid, shaded, stony soils and at base of walls, in the western Pyrenees and in the Basque Mountains. Esp.
- 6 Leaves to 10 mm long; nerve with (2-)4-6 lamellae at back above or smooth, with 1 row of central guide cells **7**
- 7 Plants to 2 cm; nerve without dorsal lamellae **D. leioneuron** Kindb.
Stem slightly tomentose, with flagelliform branches; leaves straight, ovate-lanceolate, concave, channelled, margin entire. Forms light green turfs in mires and damp sites. Very rare, in the north of the Peninsula. Esp.
- 7 Plants 2-10 cm long; nerve with lamellae at back above **8**
- 8 Lamina unistratose; nerve with 4 dorsal lamellae at back above (fig. 29, 6-10) **D. scoparium** Hedw.
Stem of young plants covered by dense, whitish tomentum. Leaves often secund, plane, margin dentate; laminal cells rectangular, with thickened longitudinal walls; nerve with a central row of guide cells. Seta yellow, reddish at base. Forms light green, glossy tufts on dry or wet, shaded, stony soils, at base of rotting trees and trunks, usually in montane areas, although it can reach high mountains, in the lowlands in northwest of the Peninsula. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 8 Lamina partly bistratose in the upper half; nerve with 4-6 dorsal lamellae at back above (fig. 29, 11-12) **D. crassifolium** Sérgio, Ochyra & Séneca

Stem with whitish tomentum. Leaves gradually tapering to a channelled subula; lamina with 3-stratose strands, alar cells yellowish to brownish; dorsal lamellae 1-3(-4) cells high. Forms rather loose, yellowish-green or light to dark green turfs, on soil or humus in open or shaded places, and on rocks and at tree bases. Widespread in the north and west of the Peninsula. Esp, Prt.

- 9 Leaves rugose or transversely undulate, mainly in the upper part **10**
- 9 Leaves not rugose or transversely undulate, channelled in the upper part **11**
- 10 Lamina rugose; leaf apex acuminate or acute (fig. 29, 13) **D. spurium** Hedw.
 Stem tomentose, 4-12 cm high. Leaves ovate-lanceolate, abruptly acuminate, acumen twisted, dentate, fragile; median cells triangular or quadrate, irregular; nerve with high mamillae at back above. Grows on shaded soils and rocks. Scattered in the north of the Peninsula. Esp.
- 10 Lamina transversely undulate; leaf apex obtuse **D. undulatum** Schrad. ex Brid.
D. bergeri Blandow, **D. affine** Funck.
 Stem to 3-8,5 cm high, with brown tomentum below. Leaves lanceolate, gradually acuminate; median cells smooth, basal cells mostly porose; nerve smooth at back above. Grows on wet soils and peaty or wet grasslands, in high mountains of the Eastern Pyrenees. Esp.
- 11 Cross section of upper part of leaf like a pair of tongs (fig. 29, 14) **D. brevifolium** (Lindb.) Lindb.
D. muehlenbeckii Bruch & Schimp. var. **cirrhatum** (Schimp.) Lindb.
 Plants 2-4 cm tall, with tomentose stem. Leaves ovate-lanceolate, attenuate to a subulate, slightly dentate point; upper cells of lamina quadrate or rectangular. Grows on calcareous rocks and soils, in high mountains of the Pyrenees. Esp, And.
- 11 Cross section of upper part of leaf orbicular **12**
- 12 Plants small, to 2 cm long; basal cells non- or only slightly porose **13**
- 12 Plants small or medium size, more than 2 cm long; basal cells porose **14**
- 13 Leaves with mamillose upper cells (fig. 29, 21-23) **D. montanum** Hedw.
 Plants to 0,6-1,5 cm tall. Leaves with margin denticulate; laminal cells quadrate or rectangular; nerve with few stereids, mamillose at back above. Capsule straight. Forms low, soft, compact light green to brownish turfs on wet or damp, shaded, humus-rich soils and rotting trunks, in lowland and montane areas of the north of the Peninsula. Esp.

- 13 Leaves with smooth upper cells **D. flagellare** Hedw.
Plants to 5 cm tall. Leaf margin entire or denticulate only in the uppermost part. Propaguliferous, flagelliform branches with short, ovate-lanceolate, appressed, leaves from axils of upper stem leaves. Forms green to yellowish green, dense turfs on decaying wood and humus-rich soils, in the lowlands of the north and northwest of the Peninsula. Esp.
- 14 Leaves strongly crisped when dry; nerve with the ventral epidermal layer of cells differentiated (fig. 29, 17) **D. muehlenbeckii** Bruch & Schimp.
Plants robust, 3-3,5 cm tall, dull. Stem with golden brown tomentum below. Leaves slightly contorted, strongly twisted when dry; upper cells of lamina regularly quadrate, 9-13 μm wide, basal cells rectangular. Grows on humus-rich soils in montane areas. Very rare in the northeast of the Peninsula. Esp, And.
- 14 Leaves straight or crisped when dry; nerve with the ventral epidermal layer of cells not differentiated **15**
- 15 Median laminal cells porose **D. spadiceum** J.E.Zetterst.
D. muehlenbeckii Bruch & Schimp. var. **neglectum** (De Not.) Pfeff.
Plants 3-4 cm long, dark or pale green. Stem with dark brown or reddish tomentum. Leaves erect-patent when dry, margin entire or denticulate in upper part. Grows on rocky, rocks and in rock crevices in high mountains of the Pyrenees and north of the peninsula. Esp.
- 15 Median laminal cells not porose **16**
- 16 Upper cells of lamina thin walled or slightly thickened; leaf margin denticulate to strongly dentate in the upper half (fig. 29, 18-19) **D. fuscescens** Sm.
Plants 1,5-6,5 cm tall. Leaves falciform, secund, upper margin partially bistratose; nerve mamillate and dentate at back above. Forms dense, yellowish green to olive green turfs on wet, shaded, stony, acidic soils and rotting stumps, in montane areas and high mountains. Distributed in the northern part of the Peninsula. Esp, And.
- 16 Upper cells of lamina thick-walled; leaf margin entire or denticulate in the upper half (fig. 29, 20) **D. scottianum** Turner ex R.Scott
D. canariense Hampe ex Müll. Hal.
Plants to 2-5 cm tall. Forms dark green turfs on siliceous, shaded rocks and trunks, in the north and northwest of the Peninsula. Esp, Prt.

Paraleucobryum (Limpr.) Loeske

Plants ± robust, glossy, pale green. Leaves lanceolate, subulate, erect or falciform, often secund; upper cells rectangular, elongate and ± porose below, alar cells differentiated; nerve broad, in section with a ventral layer of hyaline cells, a central layer of chlorophyllose cells and a dorsal layer of hyaline cells intermingled or not with chlorophyllose cells. Capsule straight, cylindrical.

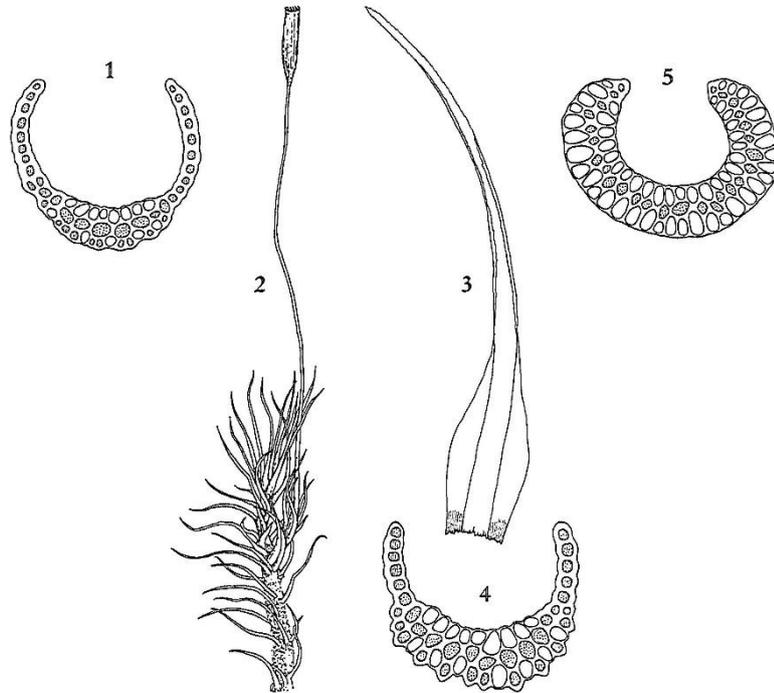


FIGURE 30. 1, *Paraleucobryum sauteri*, leaf section. 2-4, *P. longifolium*: 2, habit; 3, leaf; 4, leaf section. 5, *P. enerve*, leaf section. 2 (x3,5); 3 (x15); 1, 4, 5 (x200).

- | | | |
|---|---|---|
| 1 | Nerve less than 1/2 width of leaf base (fig. 30, 1)
Leaf margin entire; nerve in section with the dorsal layer composed of hyaline and chlorophyllose cells mixed. Forms turfs on acidic rocks and rotten stumps by streams in high mountains pine woods and fir woods of the Pyrenees. Esp, And. | <i>P. sauteri</i> (Bruch & Schimp.) Loeske |
| 1 | Nerve 1/2 or more width of leaf base | 2 |
| 2 | Nerve to 400 µm wide at base, dorsally striate, in section dorsal layer composed of hyaline cells with chlorophyllose cells mixed (fig. 30, 2-4)
Leaf margin denticulate in the upper part. Forms glossy turfs on wet acidic rocks and at tree bases in fir woods, beechwoods and pine woods, in montane areas and high mountains, in the northern half of the Peninsula and in Sierra Nevada. Esp, And. | <i>P. longifolium</i> (Hedw.) Loeske |

- 2 Nerve more than 400 μm wide at base, smooth, in section the dorsal layer composed only of hyaline cells (fig. 30, 5) **P. enerve** (Thed.) Loeske
 Leaf margin entire or with few denticulations in the upper part. Forms glossy dense turfs on wet, acidic rocks and soils in high mountains pine woods, in the Pyrenees. Esp, And.

Fam. Leucobryaceae

Campylopus Brid.

Plants small to robust, forming dense or loose turfs. Stem mostly tomentose. Leaves lanceolate, with \pm widened base, abruptly tapered to channelled apex; median cells variable, quadrate to vermicular, alar cells differentiated or not, hyaline or coloured; nerve broad, occupying 1/3-2/2 of leaf base width, excurrent in hyaline hair-point or in green or brownish arista, smooth or with low ribs at back, often with large guide cells and dorsal stereids, rarely stereids lacking.

- 1 At least upper leaves with hyaline hair-point 2
- 1 Leaves without hyaline hair-point 5

- 2 Hyaline hair-point reflexed when dry (fig. 31, 17) **C. introflexus** (Hedw.) Brid.
 Plants golden, to 15 cm tall. Leaves erect when dry, oblong, subulate, hyaline hair-point dentate; median cells of lamina short, rhomboidal, irregular, thick-walled, basal cells rectangular, extending up margins, alar cells not or poorly differentiated; nerve with ribs 1-2 (-3) cells high at back. Grows on acidic soils, in rock crevices, slopes and at base of trees, from the lowlands to high mountains, in the north and west of the Peninsula, rare in the northeastern part and in Mallorca. Esp, Prt, Bl.

- 2 Hyaline hair-point straight when dry 3
- 3 Nerve with dorsal lamellae 2-4(5) cells high (fig. 31, 18-20) **C. pilifer** Brid.
 Stem very rigid, 2-8 cm high. Leaves strongly imbricate, oblong-lanceolate; median cells of lamina irregularly oblong or rhomboidal, basal cells rectangular, narrower at margins, hyaline, extending up margins. Forms dense, golden green turfs on dry or slightly wet, acidic rocks and slopes, in rock crevices and at base of trees, from the lowlands from to high mountains. Widespread in the Peninsula and in Menorca. Esp, Prt, And, Bl.

- 3 Nerve without lamellae, smooth or crenulate on dorsal side 4
- 4 Nerve with dorsal and ventral stereids (fig. 31, 4-5) **C. brevipilus** Bruch & Schimp.
Plants to 5 cm tall. Leaves straight, often ending in short, hyaline point; median cells of lamina oblong to rhomboidal, ± porose. Forms compact, golden turfs on acidic peaty soils and wet rock crevices, in the lowlands and montane areas. Distributed in the north and west of the Peninsula and in Menorca. Esp, Prt, Bl.
- 4 Nerve with dorsal stereids only (fig. 31, 10-12) **C. atrovirens** De Not.
Stem 2-10 cm high. Leaves longly subulate, channelled; median cells of lamina vermicular; basal cells of lamina thick-walled, porose, alar cells inflated, reddish brown; nerve occupying 1/2-2/3 of leaf base width, smooth or with low ribs 1 cell high at back, excurrent in denticulate, hyaline hair-point of variable length, occasionally lacking. Forms dense, glossy dark green turfs on wet, acidic rocks from the lowlands to high mountains, in the northern half of the Peninsula. Esp, And.
- 5 Basal cells of lamina thick-walled, not hyaline; alar cells differentiated 6
- 5 Basal cells of lamina thin-walled, hyaline; alar cells not or hardly differentiated 7
- 6 Nerve in cross section showing hyalocysts smaller and more numerous than guide cells; upper laminal cells rhomboidal or shortly rectangular, 10-18(25) µm long (fig. 31, 14) **C. flexuosus** (Hedw.) Brid.
Plants with abundant reddish brown tomentum; stem 1-7 cm high. Leaves erecto-patent when dry, flexuose, longly subulate, apex channelled; alar cells orange or reddish brown, inflated, basal cells narrowly rectangular; nerve smooth, occupying 1/3-1/2 of leaf base width. Forms dense, glossy golden green turfs on humus-rich or peaty soils, in acidic rock crevices and rotten wood, in the lowlands and montane areas. Distributed in the northern and southwestern part of the Peninsula. Esp, Prt, And.
- 6 Nerve in cross section showing hyalocysts larger and in the same number as guide cells; upper laminal cells rectangular or trapezoidal, 28-36 µm long (fig. 31, 15-16) **C. setifolius** Wilson
Plants without tomentum or with few pale rhizoids; stem to 2 cm high. Leaves erecto-patent, flexuose when dry, gradually tapering to long subula, apex with 1-4 large teeth; alar cells orange red, basal cells rectangular; nerve excurrent, smooth or crenulate near apex, occupying 1/2 or more of leaf base width. Forms loose, dark bright green turfs in wet, acidic rock, in the lowlands. Rare, in the north of the Peninsula. Esp.
- 7 Nerve with stereids 8
- 7 Nerve without stereids 9

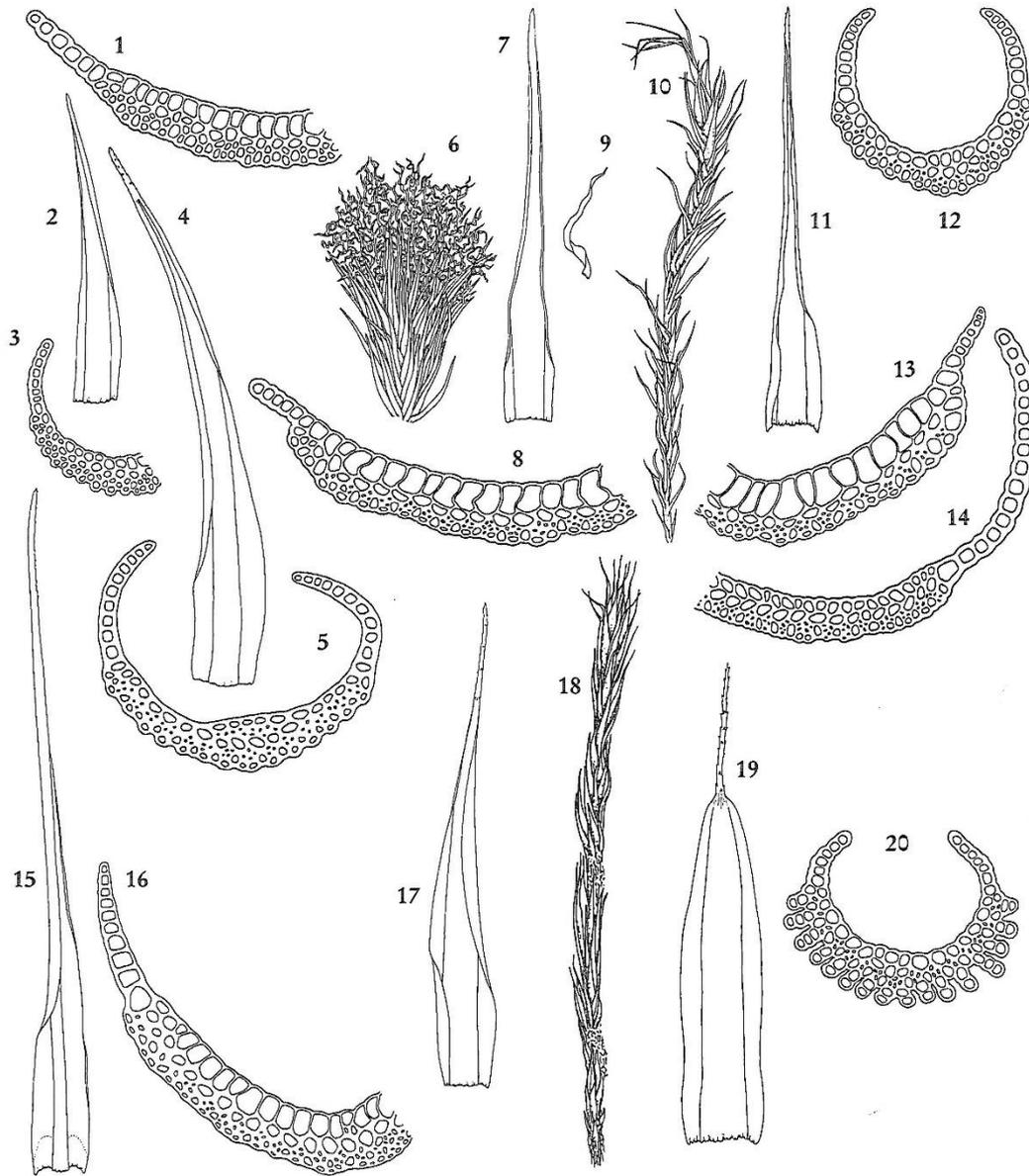


FIGURE 31. 1, *Campylopus schimperi*, leaf section. 2-3, *C. subulatus*: 2, leaf; 3, leaf section. 4-5, *C. brevipilus*: 4, leaf; 5, leaf section. 6-9, *C. fragilis*: 6, stem tip with caducous leaves; 7, leaf; 8, leaf section; 9, caducous leaf. 10-12, *C. atrovirens*: 10, habit; 11, leaf; 12, leaf section. 13, *C. pyriformis*, leaf section. 14, *C. flexuosus*, leaf section. 15-16, *C. setifolius*: 15, leaf; 16, leaf section. 17, *C. introflexus*, leaf. 18-20, *C. pilifer*: 18, habit; 19, leaf; 20, leaf section. 10, 18 (x4); 6 (x6); 2, 4, 7, 9, 11, 15, 17, 19 (x16); 1, 3, 5, 8, 12, 13, 14, 16, 20 (x200).

8 Leaves narrower at base; basal lamina 2-3-stratose towards nerve (fig. 31, 6-9)

***C. fragilis* (Brid.) Bruch & Schimp.**

Stem 0,5-2 cm high, with reddish tomentum. Leaves subulate, denticulate at apex; median cells of lamina shortly rectangular, thick-walled, basal cells longly rectangular, larger, thin-walled, hyaline, marginal cells narrower; nerve occupying 1/3-1/2 of leaf base width, excurrent, dentate. Plants sterile, often with caducous, propaguliferous leaves at stem tip. Forms loose or dense, glossy light green turfs on acidic rocks and in rock crevices in the lowlands and montane areas, in the north and west of the Peninsula. Esp, Prt.

- 8 Leaves not narrower at base; basal lamina unistratose towards nerve (fig. 31, 13)

C. pyriformis (Schultz) Brid.

Stem to 1 cm high, tomentose. Leaves longly and finely subulate; alar cells not differentiated; nerve usually occupying 1/3 of leaf base width, percurrent to longly excurrent in green, denticulate point, with low ribs at back. Forms loose, pale green to golden green turfs on damp slopes, peaty soils and at base of trees, in the north and west of the Peninsula. Esp, Prt.

- 9 Median laminal cells 9-16(20) μm long; nerve crenulate at back (fig. 31, 2-3)

C. subulatus Schimp. ex Milde

Plants not or slightly tomentose; stem 0,6-0,8 cm high. Leaves with rather short subula; upper cells regular, mainly rectangular and quadrate; alar cells slightly differentiated. Forms green or light green loose turfs on siliceous rocks crevices and ledges, from the lowlands to high mountains in the northern half and west of the Peninsula. Esp, Prt, And.

- 9 Median laminal cells (9)16-33 μm long; nerve smooth or slightly crenulate at back (fig. 31, 1)

C. schimperi Milde

Plants with reddish-brown tomentum; stem 1-6 cm high. Leaves erect, lanceolate, shortly subulate, apex channelled, slightly dentate or entire, fragile; upper cells rectangular, basal cells widely rectangular, alar cells slightly differentiated, hyaline. Forms compact, matted, dull green to yellowish brown turfs on ledges and in rock crevices by streams or in wet grasslands, in high mountains of the Pyrenees. Esp.

Dicranodontium Bruch & Schimp.

Plants with tomentose stem, forming loose, brownish yellow turfs. Leaves straight to falciform, subulate, channelled; laminal cells narrow and long, alar cells hyaline to brownish, often inflated, fragile; nerve excurrent, with dorsal and ventral stereids. Seta \pm curved, straight to sinuose when dry; capsule cylindrical, straight, smooth, without annulus; lid conical, rostrate; peristome teeth 16, divided to near base, obliquely striate at tips; calyptra cucullate. Dioicous.

- 1 Leaf margin denticulate almost throughout (fig. 32, 1)

D. asperulum (Mitt.) Broth.

Plants to 4 cm tall. Leaves often caducous, flexuose, erect. Leaves with inflated, fragile alar cells; nerve occupying about 1/5-1/3 of leaf base width. Forms soft, loose, silky or dull yellowish to dark green turfs on damp or wet siliceous slopes by streams. Very rare in the north of the Peninsula. Esp.

- 1 Leaf margin denticulate only in upper part of leaf

2

2 Nerve well defined; basal cells widely rectangular, hyaline, inflated, abruptly differentiated from marginal cells (fig. 32, 2)

D. uncinatum (Harv.) A.Jaeger

Plants to 10 cm tall. Leaves falciform, with wide base, abruptly narrowed to subula; alar cells fragile. Grows on acidic slopes from lowlands to high mountains, in the northern part of the Peninsula. Esp, And.

2 Nerve ill-defined; basal cells narrowly rectangular, coloured, gradually narrowed towards margin (fig. 32, 3-5)

D. denudatum (Brid.) E.Britton

Plants to 5 cm tall. Leaves straight or falciform, caducous, gradually subulate; alar cells inflated. Grows on acidic rocks and slopes, humus-rich soils and rotten stumps in wet forests in montane areas and high mountains, in the northern part of the Peninsula. Esp, And.

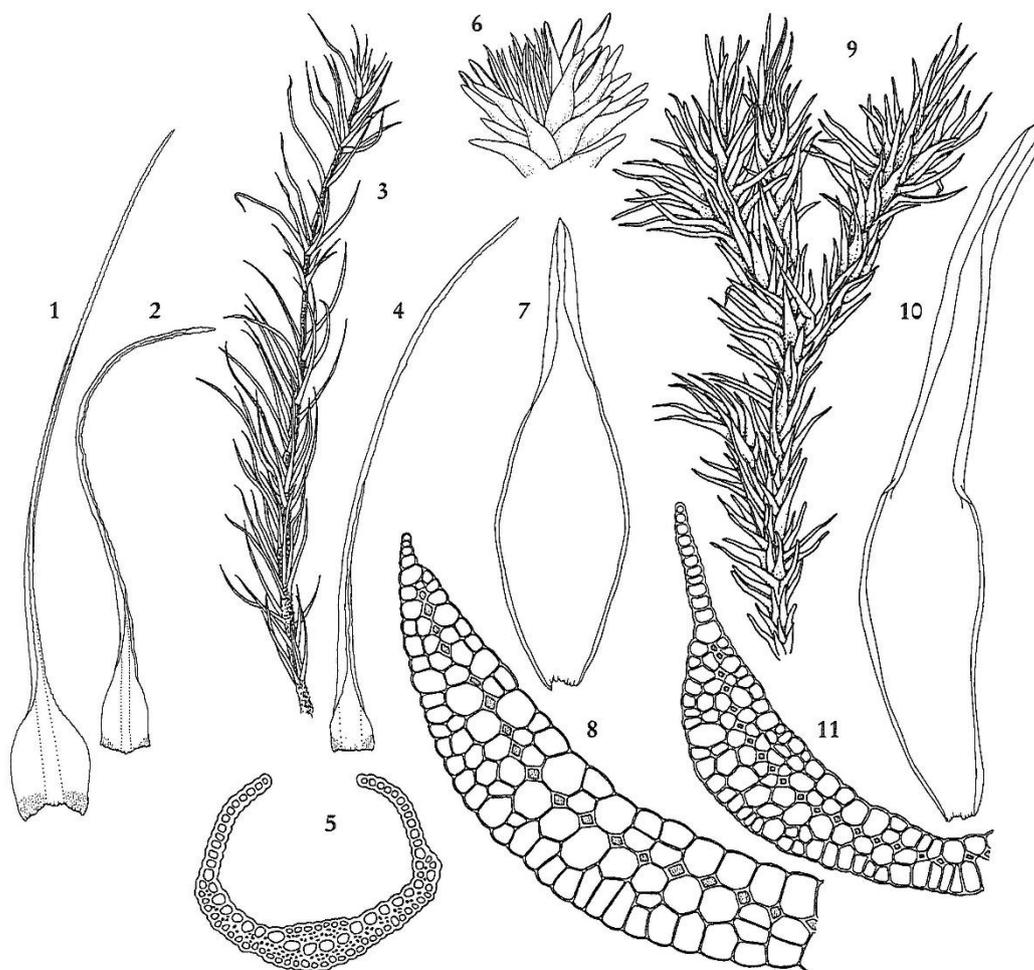


FIGURE 32. 1, *Dicranodontium asperulum*, leaf. 2, *D. uncinatum*, leaf. 3-5, *D. denudatum*: 3, habit; 4, leaf; 5, leaf section. 6-8, *Leucobryum glaucum*: 6, stem tip with caducous leaves; 7, leaf; 8, leaf section. 9-11, *L. juniperoideum*: 9, habit; 10, leaf; 11, leaf section. 9 (x2); 3, 6 (x4); 7, 10 (x14); 1, 2, 4 (x16); 8, 11 (x100); 5 (x200).

Leucobryum Hampe

Plants robust, forming glaucous to brownish cushions. Leaves lanceolate, with broad and sheathing base, lamina narrow, composed of 1-12 rows of cells; nerve very broad, occupying almost all the leaf, consisting of a central layer of chlorophyllose cells covered on both sides by 1 to several layers of hyaline cells. Vegetative propagation frequent, by means of axillary groups of caducous narrower leaves.

- 1 Upper part of leaf shorter than the basal sheathing part; lamina with 4-7 rows of cells near base (fig. 32, 6-8) **L. glaucum** (Hedw.) Ångstr.

Leaves erect; nerve in cross section near base with 3-4 layers of hyaline cells in the central part. Forms whitish to brownish compact cushions, 2,5-5 cm high, on very moist, peaty soils, in the north of the Peninsula. Esp, Prt, And.

- 1 Upper part of leaf longer than the basal sheathing part; lamina with 5-12 rows of cells (fig. 32, 9-11)

L. juniperoideum (Brid.) Müll.Hal.

Leaves erect to \pm flexuose; nerve in cross section near base with 2 layers of hyaline cells in the central part. Forms cushions, to 2-8 cm high, at base of rocks and on wet soils, in the north and west of the Peninsula and in Algeciras Mountains. Esp, Prt.

O. Pottiales

Fam. Pottiaceae

Acaulon Müll.Hal.

Plants very small, to 0,2 mm tall, bulbiform. Stem very short. Leaves erect, imbricate, ovate, concave or carinate, margin entire or dentate, plane or recurved; cells hexagonal, rhomboidal or elliptical, smooth or papillose; nerve thin, faint, excurrent in arista or apiculus, or percurrent. Seta very short, straight or curved; capsule immersed, globose, indehiscent, without apiculus or sometimes with minute apiculus.

- 1 Laminal cells papillose **2**

- 1 Laminal cells smooth **3**

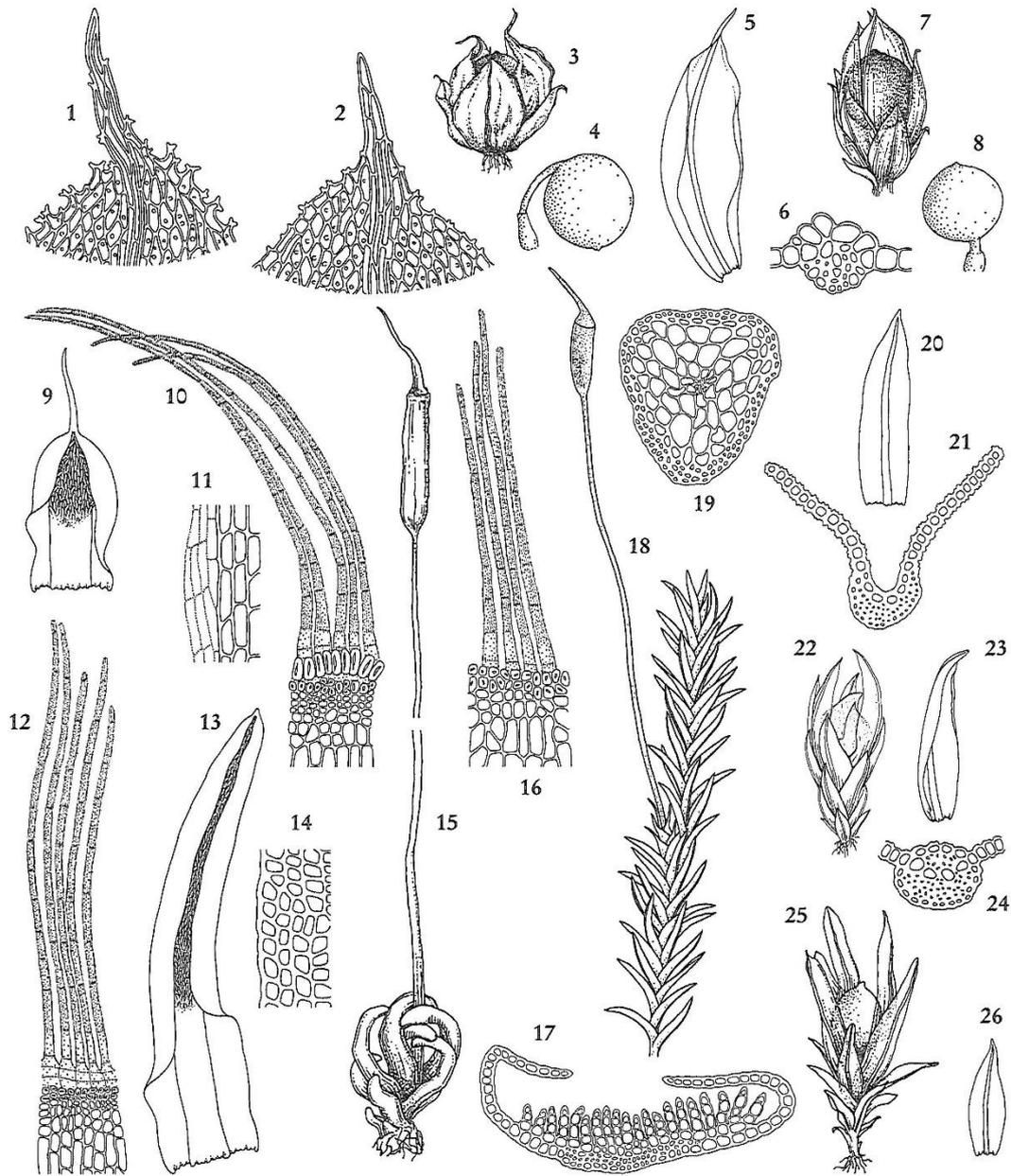


FIGURE 33. 1, *Acaulon casasianum*, leaf apex. 2, *A. dertosense*, leaf apex. 3-4, *A. triquetrum*: 3, habit; 4, capsule. 5-6, *A. fontiquerianum*: 5, leaf; 6, nerve section. 7-8, *A. muticum*: 7, habit; 8, capsule. 9, *Aloina bifrons*, leaf. 10-11, *A. rigida*: 10, peristome; 11, marginal cells near base. 12-14, *A. ambigua*: 12, peristome; 13, leaf; 14, marginal cells near base. 15-17, *A. aloides*: 15, habit when dry; 16, peristome; 17, leaf section. 18-21, *Anoetangium aestivum*: 18, habit; 19, stem section; 20, leaf; 21, leaf section. 22-24, *Aschisma cuynetii*: 22, habit; 23, leaf; 24, nerve section. 25-26, *A. carnolicum*: 25, habit; 26, leaf. 15, 18 (x9); 3, 4, 5, 7, 8, 9, 13, 20, 22, 23, 25, 26 (x18); 10, 12, 16 (x80); 1, 2, 17 (x100); 6, 11, 14, 19, 21, 24 (x180).

2 Leaf margin strongly dentate in the upper half, with forked and recurved teeth (fig. 33, 1)

***A. casasianum* Brugués & H.A.Crum**

Plants whitish. Leaves with recurved margin; laminal cells with papillae 7-8 μm high; nerve excurrent in long, reflexed, papillose or dentate arista. Spores 22-30 μm . Plants isolated or gregarious on gypsum substrata of arable field sides and scrub margins. Scattered in the Peninsula. Esp.

- 2 Leaf margin slightly dentate in the upper half, with simple and straight teeth (fig. 33, 2) **A. dertosense** Casas, Sérgio, Cros & Brugués
Plants golden brown. Leaf margin narrowly recurved; nerve excurrent in apiculus or often reflexed arista, papillose or not. Laminal cells with papillae 4 µm high. Spores 28-32 µm. Plants solitary or gregarious on exposed, calcareous soil in the East of the Peninsula. Esp.
- 3 Plants triangular in section; leaves carinate; seta curved (fig. 33, 3-4) **A. triquetrum** (Spruce) Müll.Hal.
Nerve excurrent in reflexed arista. Plants brownish yellow. Gregarious on dry, exposed, clayey soils in the lowlands. Widespread throughout the Peninsula, Mallorca and Pithyusic Islands. Esp, Prt, Bl.
- 3 Plants circular in section; leaves concave; seta straight **4**
- 4 Nerve section with 2-5 large, prominent cells on ventral side; nerve excurrent in arista (fig. 33, 5-6) **A. fontiquerianum** Casas & Sérgio
Arista orange yellow, 80-250 µm long or more; spores 18-28 µm. On slopes and exposed soils. Rare, in southern and eastern part of the Peninsula. Esp, Prt.
- 4 Nerve section without differentiated cells on ventral side; nerve excurrent in apiculus **5**
- 5 Leaves dentate at apex; spores with short papillae (fig. 33, 7-8) **A. muticum** (Hedw.) Müll.Hal.
Plants green, isolated, on exposed soils in the lowlands. Scattered in the Peninsula. Esp, Prt.
- 5 Leaves entire; spores spinose **A. mediterraneum** Limpr.
A. muticum (Hedw.) Müll.Hal. var. **mediterraneum** (Limpr.) Sérgio
Plants green, isolated on exposed, clayey soils in the lowlands. Scattered in the Peninsula. Esp, Prt.

Aloina Kindb.

Plants gregarious. Stem 0,2-0,5 cm high, dark green. Leaves thick, rigid, lingulate to ovate-lingulate, base wide, margin entire, broadly incurved covering the upper lamina; nerve broad, percurrent or excurrent, densely covered with chlorophyllose filaments on the ventral side. Capsule cylindrical, straight or slightly inclined; peristome teeth 16, divided to base, almost straight or spirally twisted; annulus deciduous.

- 1 Leaves with hyaline hair-point (fig. 33, 9) **A. bifrons** (De Not.) Delgad.
Forms turfs on dry, calcareous or gypsum stony soils, in the centre and east of the Peninsula. Esp.

- 1 Leaves without hyaline hair-point, apiculate or mucronate, often cucullate 2
- 2 Most marginal cells near leaf base not hyaline, thick-walled, quadrate, as wide as adjacent cells, not forming a distinct border 3
- 2 Marginal cells near leaf base hyaline, thin-walled, mostly longer than wide, forming at margin a well-differentiated border 4
- 3 Leaf apex apiculate or mucronate; basal membrane 1-2 layers of cells, not visible above mouth of capsule (fig. 33, 15-17) **A. aloides** (Koch ex Schultz) Kindb.
 Capsule cylindrical, straight or inclined; peristome teeth incurved when dry; spores 14-25 µm. Plants isolated or in loose turfs on dry, open, calcareous or siliceous, stony soils or walls in the lowlands. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 3 Leaf apex not apiculate or mucronate; basal membrane 3-5 layers of cells, visible above mouth of capsule (fig. 33, 12-14) **A. ambigua** (Bruch & Schimp.) Limpr.
A. aloides (Schultz) Kindb. var. **ambigua** (Bruch & Schimp.) E.J. Craig
 Capsule cylindrical, straight; peristome teeth spirally twisted when dry; spores 17-27 µm. Plants solitary or forming loose turfs on dry, exposed, calcareous or siliceous, stony soils and walls in the lowlands. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 4 Nerve with 3-6(8) stereids layers (fig. 33, 10-11) **A. rigida** (Hedw.) Limpr.
 Plants 0,3-0,8 cm tall. Leaves concave, cucullate, obtuse, lower leaves orbicular. Capsule straight; lid rostrate; peristome teeth spirally twisted when dry; spores 11-15 µm. Plants solitary or forming loose turfs on dry, open, calcareous or gypsum soils mainly in the lowlands. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 4 Nerve with 1-2 stereids layers **A. brevisrostris** (Hook. & Grev.) Kindb.
 Plants 0,2-0,3 cm tall. Leaves concave, cucullate, obtuse. Capsule straight; lid conical; peristome teeth spirally twisted when dry; spores 15-20 µm. Plants solitary or forming loose turfs on dry, open, calcareous or marly soils mainly in the lowlands. Rare, scattered in the Peninsula. Esp.

Anoetangium Schwägr.

Plants slender, yellowish green in upper part, brownish and radiculose below. Stem triangular in section, with central strand. Leaves erect-spreading, incurved, ± curled when dry, carinate, lanceolate to oblong-lanceolate, acute, margin papillose-crenulate; upper cells quadrate or rounded, strongly papillose, apical cells

smooth; nerve ending near apex, with 1 stereid band. Seta seemingly lateral. Capsule exerted, ellipsoidal; lid rostrate and oblique; peristome lacking (fig. 33, 18-21) **A. aestivum** (Hedw.) Mitt.

Forms compact turfs to 10 cm high in rock crevices and on rock ledges, often where basic and shady, by mountain streams and cascades, in high mountains of the north of the Peninsula. Esp.

Aschisma Lindb.

Plants minute, to 0,2 cm tall. Leaves oblong-lanceolate or ovate-lanceolate, apiculate, concave, margin plane, entire or sinuose-crenulate at apex or slightly dentate at base; laminal cells 6-10 μm wide, quadrate or rounded, papillose, basal cells rectangular and smooth; nerve excurrent in mucro or apiculus, with dorsal and ventral stereid bands. Seta very short; capsule immersed, indehiscent, globose, reddish or brownish, with short apiculus.

- 1 Leaves cucullate, nerve 50-60 μm wide in the upper part, prominent on dorsal side (fig. 33, 22-24)

A. cuynetii (Bizot & R.B.Pierrot) J.Guerra & M.J.Cano

Phascum cuynetii Bizot & R.B.Pierrot

Capsule yellowish to brownish. Forms loose turfs on dry, exposed, acidic or calcareous soils, in coastal Mediterranean areas. Esp.

- 1 Leaves not cucullate, nerve 25-30 μm wide in the upper part, not prominent on dorsal side (fig. 33, 25-26)

A. carniolicum (F.Weber & D.Mohr) Lindb.

Capsule reddish brown to orange. Grows on dry, exposed, calcareous, sandy or clayey ledges, in the lowlands, mainly in coastal areas of the Peninsula and in Mallorca. Esp, Prt, Bl.

Astomum Hampe

Plants small. Leaves erect to erecto-patent, lanceolate to linear-lanceolate, acuminate, incurved or crisped when dry, margin entire or sinuose-crenulate; upper cells quadrate, rounded or shortly rectangular, papillose; nerve percurrent or shortly excurrent. Seta shorter than capsule, straight; capsule immersed, globose to ellipsoidal, dehiscent or indehiscent.

- 1 Lid not easily detached from mature sporophytes; annulus not differentiated (fig. 34, 3)

A. crispum (Hedw.) Hampe var. **crispum**

* **Weissia longifolia** Mitt.

Plants to 1 cm tall. Leaves erecto-patent. Perichaetial leaves much longer than stem leaves. Lid more or less marked but not coming off when mature. Forms small, loose or compact tufts on exposed soils in the lowlands and montane

areas. Common in the eastern half of the Peninsula and in Mallorca, Menorca and Pithyusic Islands, rarer in the west of the Peninsula. Esp, Prt, And, Bl.

- 1 Lid easily detached from mature sporophytes; annulus of small, strongly differentiated cells **2**
- 2 Margins of perichaetial leaves involute in the upper half **A. crispum** var. **angustifolium** Baumgartner
* **Weissia angustifolia** (Baumgartner) D.A.Callaghan
Forms small, loose tufts on exposed soils in the lowlands of the east of the Peninsula and Pithyusic Islands. Esp, Bl.
- 2 Margins of perichaetial leaves plane to loosely incurved (fig. 34, 1-2) **A. levieri** Limpr.
* **Weissia levieri** (Limpr.) Kindb.
Plants to 1 cm tall. Leaves erect or erecto-patent. Perichaetial leaves similar to stem leaves. Forms small tufts on often basic soils in the lowlands near coastal areas. Scattered in the south and east of the Peninsula and in Mallorca. Esp, Prt, Bl.

Barbula Hedw.

Plants to 4 cm tall. Leaves lanceolate to lingulate, apex acute or obtuse, margin plane or recurved in the lower half, entire or denticulate at apex; laminal cells rounded or quadrate, papillose, basal cells rectangular, smooth and pellucid; nerve excurrent or percurrent, dorsal and ventral surface cells usually rectangular. Axillary hairs composed of hyaline cells. Capsule cylindrical; peristome teeth 16, divided to base, filiform, twisted.

- 1 Plants with axillary multicellular gemmae, pediculate, ovoid or pyriform **2**
- 1 Plants without axillary gemmae or if present then fusiform **3**
- 2 Gemmae ovoid, greenish to brown, 200-500 µm long, with conspicuously protuberant outer cells (fig. 34, 4-5) **B. crocea** (Brid.) F.Weber & D.Mohr
* **Hydrogonium croceum** (Brid.) Jan Kučera
Leaves ovate-lanceolate; basal cells elongated, thick-walled, yellowish; nerve percurrent, reddish. Forms dark green turfs 1-3 cm high on seeping, calcareous rocks in the Pyrenees. Esp.
- 2 Gemmae ovoid or pyriform, greenish to brown to purple, 90-160 µm long, with slightly protuberant outer cells **B. amplexifolia** (Mitt.) A.Jaeger
* **Hydrogonium amplexifolium** (Mitt.) P.C.Chen
Plants to 1 cm tall. Grows on damp, shaded, calcareous rocky ground in the Pyrenees. And.

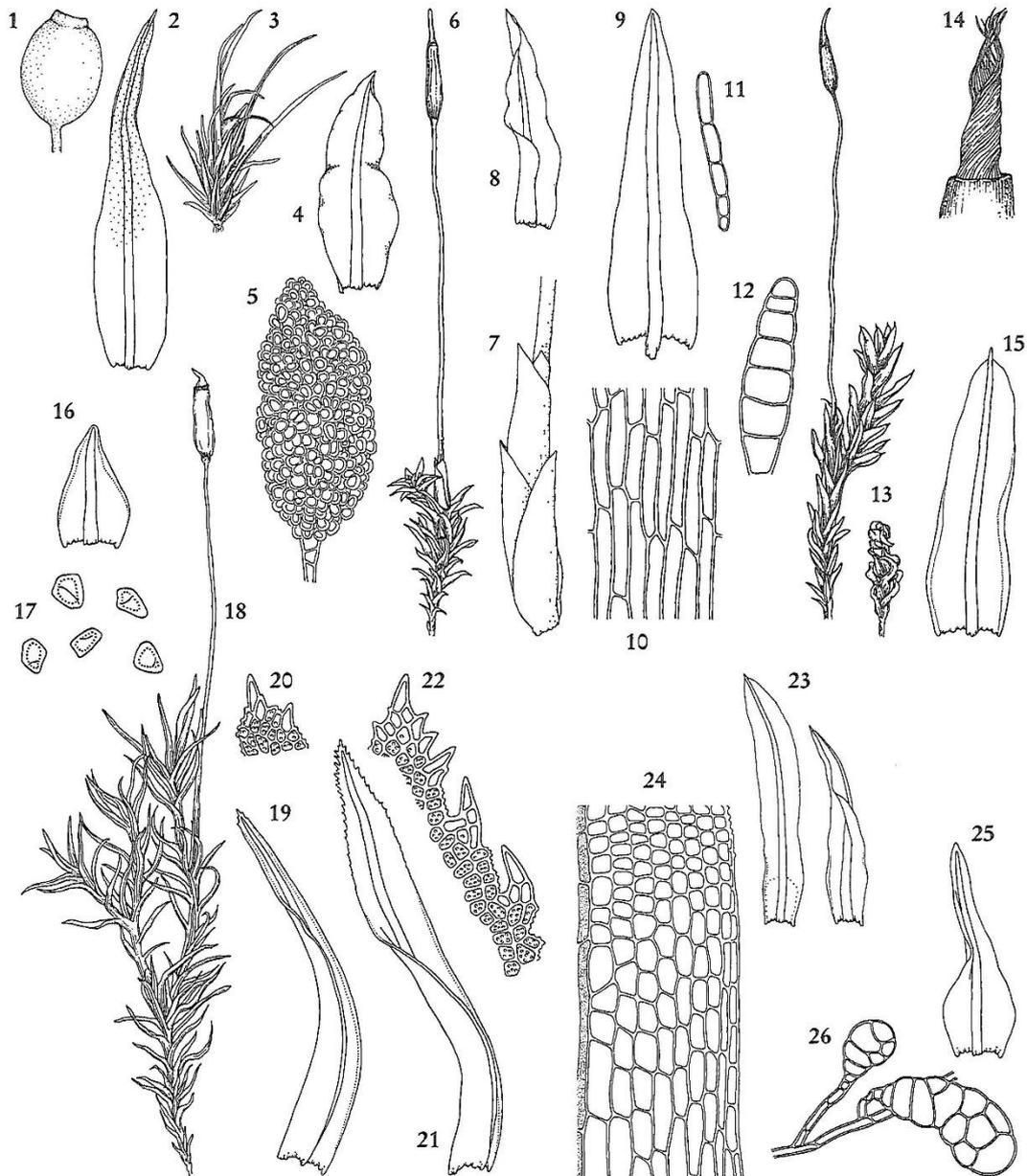


FIGURE 34. 1-2, *Astomum levieri*: 1, capsule; 2, perichaetial leaf. 3, *A. crispum* var. *crispum*, habit. 4-5, *Barbula crocea*: 4, leaf; 5, gemma. 6-8, *B. convoluta*: 6, habit; 7, perichaetial leaves; 8, leaf. 9-12, *B. bolleana*: 9, leaf; 10, basal cells; 11, axillary hair; 12, gemma. 13-15, *B. unguiculata*: 13, plants, with sporophyte when moist and without sporophyte when dry; 14, peristome; 15, leaf. 16-17, *Bryoerythrophyllum inaequalifolium*: 16, leaf; 17, gemmae. 18-20, *B. recurvirostrum* var. *recurvirostrum*: 18, habit; 19, leaf; 20, leaf apex. 21-22, *B. recurvirostrum* var. *robustum*: 21, leaf; 22, upper leaf margin. 23-24, *B. campylocarpum*: 23, leaves; 24, basal cells. 25-26, *B. ferruginascens*: 25, leaf; 26, gemmae. 18 (x4); 6, 13 (x5); 3 (x7); 1, 2, 4, 7, 8, 9, 15, 16, 19, 21, 23, 25 (x18); 14 (x25); 5, 26 (x80); 10, 11, 12, 17, 20, 22, 24 (x180).

3 Leaves 2,5-3,5 mm long; plants aquatic (fig. 34, 9-12)

B. bolleana (Müll.Hal.) Broth.

* *Hydrogonium bolleanum* (Müll.Hal.) A.Jaeger, *H. ehrenbergii* (Lorentz) A.Jaeger

Leaves with obtuse apex, often cucullate; laminal cells 15 µm, almost smooth. Often with red, fusiform gemmae, formed on branched filaments in the axils of upper leaves. Forms lax turfs, 1-4 cm high, frequently with calcium

carbonate encrustations, on rocks, water tanks and irrigation channels in the lowlands. Common in the Mediterranean coastal area, rare in the centre and west of the Peninsula and in Mallorca. Esp, Prt, Bl.

- 3 Leaves less than 2,5 mm long; plants of dry sites 4

- 4 Perichaetial leaves sheathing, strongly differentiated; nerve percurrent or ending below apex
(fig. 34, 6-8)

B. convoluta Hedw.

* **Streblotrichum convolutum** (Hedw.) P.Beauv.

Plants green, 1-2 cm tall. Stem without central strand or slightly differentiated, with reddish rhizoids, occasionally with globose rhizoidal gemmae. Leaves ovate-lanceolate, apiculate, carinate, less than 1 mm long, margin plane or slightly undulate; nerve ending below apex or shortly excurrent. Seta yellowish. Forms dense turfs on calcareous rocks ledges, walls, dry, open soils. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 4 Perichaetial leaves not sheathing, similar to vegetative leaves; shortly excurrent (fig. 34, 13-15)

B. unguiculata Hedw.

Leaves with obtuse or rounded apex, apiculate; laminal cells strongly papillose. Seta reddish. Forms turfs 0,5-3 cm high, at side of roads, on walls and arable fields. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

Sterile specimens may be confused with *Trichostomum brachydontium*, but in that species the nerve has quadrate or rounded cells on ventral side.

Bryoerythrophyllum P.C. Chen

Plants rusty red or brownish green. Leaves appressed, erect or reflexed, curled when dry, ovate-triangular to lanceolate, usually sheathing at base, margin entire, crenulate or dentate; laminal cells quadrate, thin-walled or incrassate, with c-shaped papillae, basal cells rectangular, smooth and thin-walled; nerve ending below apex to percurrent. Often with hyaline axillary hairs. Capsule erect, cylindrical, annulus wide, caducous; peristome teeth 16, papillose, divided to the middle or to base; calyptra cucullate.

- 1 Leaves ovate-lanceolate, obtuse, cucullate, margin entire, strongly recurved to apex (fig. 34, 16-17)

B. inaequalifolium (Taylor) R.H.Zander

Plants slender, to 0,5 cm tall. Mostly with axillary gemmae, unicellular, yellowish to brownish, angulate, 14-22 µm wide. Forms compact turfs on calcareous rocks in montane areas. Rare, in the eastern Pyrenees. Esp, Prt.

- 1 Leaves ovate-lanceolate, lanceolate or oblong-lanceolate, acute, margin dentate, crenulate or entire, plane or recurved 2

- 2 Leaves lanceolate, not carinate; leaf margin narrowly recurved to near apex; monoicous, dioicous or polyoicous (fig. 34, 18-22) **B. recurvirostrum** (Hedw.) P.C.Chen

Plants to 2 cm tall. Leaves narrow, from wide base to acute apex, often dentate, with teeth and terminal cell smooth and pellucid. Forms compact turfs on calcareous rocks and soils, in montane areas and high mountains.

var. **recurvirostrum**: Leaf margin entire or with unicellular teeth in the upper part. Distributed in the Peninsula and in Mallorca. Esp, And, Bl (fig. 34, 18-20).

var. **robustum** K.Saito: Leaf margin deeply dentate, teeth of 1-3 cells. Distributed in the Pyrenees. Esp (fig. 24, 21-22).

- 2 Leaves ovate-lanceolate or lanceolate, carinate at apex; leaf margin plane or recurved at base; dioicous **3**

- 3 Leaves linear to lingulate, crenulate, entire or dentate at apex, with a basal margin of narrower cells (fig. 34, 23-24) **B. campylocarpum** (Müll.Hal.) H.A.Crum

Hyophila lusitanica Cardot & Dixon, **H. machadoana** (Sérgio) M.O.Hill

Plants to 1,5 cm tall. Leaves with a terminal cell as an apiculus pellucid, brownish yellow, margin rarely dentate; transition between basal smooth cells and upper papillose cells abrupt. Grows on wet slopes by streams, in the northwest of the Peninsula. Prt.

- 3 Leaves ovate-lanceolate, crenulate, without teeth at apex, basal margin of narrower cells absent (fig. 34, 25-26) **B. ferruginascens** (Stirt.) Giacom.

Plants to 2 cm tall. Transition between basal smooth cells and upper papillose cells gradual. Often with dark brownish, pluricellular rhizoidal gemmae. Forms loose turfs on damp, calcareous soils, in montane areas and high mountains of the Pyrenees. Rare. Esp.

Cinclidotus P.Beauv.

Plants aquatic or growing in very moist sites, large and robust. Stem without central strand. Leaves erect or falciform, lanceolate to oblong, apex obtuse or acute, margin plane, thick, of (2-)4-6-stratose; laminal cells hexagonal, smooth or slightly papillose, basal cells rectangular; nerve stout, percurrent or excurrent in mucro. Capsule immersed or exserted; peristome teeth 16, bifurcate above.

- 1 Leaves falciform, linear-lanceolate, very long and rigid; nerve 240 µm wide or more at base (1/3 width of leaf base) (fig. 35, 1) **C. aquaticus** (Hedw.) Bruch & Schimp.

Stem mostly very long, to 20 cm long, denudate at base, with short branches in the upper part. Capsule immersed. Grows on submerged calcareous rocks, in the lowlands and montane areas, in the east, south and west of the Peninsula and in Mallorca. Esp, Prt, Bl.

- 1 Leaves straight or slightly incurved or falciform, elliptical, lanceolate or oblong, rigid or not; nerve less than 230 μm wide at base (less 1/3 width of leaf base) **2**
- 2 Leaves elliptical or oblong, widest at middle (fig. 35, 2) **C. riparius** (Host ex Brid.) Arn.
Stem with abundant short branches. Leaves slightly twisted when dry. Seta to 3 mm long; capsule exceeding perichaetial leaves. Plants 2-5 cm long, straight, forming lax, blackish green cushions on submerged calcareous rocks, in montane areas and high mountains, in the north of the Peninsula, in Sierra Nevada and in Mallorca. Esp, Prt, And, Bl.
- 2 Leaves oblong or lanceolate, with maximum width at base **3**
- 3 Leaves oblong-lanceolate, carinate, twisted when dry (fig. 35, 3-6) **C. fontinaloides** (Hedw.) P.Beauv.
Stem to 12 cm long, usually not denudate at base. Seta short, 0,5 mm long; capsule immersed. Submerged or periodically submerged, forms loose, dark or blackish turfs on rocks and tree bases, and in waterfalls and mountain streams. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, Bl.
- 3 Leaves lanceolate, plane, straight, slightly incurved or falciform when dry **C. vivesii** Ederra
Plants rigid. Stem to 6 cm long, not denudate at base. Found submerged in a fountain. Very rare, in the northeastern part of the Peninsula. Esp.

Crossidium Jur.

Plants small, often forming dense turfs or cushions. Leaves wide, ovate or oblong, concave, margin plane, recurved or revolute; cells quadrate, rhomboidal to shortly rectangular; nerve excurrent in apiculus or in hair-point, with chlorophyllose filaments, branched or unbranched, on ventral side. Seta long; capsule ovoid or cylindrical; peristome of 32 filiform teeth.

- 1 Upper laminal cells strongly incrassate, lumen hard to discern, marginal cells hyaline (fig. 35, 7-10) **C. squamiferum** (Viv.) Jur.
Plants to 1 cm tall. Filaments of the ventral side of the nerve 8-12 cells high, the terminal cell conical, thick-walled and with 2-5 long papillae. Forms dense light green or whitish turfs on rock ledges and open calcareous soils, in the lowlands and montane areas of the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, Bl.
- 1 Upper laminal cells thin-walled, lumen large, marginal cells green or brownish **2**

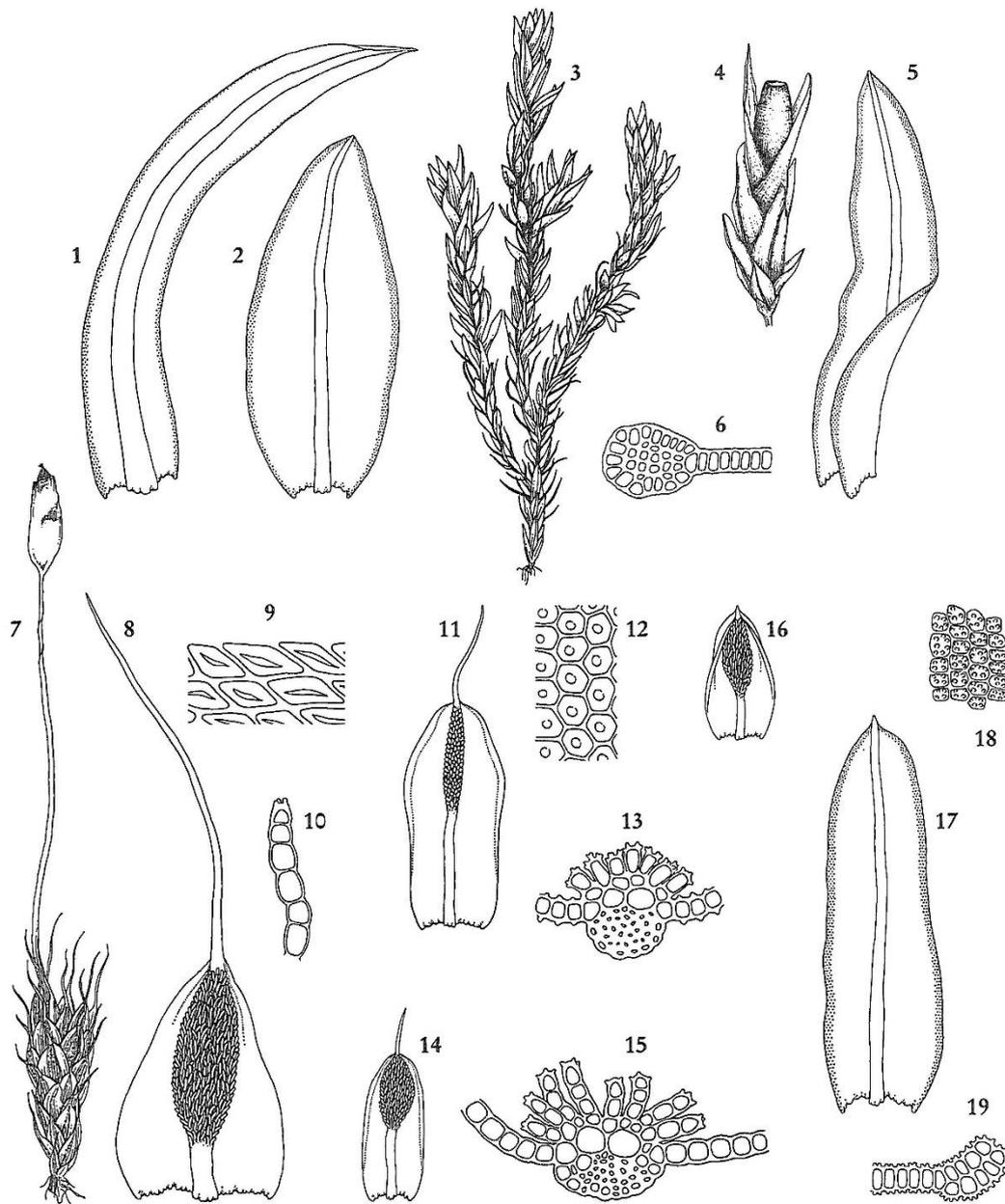


FIGURE 35. 1, *Cinclidotus aquaticus*, leaf. 2, *C. riparius*, leaf. 3-6, *C. fontinaloides*: 3, habit; 4, capsule; 5, leaf; 6, leaf margin section. 7-10, *Crossidium squamiferum*: 7, habit; 8, leaf; 9, upper cells; 10, upper part of the filament of nerve. 11-13, *C. aberrans*: 11, leaf; 12, upper cells; 13, nerve section. 14-15, *C. crassinerve*: 14, leaf; 15, nerve section. 16, *C. laevipilum*, leaf. 17-19, *Diallytrichia mucronata*: 17, leaf; 18, median cells; 19, leaf margin section. 3 (x2,5); 4, 7 (x7); 1, 2, 5 (x16); 8, 11, 14, 16, 17 (x18); 6, 10, 13, 15, 19 (x180); 9, 12, 18 (x280).

2 Upper laminal cells smooth or with one papilla on each side; filaments 1-2(-3) cells high, occupying a narrow leaf area (fig. 35, 11-13) ***C. aberrans* Holz. & E.B.Bartram**

Plants to 0,3 cm. Leaf margin recurved or revolute. Filaments with the terminal cells sub-spherical or cylindrical, with 2-4 short papillae. Grows solitary or forming loose turfs on dry, sandy or clayey, calcareous, often gypsum-rich soils, in the eastern part of the Peninsula. Esp.

2 Upper laminal cells smooth, rarely with one papilla on dorsal side near apex; filaments (2)4-12 cells high, occupying a wide leaf area 3

3 Nerve often excurrent in a hyaline hair-point; apex not cucullate; peristome long and curled (fig. 35, 14-15)

C. crassinervium (De Not.) Jur.

Plants to 0,3 cm tall. Filaments 3-12 cells high, the terminal cell cylindrical, conical or globose, with 2-4 short papillae or smooth. Grows solitary or forming small turfs on dry, exposed rocks and soils, in the lowlands, in the eastern Mediterranean region, rare in the western part of the Peninsula, and in Mallorca and Pithyusic islands. Esp, Prt, Bl.

3 Nerve often excurrent in mucro; apex cucullate; peristome short and straight (fig. 35, 16)

C. laevipilum Thér. & Trab.

Plants to 0,3 cm tall. Filaments (2)4-10 cells high, with terminal cell cylindrical, conical or sub-spherical, with 2-6 short papillae. Forms turfs on very dry, exposed, saline, gypsum or calcareous soils, in the lowlands of the eastern half of the Mediterranean region of the Peninsula and in Mallorca and Pithyusic Islands. Esp, Bl.

Some authors regard this species as a variety of *C. crassinerve*.

Dialytrichia (Schimp.) Limpr.

Stem with central strand. Leaves patent to spreading when moist, more or less curled when dry, oblong, obtuse or mucronate, margin recurved, entire or crenulate, thickened, 2-4-stratose; laminal cells irregularly quadrate-hexagonal, strongly papillose, basal cells rectangular; nerve stout, excurrent in mucro. Capsule exserted, ellipsoidal to cylindrical; peristome teeth 32, filiform.

1 Leaf margin entire; leaves not fragile (fig. 35, 17-19)

D. mucronata (Brid.) Broth.

Cinclidotus mucronatus (Brid.) Guim.

Plants 1-3 cm tall. Leaves curled when dry. Forms rather compact, dark green or brownish cushions at tree bases and on rocks by watercourses, in periodically waterlogged places grows in the lowlands and montane areas. Scattered in the Peninsula, mainly in the western part, and in Mallorca. Esp, Prt, Bl.

1 Leaf margin crenulate 1/3 way up leaf; leaves fragile

D. saxicola (Lamy) M.J.Cano

D. mucronata var. **fragilifolia** Bizot & J. Roux

Plants 1-2 cm tall. Leaves twisted when dry. Epiphytic or saxicolous in shaded places in the lowlands and montane areas. Scattered in the western part of the Peninsula, rare in the central part. Esp, Prt.

Didymodon Hedw.

Plants 0,2-4 cm tall. Leaves appressed to twisted when dry, ovate-lanceolate to linear, apex acuminate, acute or obtuse, margin entire, crenulate or denticulate at apex, plane or recurved, unistratose or bistratose; laminal cells rounded or quadrate, thick-walled or thin-walled, smooth, papillose, basal cells not differentiated or rectangular and smooth; nerve percurrent or excurrent in short or long point, cells quadrate and papillose or rectangular and smooth on ventral side; axillary hairs hyaline, with brownish yellow basal cell. Some species have globose, pluricellular gemmae on branched axillary filaments, or rhizoidal gemmae. Capsule ovoid to cylindrical; peristome teeth 16-32, rudimentary to long, twisted and very papillose.

1 Leaf margin erose or irregularly notched **2**

1 Leaf margin not erose or notched **4**

2 Leaves with fragile apex (fig. 37, 8) **D. sinuosus** (Mitt.) Delogne
Plants greenish brown, to 3 cm tall. Leaves erecto-patent to spreading, flexuose, crisped when dry, linear-lanceolate, not carinate, apex acute, with 1 hyaline cell, margin unistratose, papillose-crenulate, dentate at apex, nerve ending below apex, with 1-3 layers dorsal stereids; median cells \pm quadrate, 5-12 x 5-10 μm , with 1-4 papillae, basal cells rectangular. Forms loose turfs on wet, shaded basic rocks and in rock crevices, in the lowlands and montane areas, in the eastern half of the Peninsula and in Mallorca. Esp, Prt, Bl.

2 Leaves not fragile apex **3**

3 Leaf margin unistratose **D. erosus** J.A.Jiménez & J.Guerra
*** D. tophaceus** (Brid.) Lisa subsp. **erosus** (J.A.Jiménez & J.Guerra) Jan Kučera
Plants green olive, to 3 cm tall. Rhizoidal gemmae at base of stem. Leaves erecto-patent to incurved, sometimes twisted when dry, lanceolate, flat, lamina usually unistratose, nerve excurrent in stout point, 0-1 stereid band; median cells rounded to polygonal, 8-12 x 6-10 μm , with 1-2 papillae, basal cells rectangular. Grows on wet rocks. Very rare, in the west of Iberian Peninsula. Esp, Prt.

3 Leaf margin bistratose (fig. 37, 9-11) **D. eckeliae** R.H.Zander
Plants dark green, to 1 cm tall. Leaves patent to spreading, flexuose, incurved when dry, carinate, margin bistratose in the upper 2/3-3/4 of leaf, recurved in the lower 1/3, papillose-crenulate, nerve shortly excurrent; marginal cells often oblate, upper cells quadrate to shortly rectangular, 10-15 x 10-12 μm , with 2-4 papillae, median and basal cells 12-22 x 10-12 μm ; nerve with 1-2 stereid bands. Forms loose turfs on calcareous rocks in the lowlands, in the east of the Peninsula. Esp, Prt.

4 Leaves squarrose or reflexed when wet

5

4 Leaves erecto-patent or spreading when wet

6

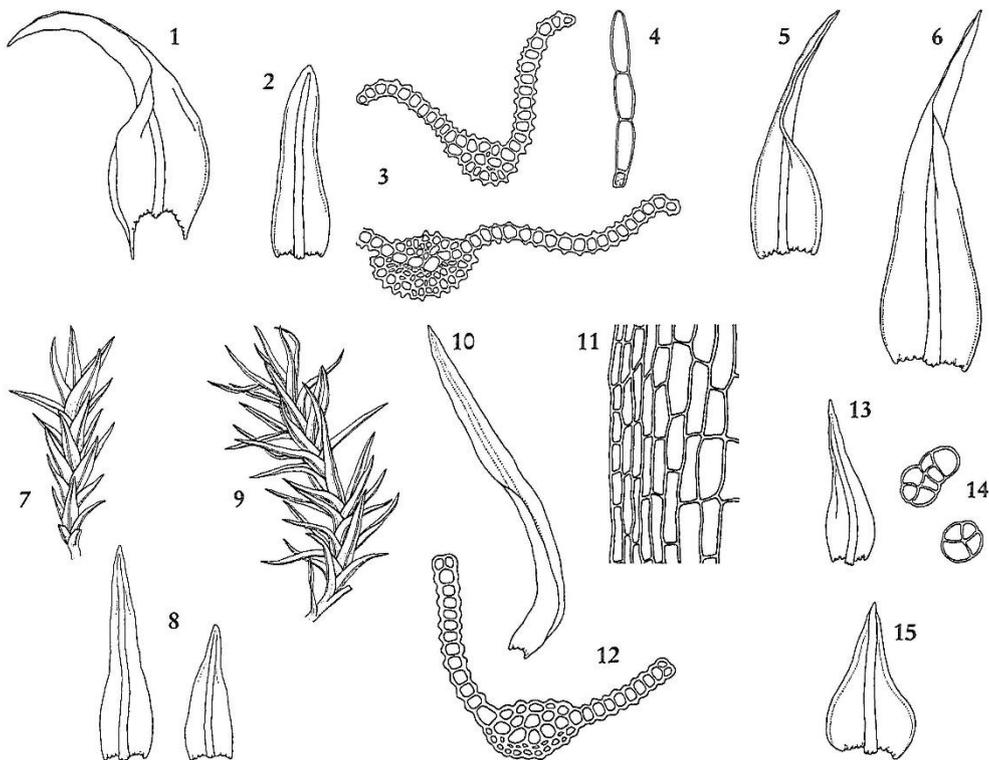


FIGURE 36. 1, *Didymodon ferrugineus*, leaf. 2-4, *D. tophaceus*: 2, leaf; 3, leaf sections; 4, axillary hair. 5, *D. fallax*, leaf. 6, *D. spadiceus*, leaf. 7-8, *D. australasiae*: 7, habit; 8, leaves. 9-12, *D. umbrosus*: 9, habit; 10, leaf; 11, basal cells; 12, leaf section. 13-14, *D. rigidulus*: 13, leaf; 14, gemmae. 15, *D. cordatus*, leaf. 7, 9 (x10); 1, 2, 5, 6, 8, 10, 13, 15 (x18); 3, 4, 11, 12, 14 (x180).

5 Ventral cells of nerve rectangular, smooth (fig. 36, 1) ***D. ferrugineus*** (Schimp. ex Besch.) M.O.Hill
Plants 0,8-3(5) cm tall. Ventral cells of nerve rectangular, smooth. Leaves ovate-lanceolate, keeled. Forms loose, green to reddish brown turfs on basic or acidic soils and rocks, in the lowlands and montane areas, in the northwest and eastern half of the Peninsula. Esp, And.

5 Ventral cells of nerve quadrate or shortly rectangular, papillose (fig. 37, 6-7)

D. asperifolius (Mitt.) H.A.Crum, Steere & L.E.Anderson

Plants to 3 cm tall, reddish brown. Leaves patent, flexuose when dry, curved, keeled, margin recurved from base to apex, nerve ending below apex with a small area of rectangular, smooth translucent cells just below apex on ventral side; laminal cells rounded to hexagonal, papillose, basal cells rectangular. Forms loose turfs on calcareous rocks in high mountains. Very rare in the Central Pyrenees. Esp.

- 6 Basal cells of lamina differentiated, rectangular, hyaline, narrower at margin 7
- 6 Basal cells of lamina not differentiated 8
- 7 Leaves oblong-lanceolate to lanceolate; stem without hyaloderm (fig. 36, 7-8)
D. australasiae (Hook. & Grev.) R.H.Zander
Trichostomopsis australasiae (Hook. & Grev.) H.Rob.
Plants to 1,5 cm tall. Leaves erecto-patent to spreading, curled when dry, 0,6-2,7 mm long, margin 2-3-stratose; median cells papillose; nerve to 125 µm wide at base, with quadrate, papillose cells on ventral side; basal cells elongated, hyaline, thick-walled, marginal cells not or poorly differentiated. Occasionally with gemmae. Forms dense turfs, on rocky soils. Scattered in the Peninsula. Esp, Prt.
- 7 Leaves lanceolate; stem with hyaloderm (fig. 36, 9-12) **D. umbrosus** (Müll.Hal.) R.H.Zander
Trichostomopsis umbrosa (Müll.Hal.) H.Rob.
Plants to 1 cm tall. Leaves spreading or reflexed, curled when dry, 1,2-3 mm long, margin bistratose; cells quadrate, papillose, usually thick-walled; nerve to 75 µm wide, with quadrate, papillose cells on ventral side; basal cells elongated, hyaline, thin-walled, 2-6 rows of narrow marginal cells not or poorly differentiated. Forms turfs on disturbed soils. Scattered in the Peninsula. Esp, Prt.
- 8 Ventral cells of nerve rectangular, smooth; laminal cells papillose 9
- 8 Ventral cells of nerve quadrate, papillose; laminal cells papillose, mamilliose or smooth 11
- 9 Leaf apex obtuse or rounded (fig. 36, 2-4) **D. tophaceus** (Brid.) Lisa
Plants 0,3-4 cm tall. Leaves ovate to ovate-lanceolate or lingulate, margin plane or slightly recurved; basal cells of lamina rectangular; nerve ending below apex. Forms olive-green to brownish turfs on calcareous soils and seeping rocks in the lowlands and montane areas, throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 9 Leaf apex acute 10
- 10 Leaf margin recurved from base to 3/4 way up; plants to 2,8 cm tall, growing on dry, calcareous soils (fig. 36, 5) **D. fallax** (Hedw.) R.H.Zander
Leaves erecto-patent to spreading when wet, somewhat recurved, flexuose or twisted when dry, lanceolate to ovate-lanceolate, keeled; nerve percurrent; basal cells rectangular, median cells irregularly hexagonal. Forms loose, green to brownish turfs in calcareous arable fields, walls, roadsides in the lowlands and montane areas, throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 10 Leaf margin recurved in the lower half; plants to 4 cm tall, growing on humid or wet soils (fig. 36, 6) **D. spadiceus** (Mitt.) Limpr.
 Leaves erecto-patent to spreading when wet, flexuose or twisted when dry, lanceolate to ovate-lanceolate; nerve percurrent. Forms green to brownish turfs on calcareous rocks by springs and streams in the lowlands and montane areas, in the northern half of the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 11 Leaf margin revolute from base to apex (fig. 36, 15) **D. cordatus** Jur.
 Plants 0,5-1,5 cm tall. Leaf widely ovate-cordiform, slightly decurrent, lamina unistratose, margin sometimes bistratose near apex, occasionally; laminal cells mamillose; laminal cells quadrate or rounded, 4-10 µm; nerve excurrent in stout apiculus, 50-100 µm wide at base. Axillary gemmae sometimes present. Forms dark green turfs on humid rocks, in the northeastern part of the Peninsula. Esp, And.
- 11 Leaf margin plane or more or less recurvate **12**
- 12 Lamina or margins bistratose in the upper part **13**
- 12 Lamina or margins unistratose **18**
- 13 Lamina regularly bistratose (fig. 37, 12-13) **D. bistratosus** Hébr. & R.B.Pierrot
 Plants to 0,8 cm tall, brownish, reddish at base. Leaves lanceolate to ovate-lanceolate, margin recurved to 3/4 way up, papillose-crenulate in the upper part. Forms turfs on dry rocks or sandy soils, in the southwestern part of the Peninsula. Esp, Prt.
- 13 Lamina unistratose or irregularly bistratose **14**
- 14 Leaf margin regularly 2-4-stratose **15**
- 14 Leaf margin irregularly bistratose in the upper part **16**
- 15 Nerve 2 layers of guide cells above; leaf apex obtuse or rounded, mostly cucullate (fig. 37, 1-2) **D. nicholsonii** Culm.
 Plants 0,5-2 cm tall. Leaves patent to erect-patent, ovate-lanceolate, appressed or slightly twisted when dry when dry, margin recurved to 3/4 way up; laminal cells rounded, quadrate or hexagonal, papillose, basal cells quadrate or rectangular, nerve with 1 dorsal stereid band. Forms brownish green to reddish turfs on wet, shaded rocks by streams in the lowlands. Scattered in the Peninsula and in Mallorca. Esp, Prt, Bl.

15 Nerve with 1 layer of guide cells; leaf apex acute (fig. 36, 13-14)

D. rigidulus Hedw.

Plants to 2 cm tall. Leaves erecto-patent, appressed when dry, ovate-lanceolate, gradually narrowed in long point, lamina sometimes regularly bistratose, margin recurved from base to upper third; laminal cells near apex mostly papillose; nerve percurrent or excurrent. Axillary pluricellular gemmae present. Forms light green to dark green turfs on basic walls, rocks and soils from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

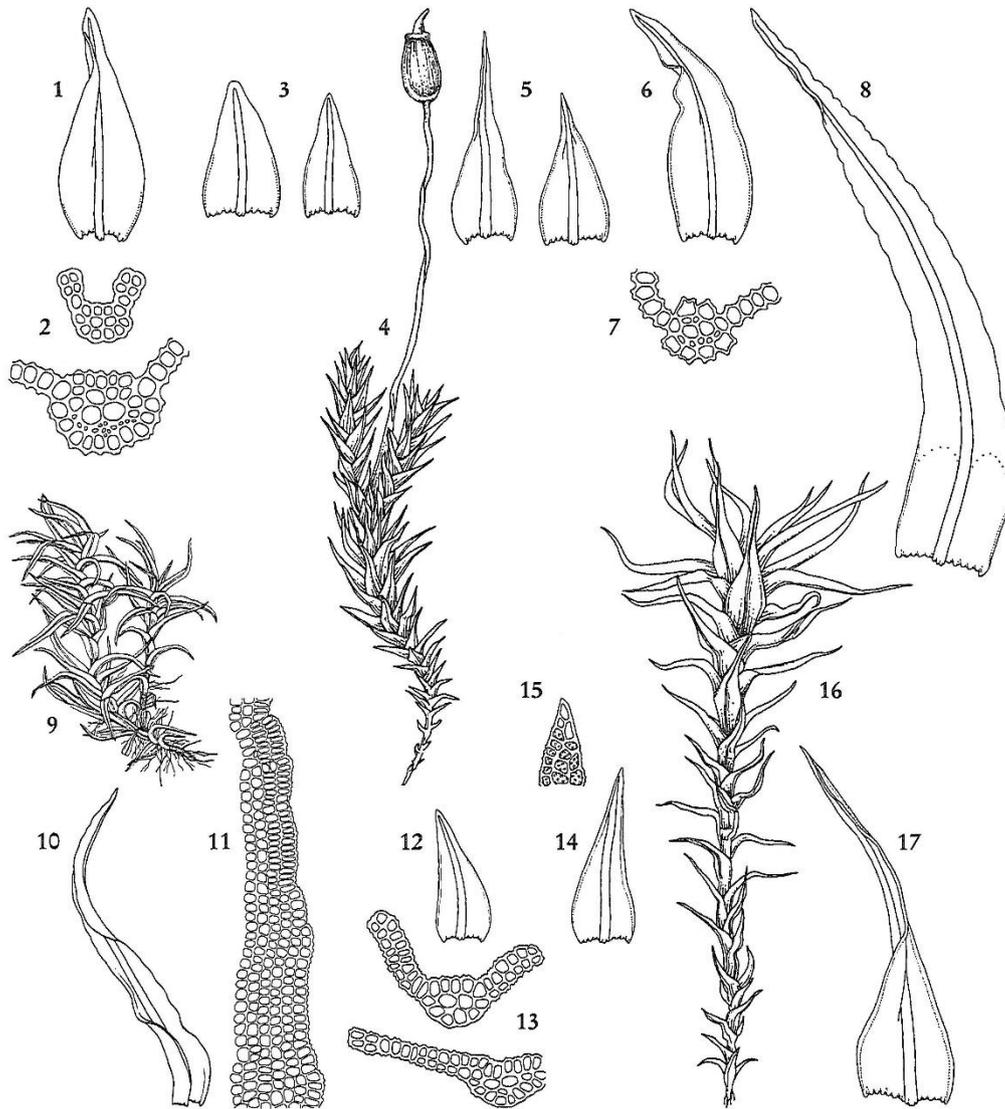


FIGURE 37. 1-2, *Didymodon nicholsonii*: 1, leaf; 2, leaf sections. 3, *D. luridus*, leaves. 4-5, *D. acutus*: 4, habit; 5, leaves. 6-7, *D. asperifolius*: 6, leaf; 7, nerve section. 8, *D. sinuosus*, leaf. 9-11, *D. eckeliae*: 9, habit; 10, leaf; 11, leaf margin. 12-13, *D. bistratosus*: 12, leaf; 13, leaf sections. 14-15, *D. vinealis*: 14, leaf; 15, leaf apex. 16-17, *D. insulanus*: 16, habit; 17, upper leaf. 4, 9, 16 (x7); 1, 3, 5, 6, 8, 10, 12, 14, 17 (x18); 2, 7, 11, 13, 15 (x180).

16 Leaves ovate

D. sicculus M.J.Cano, Ros, García-Zamora & J.Guerra

* **D. tophaceus** subsp. **sicculus** (M.J.Cano, Ros, García-Zamora & J.Guerra) Jan Kučera

Plants to 0,7 cm tall, olive-green to brownish. Leaves with acute to rounded apex, margin recurved to 3/4 way up leaf, occasionally bistratose, median cells of lamina papillose, basal cells rectangular, to 50 µm long. Grows on dry, sandy, exposed soils. Scattered in the Peninsula and in Mallorca. Esp, Prt, Bl.

16 Leaves lanceolate or lineal-lanceolate

17

17 Leaves lanceolate or ovate-lanceolate, 1-3 mm long (fig. 37, 14-15) **D. vinealis** (Brid.) R.H.Zander
Plants to 2,5 cm tall. Leaves erecto-patent to spreading, twisted when dry, all similar in length, margin entire or slightly papillose-crenulate; nerve percurrent or shortly excurrent, with a small area of rectangular, smooth translucent cells just below apex on ventral side. Forms green to brownish turfs on walls and exposed, calcareous rocks from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

17 Leaves longly linear-lanceolate, 1-5 mm long (fig. 37, 16-17) **D. insulanus** (De Not.) M.O.Hill
Plants 0,5-3,5 cm tall. Leaves erecto-patent to spreading, twisted when dry, margin entire or slightly papillose-crenulate, upper leaves longer, nerve percurrent or shortly excurrent, with a small area of rectangular, smooth translucent cells just below apex on ventral side. Forms green turfs on humid, calcareous soils, rocks and walls from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

18 Leaf apex gradually tapered into ± long point; nerve ending below apex or excurrent in short or long point (fig. 37, 4-5) **D. acutus** (Brid.) K.Saito
Plants 0,5-2 cm high. Leaves erecto-patent, erect when dry, concave or flat, nerve 45-75 µm wide, excurrent in long or short point; laminal cells rounded to quadrate, thick-walled, smooth. Forms dark green to brown turfs on exposed, calcareous soils, rock ledges, walls and by road sides. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

18 Leaf apex acute to rounded; nerve ending below apex, percurrent or excurrent in apiculus

19

19 Median cells of lamina smooth, basal cells quadrate or rectangular, to 30 µm long (fig. 37, 3)

D. luridus Hornsch.

Plants to 2 cm tall. Leaves erect to patent, appressed when dry, margin recurved at base. Forms olive-green on exposed, usually calcareous rocks and soils, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

19 Median cells of lamina papillose, basal cells rectangular, to 50 µm long

D. sicculus M.J.Cano, Ros, García-Zamora & J.Guerra

* **D. tophaceus** subsp. **sicculus** (M.J.Cano, Ros, García-Zamora & J.Guerra) Jan Kučera

Plants to 0,7 cm tall, olive-green to brownish. Leaves with acute to rounded apex, margin recurved to 3/4 way up leaf, occasionally bistratose, median cells of lamina papillose, basal cells rectangular, to 50 µm long. Grows on dry, sandy, exposed soils. Scattered in the Peninsula and in Mallorca. Esp, Prt, Bl.

Eucladium Bruch & Schimp.

Stem 1-3 cm high. Leaves linear to linear-lanceolate, erecto-patent, appressed when dry, margin plane, with some reflexed teeth near base; laminal cells 10 µm wide, quadrate, papillose, basal cells longer, smooth, hyaline; nerve ending below apex or excurrent. Sometimes with fusiform, pluricellular gemmae on axillary rhizoidal filaments. Capsule ovoid to cylindrical, smooth and straight; lid rostrate; peristome teeth 16, papillose, nodulose and perforated; spores 12 µm, smooth, yellowish (fig. 38, 1-3)

E. verticillatum (With.) Bruch & Schimp.

Forms dense, light green turfs, often with calcium carbonate encrustations, in dripping places and calcareous springs in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

Gymnostomum Nees & Hornsch.

Plants medium-sized to small. Leaves linear, lingulate, ovate or ovate-lanceolate, apex rounded to widely acute, frequently apiculate, margin plane, entire or crenulate; laminal cells quadrate or rounded, pluripapillose, basal cells quadrate or shortly rectangular, longer, smooth or slightly papillose; nerve ending below apex or percurrent. Capsule ellipsoidal, annulus of 2-3 rows of small, oblate cells, rudimentary or absent; lid longly rostrate, oblique; peristome lacking.

1 Nerve 60-110 µm wide near base; laminal cells more than 15 µm (fig. 38, 11) **G. aeruginosum** Sm.

Plants to 4 cm tall. Leaves lingulate or linear, obtuse, erect or ± contorted, twisted when dry. Forms dense turfs or cushions on wet or seeping, calcareous rocks in montane areas and high mountains. Widespread in the northern half of the Peninsula and in Sierra Nevada. Esp, And.

var. **aeruginosum**: Lamina unistratose.

var. **obscurum** J.Guerra: Lamina irregularly bistratose, leaf margin bistratose.

1 Nerve to 45 µm wide near base; laminal cells to 10 µm **2**

2 Leaves ovate or obovate, 2-4 times as long as wide, with rounded apex (fig. 38, 12-15)

G. viridulum Brid.

Plants 1,5-5 mm tall. Pluricellular, obovoid, biseriate gemmae in leaf axils frequent. Perichaetial leaves short, similar to stem leaves, with unistratose margin. Grows on rocks and dry, calcareous soils in the lowlands. Widespread throughout the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, Bl.

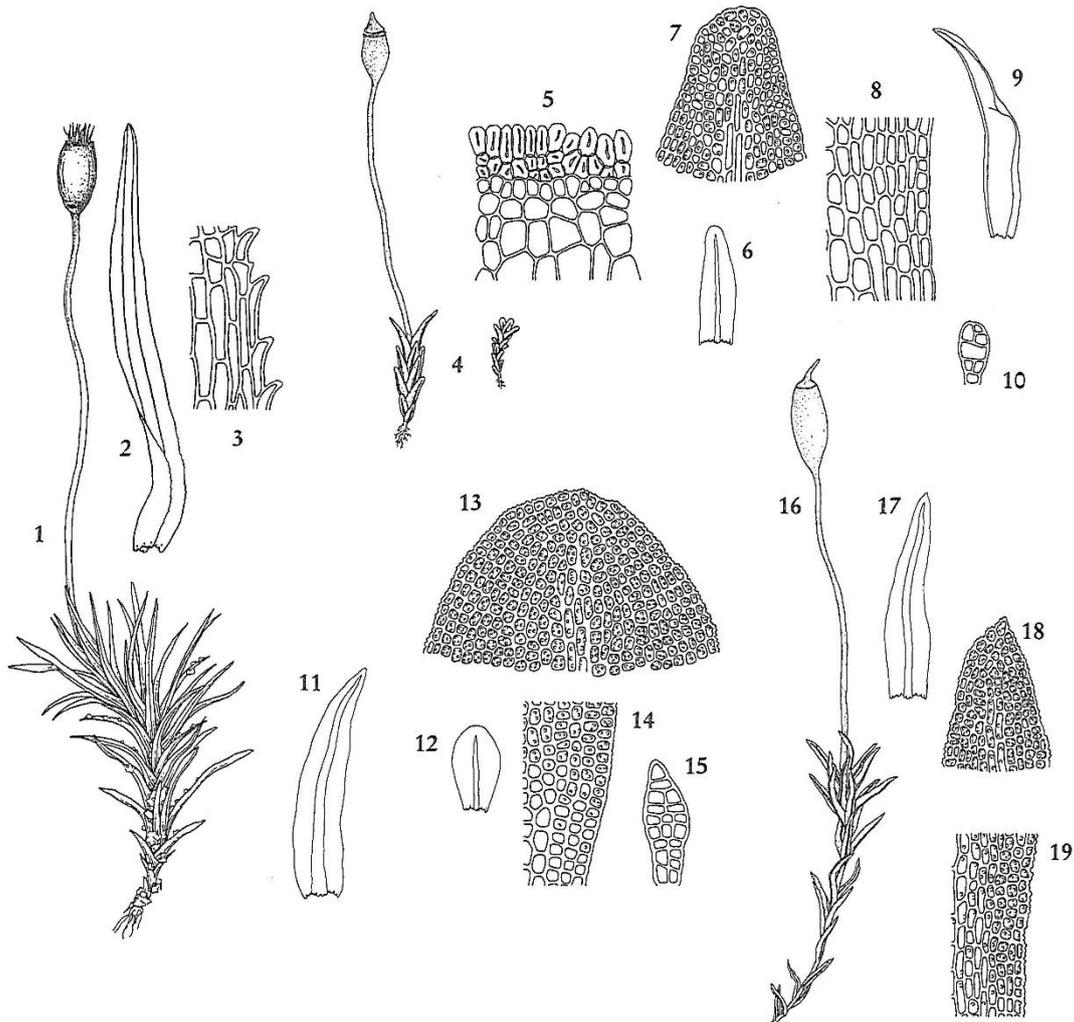


FIGURE 38. **1-3, *Eucladium verticillatum***: 1, habit; 2, leaf; 3, basal margin. **4-10, *Gyroweisia tenuis***: 4, habit, plants with and without sporophyte; 5, annulus; 6, leaf; 7, leaf apex; 8, basal cells; 9, perichaetial leaf; 10, gemma. **11, *Gymnostomum aeruginosum***, leaf. **12-15, *G. viridulum***: 12, leaf; 13, leaf apex; 14, basal cells; 15, gemma. **16-19, *G. calcareum* var. *calcareum***: 16, habit; 17, leaf; 18, leaf apex; 19, basal cells. **1** (x7); **16** (x9); **4** (x11); **2, 6, 9, 11, 12, 17** (x30); **3, 5, 7, 8, 10, 13, 14, 15, 18, 19** (x200).

- 2 Leaves lingulate or linear, 4-7(8) times as long as wide, with obtuse or acute apex (fig. 38, 16-19)

***G. calcareum* Nees & Hornsch.**

var. **calcareum**: Plants to 2 cm tall. Leaves flexuose or crisped when dry; margin unistratose. Perichaetial leaves larger than stem leaves. Forms dense, light green turfs on damp, calcareous rocks. Widespread throughout the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, Bl (fig. 38, 16-19).

var. **atlanticum** Sérgio: Plants to 0,5 cm tall. Leaves erect or erecto-patent when dry; margin frequent and regularly bistratose. Pluricellular, fusiform clavate uniseriate gemmae in leaf axils frequently present. Perichaetial leaves

little longer than stem leaves, linear-lanceolate, frequently bistratose from 1/3 to apex. Annulus absent. Grows on wet, calcareous soils and rocks in the lowlands or mountains of the oceanic areas. Esp, Prt.

var. **lanceolatum** (M.J.Cano, Ros & J.Guerra) Sérgio: Plants to 1 cm tall. Leaves erect or erecto-patent when dry; margin frequent and regularly bistratose. Pluricellular gemmae in leaf axis infrequently present. Perichaetial leaves much longer than stem leaves, linear-lanceolate, frequently bistratose from to apex. Annulus absent or vestigial, caducous. Grows on dry, calcareous or gypsum soils in the lowlands of the Mediterranean region of the Peninsula and Mallorca. Esp, Bl.

Gyroweisia Schimp.

Fertile plants to 0,3 cm tall, sterile plants shorter. Leaves lingulate, apex obtuse or rounded, margin plane, finely crenulate; cells \pm quadrate, finely papillose, basal cells narrowly rectangular, occupying 1/2-1/4 of lamina, smooth, inflated; nerve nearly reaching apex. Perichaetial leaves lanceolate, longer than stem leaves, with longly sheathing base. Often with pluricellular rhizoidal gemmae. Capsule with annulus of large and often inflated cells; lid conical; peristome lacking or rudimentary.

- 1 Peristome lacking; upper and perichaetial leaves patent to reflexed; annulus of inflated, well differentiated cells (fig. 38, 4-10) **G. tenuis** (Hedw.) Schimp.

Forms turfs on calcareous rocks or sandstone in damp, shady sites. Scattered in the north and east of the Peninsula. Esp, Prt.

- 1 Peristome rudimentary; upper and perichaetial leaves reflexed to squarrose; annulus of slightly differentiated cells **G. reflexa** (Brid.) Schimp.

Forms turfs on soil and calcareous rocks. Scattered throughout the Peninsula. Esp, Prt.

Henediella Paris

Plants to 1 cm tall. Leaves oblong-elliptical or ovate, margin dentate at apex, plane with patches of elongate cells; laminal cells quadrate or hexagonal, papillose, marginal cells smooth or slightly papillose, thick-walled but not forming distinct border. Capsule cylindrical, short; lid attached to columella after dehiscence; peristome lacking (fig. 39, 1-3) **H. heimii** (Hedw.) R.H.Zander

Pottia heimii (Hedw.) Hampe

Forms loose, yellowish green turfs in the salt-marshes. Only one locality in the centre of the Peninsula. Esp.

Hymenostylium Brid.

Stem to 10 cm high, rounded pentagonal to triangular in section, without central strand. Leaves linear-lanceolate to oblong-lanceolate, gradually tapering into acute or acuminate point, carinate in upper part, margin finely crenulate, recurved on one or both sides; laminal cells quadrate, rhomboidal or rectangular, smooth or papillose, thin-walled or thick-walled; nerve percurrent, with 2 stereid bands. Capsule erect, ovoid; lid rostrate, attached to columella after ripening of spores; peristome lacking (fig. 39, 4-7)

H. recurvirostrum (Hedw.) Dixon

Plants very variable in habit and in shape of leaf cells. Forms dense turfs 1-4(-10) cm high, often with calcium carbonate encrustations, on calcareous rocks, in waterfalls and dripping places, in montane areas of the Peninsula.

var. **recurvirostrum**: Leaves with basal cells not or slightly porose; nerve to 50 μm wide (fig. 39, 4-7). Esp, And.

var. **insigne** (Dixon) E.B. Bartram: Leaf basal cells porose; nerve more than 50 μm wide. Esp.

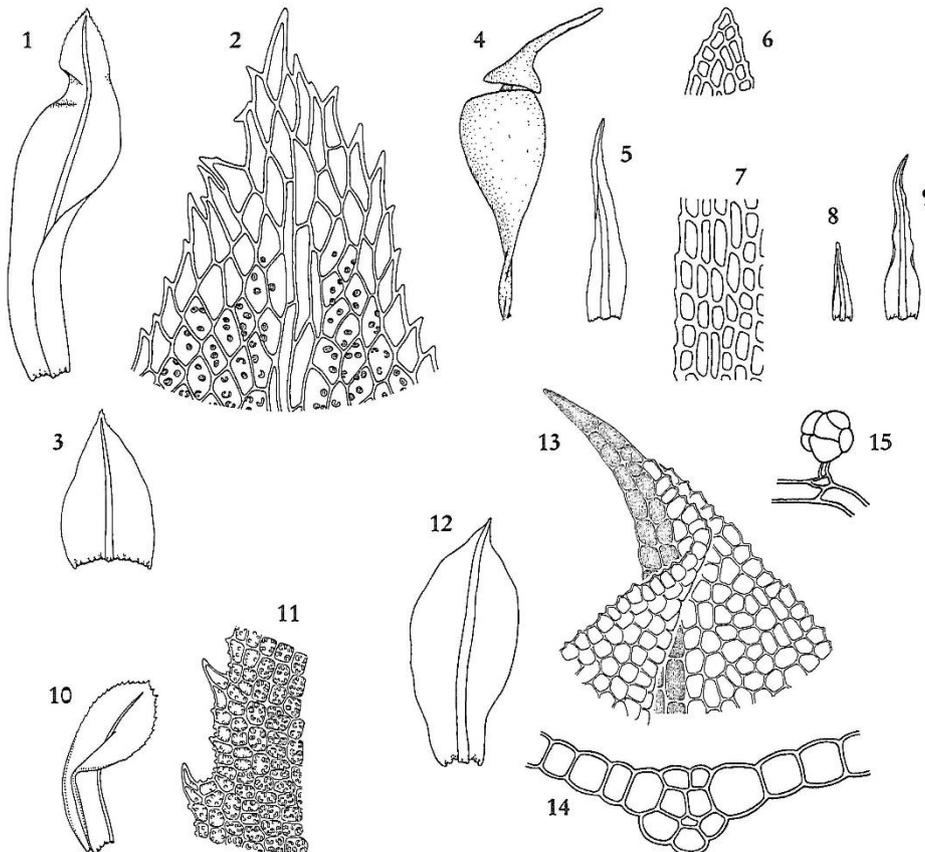


FIGURE 39. 1-3, *Hennediella heimii*: 1, upper leaf; 2, leaf apex; 3, lower leaf. 4-7, *Hymenostylium recurvirostrum* var. **recurvirostrum**: 4, capsule; 5, leaf; 6, leaf apex; 7, basal cells. 8-9, *Leptobarbula berica*: 8, leaf; 9, perichaetial leaf. 10-11, *Leptodontium flexifolium*: 10, leaf; 11, upper cells. 12-15, *Chenia leptophylla*: 12, leaf; 13, leaf apex; 14, nerve section; 15, gemma. 1, 3, 4, 5, 8, 9, 10, 12 (x18); 13, 15 (x140); 2, 6, 7, 11, 14 (x200).

Hyophila Brid.

Plants 2 cm tall. Leaves tubulose and incurved when dry, spreading when moist, oblong-ovate to oblong-spathulate, apex rounded to obtuse, margin denticulate in the upper half, plane or broadly involute, sometimes apiculate; laminal cells quadrate or rounded, mamilllose on the ventral side, basal cells shortly rectangular, smooth; nerve ending below apex or percurrent, stout. Capsule cylindrical, annulus well differentiated, red-brown, of vesiculose cells, persistent or deciduous; lid conic-rostrate, erect; peristome lacking

H. involuta (Hook.) A. Jaeger

Forms turfs on calcareous, moist, rocky riverbank in an *Alnus* Mill. forest formation in the lowlands. Very rare, in the western Pyrenees. Esp.

Leptobarbula Schimp.

Plants to 0,5 cm tall. Leaves lanceolate, erecto-patent, apex abuse or acute, margin plane, papillose-crenulate; laminal cells 5-7 μm wide, papillose on both sides, basal cells larger, thick-walled, smooth; nerve percurrent. Perichaetial leaves sheathing, larger than stem leaves. Mostly with sporophytes. Capsule smooth, ovoid to ellipsoidal; peristome teeth 16, filiform, divided to base, slightly twisted (fig. 39, 8-9)

L. berica (De Not.) Schimp.

Forms loose turfs on open, calcareous rocks and soils in the lowlands, near to coastal areas of the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

Leptodontium (Müll.Hal) Lindb.

Plants to 1,5 cm tall, green or brownish. Leaves erect to patent, incurved and flexuose when dry, oblong-lanceolate to lingulate-spathulate, apex rounded to widely acute, apiculate, margin plane, recurved below, coarsely toothed above; median cells quadrate, rounded or hexagonal, densely papillose; nerve ending below apex. Occasionally with stalked, obovoid axillary gemmae (fig. 39, 10-11)

L. flexifolium (Dicks.) Hampe

Forms lax turfs on acidic soils and rocks, in montane areas. Very rare, in the north and western part of the Peninsula. Esp, Prt (Extinct).

Chenia R.H.Zander

Plants small. Leaves broadly ovate-elliptical to obovate to spathulate or oblong-spathulate, apex acute, ending in thick-walled, sharp, smooth spine, margin plane, dentate or crenulate above; laminal cells quadrate, hexagonal or shortly rectangular, thin-walled, smooth or papillose; nerve percurrent. Rhizoidal gemmae often developed.

1 Laminal cells smooth (fig. 39, 12-15) **C. leptophylla** (Müll.Hal.) R.H.Zander

Leptophascum leptophyllum (Müll.Hal.) J.Guerra & M.J.Cano

Plants to 0,6 cm, gregarious, glossy green to brownish. Leaves; laminal cells quadrate or shortly rectangular, 16-30 µm wide, brownish; nerve thin, of slightly differentiated cells, without stereids. Rhizoidal gemmae brownish or reddish. Grows in nitrophilous sites in the lowlands of the eastern half and west of the Peninsula. Esp, Prt.

1 Laminal cells papillose **C. ruigteveia** Hedd. & R.H.Zander

Plants to 0,5 cm, green above to brown to yellow below. Laminal cells quadrate or hexagonal, 12-20 µm wide, papillose, basal cells shortly rectangular; nerve thin, in cross section round to elliptical, with differentiated ventral and dorsal cells and small stereid band. Rhizoidal gemmae brown. Grows on shaded, wet soils by streams. One locality in the east of the Peninsula. Esp.

Microbryum Schimp.

Plants small, brownish or reddish. Leaves ovate, oblong, elliptical or lanceolate, apiculate or mucronate, margin recurved in the upper part; nerve excurrent in mucro or in apiculus, percurrent or ending below apex, stereids few, 2-3, in 1-2 bands; laminal cells quadrate, hexagonal or shortly rectangular, papillose. Seta straight or curved, short or long; capsule erect, globose, ellipsoidal or cylindrical, dehiscent or indehiscent, exserted, immersed or emergent; lid conical or not differentiated; peristome well developed (with 16 teeth), rudimentary or lacking.

1 Capsule exserted **2**

1 Capsule immersed or laterally emergent **6**

2 Capsule globose (fig. 40, 1) **M. rectum** (With.) R.H.Zander

Pottia recta (With.) Mitt.

Leaves oblong-lanceolate, margin recurved; cells 10-12 µm, papillose. Capsule with a small apiculus delimited from the rest of the capsule by 1 row of isodiametric, thick-walled cells. Plants very small, to 1,2 mm tall, brownish, forming loose turfs on open, calcareous soils, by roadsides and in gardens, in the lowlands in the eastern part of the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

2 Capsule cylindrical or ellipsoidal **3**

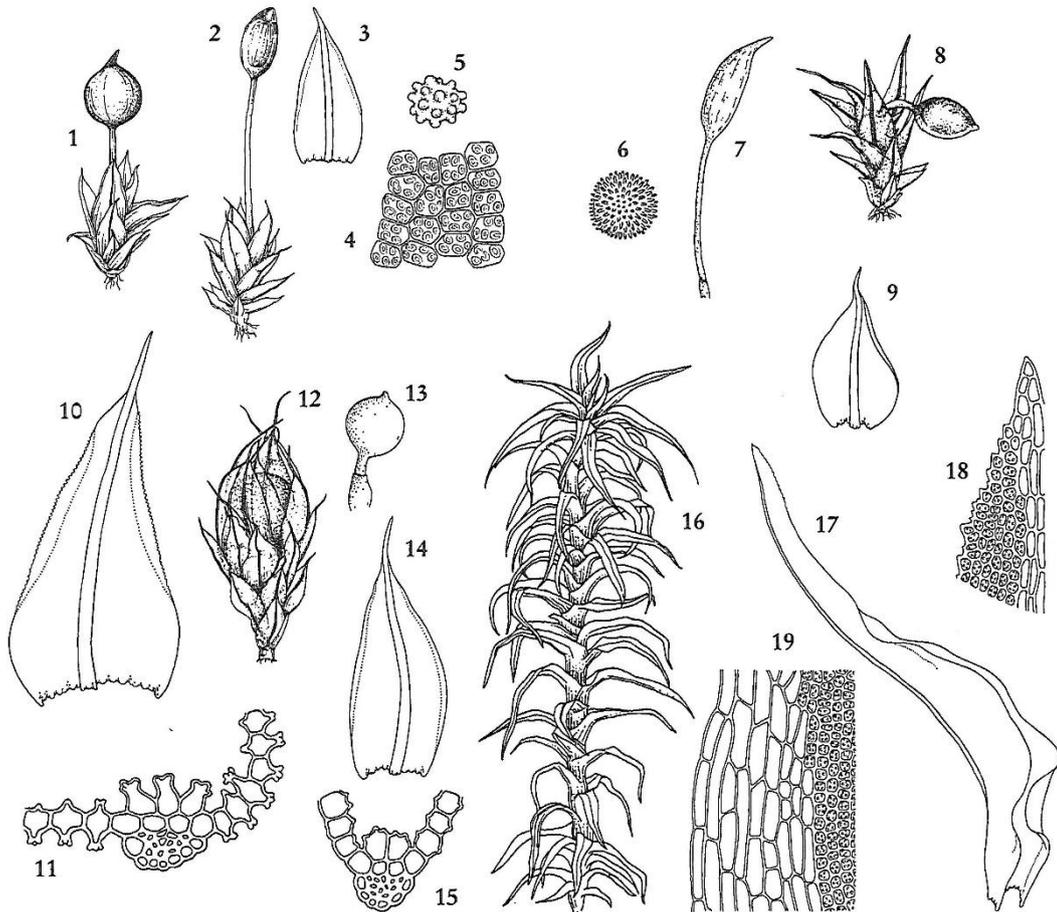


FIGURE 40. 1, *Microbryum rectum*, habit. 2-5, *M. starckeanum*: 2, habit; 3, leaf; 4, upper cells; 5, spore. 6, *M. davallianum*, spore. 7, *M. longipes*, capsule and seta. 8, *M. curvicollum*, habit. 9, *M. floerkeanum*, leaf. 10-11, *Phascum vlassovii*: 10, leaf; 11, nerve section. 12-15, *P. cuspidatum* var. *cuspidatum*: 12, habit; 13, capsule and seta; 14, leaf; 15, nerve section. 16-19, *Pleurochaete squarrosa*: 16, habit; 17, leaf; 18, apical cells; 19, basal cells. 16 (x5); 1, 2, 7, 8, 12, 13 (x10); 3, 9, 10, 14, 17 (x18); 11, 15, 18, 19 (x180); 5, 6 (x280); 4 (x380).

3 Spores with big, rounded warts 4

3 Spores spinose or smooth 5

4 Capsule dehiscent (fig. 40, 2-5) ***M. starckeanum*** (Hedw.) R.H.Zander

Pottia starckeana (Hedw.) Müll.Hal.

Plants very small, to 1,5 mm tall, bright green or brownish. Leaves ovate-lanceolate; nerve excurrent in apiculus. Peristome rudimentary to well developed, teeth lingulate, strongly papillose. Grows on dry, exposed soils, in the Mediterranean region of the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

4 Capsule indehiscent ***M. fosbergii*** (E.B.Bartram) Ros, O.Werner & Rams

Pottia fosbergii E.B.Bartram

Plants to 2,3 mm tall. Leaves ovate or ovate-lanceolate; nerve excurrent in apiculus. Capsule ellipsoidal; lid not differentiated. Grows on exposed soils in grasslands and clearings. Distributed in the southwestern part of the Peninsula. Esp, Prt.

- 5 Spores spinose; capsule dehiscent (fig. 40, 6)

M. davallianum (Sm.) R.H.Zander

Pottia davalliana (Sm.) C.O.E.Jensen, **P. commutata** Limpr., **P. conica** (Schleich. ex Schwägr.) Fürnr. ex Paris

Plants to 1,5 mm tall. Leaves ovate-lanceolate; nerve excurrent. Peristome with well-developed teeth or with short, irregular teeth or lacking. Plants very small, brownish, gregarious or forming loose turfs on dry soils. Scattered in the lowlands, in the Mediterranean region of the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

- 5 Spores smooth; capsule indehiscent (fig. 40, 7)

M. longipes (J.Guerra, J.J.Martínez & Ros) R.H.Zander

Phascum longipes J.Guerra, J.J.Martínez & Ros

Plants gregarious, very small to 1,2 mm tall. Leaves ovate-lanceolate, acuminate, margin recurved or plane; nerve reaching apex or shortly excurrent. Seta about 2 mm long; capsule longly exerted, ellipsoidal or cylindrical, yellowish, with apiculus to 0,3 mm long. Grows on exposed, gypsum soils or on sheltered, calcareous soils. Distributed in the southeastern part of the Peninsula. Esp.

- 6 Seta curved; capsule laterally emergent (fig. 40, 8)

M. curvicolium (Hedw.) R.H.Zander

Phascum curvicolium Hedw., **P. piptocarpum** Durieu & Mont.

Plants reddish brown to 2 mm tall. Leaves ovate-lanceolate, acuminate, margin strongly recurved; nerve excurrent in apiculus. Capsule ellipsoidal. Grows among other mosses or forming loose turfs on dry, exposed, clayey or sandy basic soils, in the lowlands. Mainly in the eastern half of the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, Bl.

- 6 Seta straight; capsule immersed (fig. 40, 9)

M. floerkeanum (F.Weber & D.Mohr) Schimp.

Phascum floerkeanum F.Weber & D.Mohr

Plants reddish brown to 2 mm tall. Leaves ovate, elliptical or lanceolate, concave; nerve brownish red, excurrent in apiculus. Capsule sub-globose. Spores to 32 µm. Grows isolated on dry, exposed basic soils, in the lowlands, in the eastern part of the Peninsula. Esp, Prt.

Phascum Hedw.

Plants light green to brownish, small, less than 1 cm tall, often forming lax turfs. Stem erect. Leaves ovate to lanceolate, margin recurved, entire; laminal cells quadrate, hexagonal or rhomboidal, smooth or papillose; nerve excurrent in apiculus, in arista or in a hair-point, with numerous dorsal stereids, in 2-3(-4) layers, flask-

shaped cells on ventral side above present or not. Capsule globose or ovoid, apiculate, indehiscent, immersed or laterally emergent; seta straight or curved, short.

- 1 Nerve with flask-shaped, papillose cells on ventral side above; upper laminal cells with 1 central, high papilla bi- or trifurcate (fig. 40, 10-11) **P. vlassovii** Laz.

* **Microbryum vlassovii** (Laz.) R.H.Zander, **Tortula vlassovii** (Laz.) Ros & Herrnst.

Stem to 0,4 cm high. Upper leaves widely ovate, acute; nerve excurrent in arista 0,3-0,7 mm long, yellowish green or hyaline. Capsule immersed. Forms loose turfs on dry, exposed, gypsum soils, in the eastern part of the Peninsula. Esp.

- 1 Nerve with rectangular, not flask-shaped cells, smooth or papillose on ventral side above; upper laminal cells smooth or with 2-4(-6) low papillae, simple to trifurcate (fig. 40, 12-15) **P. cuspidatum** Hedw.

* **Tortula acaulon** (With.) R.H.Zander

Plants greenish or yellowish, to 0,9 cm tall. Upper leaves ovate or ovate-lanceolate, acute; nerve excurrent in a mucro, in brown, yellowish arista or in hyaline hair. Seta usually short, straight or curved, occasionally to 1,5 mm long and cygneous; spores 25-40 µm. Grows on exposed, acidic or basic soils in the lowlands, in the eastern and southern half of the Peninsula and in Mallorca and Menorca.

Taxon very variable, includes diverse varieties:

var. **cuspidatum** (* **Tortula acaulon** var. **acaulon**): Nerve excurrent in a hair less than 0,4 mm long (fig. 40, 13-16). Esp, Prt, And, Bl.

var. **papillosum** (Lindb.) G.Roth (=* **Tortula acaulon** var. **papillosa** (Lindb.) R.H.Zander): Upper cells of lamina strongly papillose, with 3-4(5) conical, bifurcate or trifurcate papillae. Esp, Prt.

var. **piliferum** (Hedw.) Hook. & Taylor (=* **Tortula acaulon** var. **pilifera** (Hedw.) R.H.Zander): Nerve excurrent in a hair more than 0,4 mm long. Esp, Prt.

var. **retortifolium** J.Guerra & Ros (=* **Tortula acaulon** var. **retortifolia** (J.Guerra & Ros) R.H.Zander): Leaves strongly curled; nerve excurrent in yellowish green hair to 1,5 mm long. Seta curved; capsule laterally emergent. Esp, Bl.

var. **schreberianum** (Dicks.) Brid. (=* **Tortula acaulon** var. **schreberiana** (Dicks.) R.H.Zander): Stem to 9 mm high, branched. Nerve excurrent in a hair to 0,5 mm long. Esp.

Pleurochaete Lindb.

Stem 2-3 cm high. Leaves lanceolate, squarrose, crisped when dry, base erect, sheathing, apical margin incurved and dentate; laminal cells 8-10 µm, hexagonal, papillose, basal cells rectangular, forming at margin a wide and hyaline border, narrowing when ascending up margin; nerve percurrent or excurrent and ending in a mucro. Seta lateral; capsule cylindrical, straight or slightly inclined; peristome teeth 32, filiform, papillose, slightly twisted (fig. 40, 16-19) **P. squarrosa** (Brid.) Lindb.

* **Tortella squarrosa** (Brid.) Limpr.

Forms light green or yellowish, loose turfs, on dry, open, sandy, calcareous soils, in the lowlands of the Mediterranean region and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

Pottia (Reichenb.) Fürnr.

Plants minute or small, scattered, gregarious or forming loose or dense turfs, mainly on disturbed soils, in roadside ledges, gardens or arable fields. Leaves ovate-lanceolate to oblong, lingulate or spatulate, margin plane or recurved; laminal cells quadrate or hexagonal, papillose or smooth; nerve percurrent or excurrent in apiculus, arista or hair-point. Seta straight; capsule exserted, dehiscent, ovoid, ellipsoidal or cylindrical; lid rostrate; peristome lacking, rudimentary or with 16 long and well-developed teeth; calyptra cucullate.

1 Peristome with well-developed teeth (fig. 41, 1-3) **P. lanceolata** (Hedw.) Müll.Hal.

* **Tortula lindbergii** Broth., **Tortula lanceola** R.H.Zander

Plants to 0,4 cm tall. Leaves oblong-lanceolate or lingulate, twisted when dry; laminal cells papillose or almost smooth; nerve excurrent in arista longer than 150 µm. Capsule cylindrical; peristome red or whitish, irregularly divided and perforated, with long teeth, 230-500 µm. Forms dense or loose, green turfs on open, basic or even gypsiferous soils, in the Mediterranean region of the Peninsula and in Mallorca. Esp, Prt, And, Bl.

1 Peristome lacking or rudimentary **2**

2 Mature capsule turbinate, widest at mouth (fig. 41, 4) **P. truncata** (Hedw.) Bruch & Schimp.

* **Tortula truncata** (Hedw.) Mitt.

Plants to 0,5 cm tall. Leaves broadly oblong or oblong-lanceolate, margin plane or recurved at base; laminal cells quadrate, smooth or slightly papillose; nerve percurrent or excurrent in short apiculus. Capsule ovoid, short, wide-mouthed after ripening of spores; peristome lacking or very reduced. Forms very lax turfs on acidic soils, in the lowlands, rarely in montane areas. Scattered in the Peninsula and in Menorca. Esp, Prt, Bl.

2 Mature capsule not turbinate, widest below mouth **3**

3 Laminal cells papillose **4**

3 Laminal cells smooth **5**

4 Laminal cells 10-18 µm wide (fig. 41, 5) **P. wilsonii** (Hook.) Bruch & Schimp.

* **Tortula wilsonii** (Hook.) R.H.Zander

Leaves obovate or spatulate, apex acute or obtuse; nerve excurrent in apiculus or in yellowish hair-point. Capsule ellipsoidal or cylindrical; peristome rudimentary. Spores more than 16 µm. Plants to 0,4 cm tall, gregarious or forming green turfs on wet slopes and arable fields, in the lowlands and montane areas. Scattered in the Peninsula and in Menorca. Esp, Prt, Bl.

- 4 Laminal cells 18-28 µm wide (fig. 41, 6)

P. crinita Bruch & Schimp.

* **Tortula viridifolia** (Mitt.) Blockeel & A.J.E.Sm.

Plants to 0,3 cm tall. Leaves spatulate, apex rounded; laminal cells 16 µm wide or more; nerve excurrent in apiculus or in yellowish hair-point. Capsule ovoid; peristome rudimentary; spores more than 20 µm. Forms cushions on calcareous rocks. Scattered in the northeast, centre and northwest of the Peninsula and in Mallorca and Menorca. Esp, Bl.

- 5 Leaf apex acute (fig. 41, 7)

P. intermedia (Turner) Fürnr.

* **Tortula caucasica** Broth.

Plants to 0,7 cm tall. Leaves oblong-lanceolate or spatulate; laminal cells quadrate, smooth or slightly papillose; nerve excurrent in apiculus. Capsule ellipsoidal or cylindrical; peristome rudimentary or incompletely developed. Spores to 34 µm. Forms lax, olive-green turfs on exposed, often saline soils, in the lowlands and montane areas, in the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

- 5 Leaf apex rounded or obtuse (fig. 41, 8)

P. pallida Lindb.

* **Tortula pallida** (Lindb.) R.H.Zander

Plants to 0.5 cm tall. Leaves oblong-spatulate; nerve excurrent in apiculus or in yellow hair-point; laminal cells smooth or scarcely papillose. Capsule cylindrical or ellipsoidal, yellowish; peristome lacking or rudimentary. Spores to 28 µm. Forms compact, yellowish green turfs on temporarily wet, saline soils. Scattered in the Mediterranean region of the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

Pottiopsis Blockeel & A.J.E. Sm.

Plants minute. Leaves oblong-lanceolate, acute, margin plane, entire; laminal cells quadrate or rounded, thick-walled; nerve excurrent in apiculus. Perichaetial leaves broader than stem leaves, sheathing, concave. Seta long; capsule dehiscent, ovoid; lid conical, oblique; peristome short, with irregular teeth, rudimentary (fig. 41, 9-12)

P. caespitosa (Bruch ex Brid.) Blockeel & A.J.E.Sm.

Trichostomum triumphans De Not., **Trichostomum pallidisetum** H.Müll.

Forms small, loose turfs on soils and in calcareous rock crevices, in the lowlands. Distributed in the south and east of the Peninsula and in Mallorca. Esp, Prt, And, Bl.

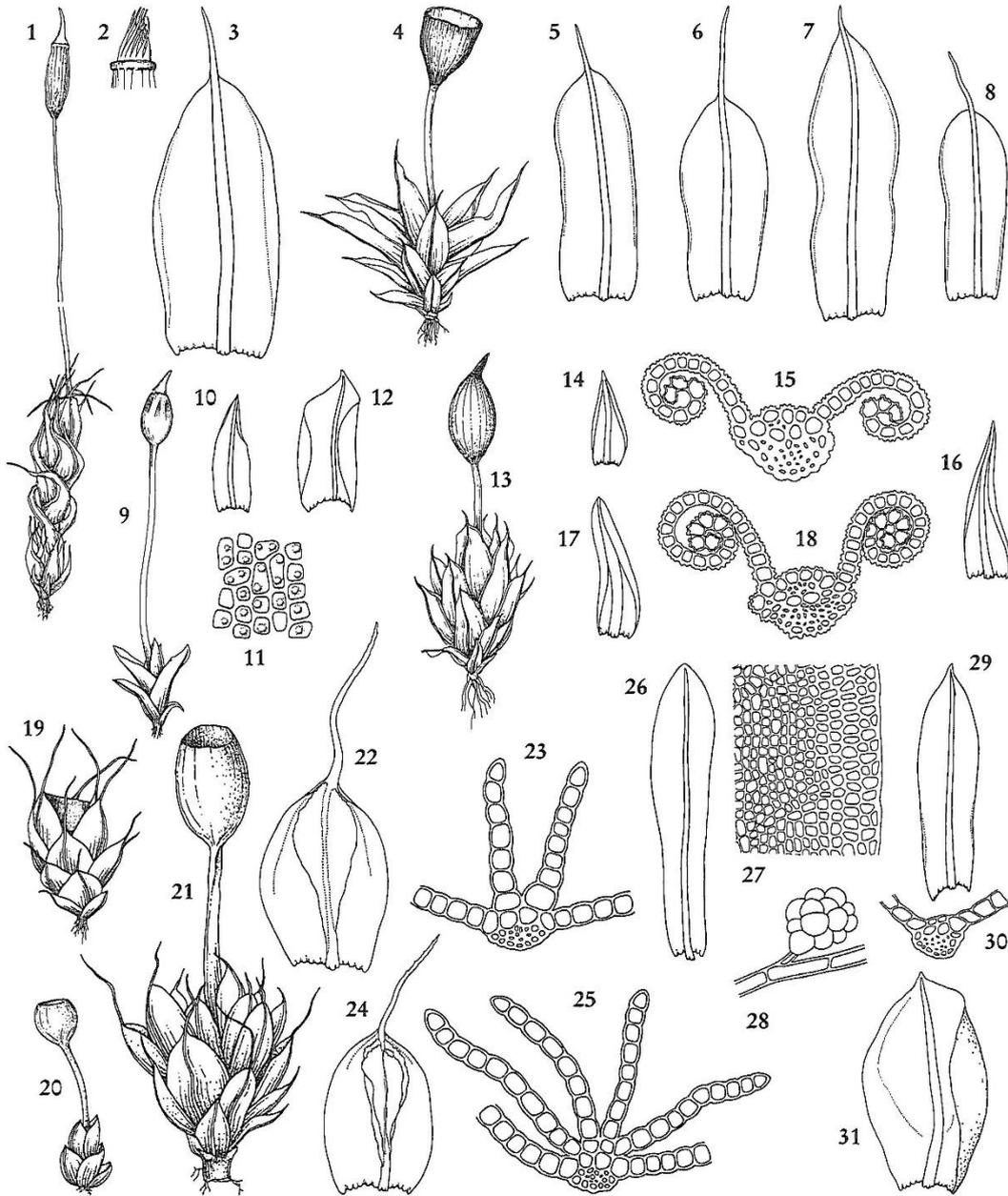


FIGURE 41. 1-3, *Pottia lanceolata*: 1, habit when dry; 2, peristome; 3, leaf. 4, *P. truncata*, habit. 5, *P. wilsonii*, leaf. 6, *P. crinita*, leaf. 7, *P. intermedia*, leaf. 8, *P. pallida*, leaf. 9-12, *Pottiopsis caespitosa*: 9, habit; 10, leaf; 11, upper cells; 12, perichaetial leaf. 13, *Protobryum bryoides*, habit. 14-15, *Pseudocrossidium obtusulum*: 14, leaf on dorsal side; 15, leaf section. 16, *P. hornschurchianum*, leaf on dorsal side. 17-18, *P. revolutum*: 17, leaf on dorsal side; 18, leaf section. 19, *Pterygoneurum subsessile*, habit. 20, *P. sampaianum*, habit. 21-25, *P. ovatum*: 21, habit; 22, 24, leaves; 23, 25, nerve sections. 26-28, *Scopelophila ligulata*: 26, leaf; 27, marginal cells; 28, gemma. 29-30, *S. cataractae*: 29, leaf; 30, nerve section. 31, *Stegonia latifolia*, leaf. 1, 4, 9, 13, 19, 20, 21 (x10); 2, 3, 5, 6, 7, 8, 10, 12, 14, 16, 17, 22, 24, 26, 29, 31 (x18); 15, 18, 23, 25, 27, 28, 30 (x180); 11 (x380).

Protobryum J.Guerra & M.J.Cano

Plants very small, to 0,6 cm tall, brownish. Leaves lanceolate or ovate-lanceolate, margin entire, recurved; laminal cells quadrate, 15-20 μ m, smooth or slightly papillose; nerve excurrent in a yellowish green arista. Seta

long; capsule emergent or shortly exerted, ellipsoidal, longly apiculate, indehiscent; lid differentiated but persistent (fig. 41, 13)

P. bryoides (Dicks.) J.Guerra & M.J.Cano

* **Tortula protobryoides** R.H.Zander

Scattered or gregarious on open, calcareous soils, in the Mediterranean region of the Peninsula and in Mallorca. Esp, Bl.

Pseudocrossidium R.S. Williams

Plants 0,3-1,5 cm tall. Leaves spirally twisted when dry, ovate, lanceolate, triangular or lingulate; margin entire, revolute from base to apex; laminal cells quadrate or oblate, thick-walled, papillose, basal cells rectangular; nerve stout, excurrent in mucro. Gemmae often present, pluricellular, on ventral side of nerve. Capsule ellipsoidal; lid rostrate; peristome teeth 16, filiform, divided to base, spirally twisted.

1 Leaves ovate or ovate-lanceolate; slightly spirally twisted when dry (fig. 41, 14-15)

P. obtusulum (Lindb.) H.A.Crum & L.E.Anderson

Leaf apex obtuse and apiculate or acute, margin once revolute. Grows on calcareous, saline or gypsum soils. Scattered in the Peninsula. Esp, And.

1 Leaves triangular, lanceolate, oblong or lingulate, strongly spirally twisted when dry

2

2 Leaves triangular, lanceolate, with acuminate apex (fig. 41, 16)

P. hornschurchianum (Schultz) R.H.Zander

Leaf margin narrowly revolute more than 1 turn. Gemmae lacking. Forms compact turfs on disturbed soils of arable fields, walls and calcareous rocks, in the lowlands. Widespread throughout the Peninsula and in Mallorca, Menorca, and Pithyusic Islands. Esp, Prt, And, Bl.

2 Leaves oblong or lingulate, with obtuse apex (fig. 41, 17-18)

P. revolutum (Brid.) R.H.Zander

Leaf margin widely revolute, often with pluricellular gemmae on the ventral side of nerve. Forms dense, dark green turfs on dry, calcareous soils and rocks, in open sites, in the lowlands. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

Pterygoneurum Jur.

Plants small. Stem to 0,5 cm high, branched or not. Leaves ovate or oblong-ovate, concave, margin plane or narrowly recurved; cells short, variable in shape; nerve ending below apex or excurrent in hyaline hair-point, in apiculus or in mucro, with 2-4 lamellae on ventral side 4-20 cells high, in the upper part or from base to

apex, occasionally with filaments on both sides of lamella. Seta short or long; capsule immersed or exerted, globose to cylindrical; peristome rudimentary or lacking.

- 1 Seta short, capsule immersed (fig. 41, 19) **P. subsessile** (Brid.) Jur.
Plants to 0,3 cm tall. Nerve excurrent in hyaline hair-point, with 2-4 lamellae, usually in the upper half, occasionally with short filaments. Forms loose turfs on saline, periodically wet soils. Scattered in the eastern part of the Peninsula. Esp.

- 1 Seta long, capsule exerted **2**

- 2 Nerve ending below leaf apex or excurrent in mucro; capsule globose or sub-globose (fig. 41, 20) **P. sampaianum** (Guim.) Guim.
Plants to 0,2 cm tall. Nerve with 2-4 lamella from near leaf base to apex. Spores 30-60 μm . Grows isolated on clayey soils. Scattered in the Mediterranean region of the Peninsula and in Mallorca. Esp, Prt (Extinct), Bl.

- 2 Nerve excurrent in hyaline hair-point or yellowish long apiculus; capsule ovoid or cylindrical **3**

- 3 Lid cells in helicoidal rows; peristome usually rudimentary **P. lamellatum** (Lindb.) Jur.
Plants to 0,5 cm tall. Nerve excurrent in hyaline hair-point or yellowish apiculus, with 2-3 lamellae in the upper part, usually with branched filaments. Spores 10-20 μm . Grows on dry, exposed soils in the lowlands, in the eastern part of the Peninsula. Esp.

- 3 Lid cells in straight rows; peristome lacking (fig. 41, 21-25) **P. ovatum** (Hedw.) Dixon
Plants to 0,3 mm. Nerve excurrent in hyaline hair, smooth or slightly dentate, longer than leaf or more, rarely short; 2-4 lamellae from base to apex, sometimes transversely divided, occasionally with short filaments. Spores 25-35 μm . Forms cushions in exposed, calcareous soils in the lowlands, occasionally in montane areas. Mainly in the Mediterranean region of the Peninsula and in Mallorca and Pithyusic Islands. Esp, And, Bl.

Scopelophila (Mitt.) Lindb.

Plants small. Leaves long, lingulate or spatulate, apex rounded to acute, margin entire, plane, recurved at base; cells quadrate or hexagonal, smooth or finely papillose, 6-11 μm wide; nerve ending below apex or percurrent. Plants growing on mineral-rich substrata.

- 1 Leaf apex acute; nerve section with 1 layer of differentiated ventral cells (fig. 41, 29-30) **S. cataractae** (Mitt.) Broth.

Plants to 3 cm tall. Forms dense, dark green turfs on deep blue grey muds, rich in heavy metals. Rare in the north and in the south of the Peninsula. Esp.

- 1 Leaf apex obtuse or rounded; nerve section without differentiated ventral cells (fig. 41, 26-28)

S. ligulata (Spruce) Spruce

Plants to 1,5 cm tall, rhizoids with pluricellular gemmae. Leaves with several rows of thick-walled, marginal cells. Forms olive-green turfs on humid, iron-rich rocks and soils in montane areas, in the Central and Eastern Pyrenees. Esp, And.

Stegonia Venturi

Plants small, 0,2 mm tall, bulbiform. Leaves obovate, wide, very concave, imbricate, apex rounded or obtuse, obtuse, apiculate and denticulate, margin plane, entire; laminal cells rhomboidal and smooth; nerve thin, percurrent. Seta long; capsule cylindrical, straight; peristome teeth 16, irregularly cleft at apex and perforated; spores 40 µm, papillose, reddish brown (fig. 41, 31) **S. latifolia** (Schwägr.) Venturi ex Broth.

Forms small light green turfs on rocky and calcareous clearings of grasslands, in high mountains. Rare, in the Pyrenees and in the north of the Peninsula. Esp, And.

Syntrichia Brid.

Plants 0,2-10 cm tall. Leaves lingulate, spatulate or oblong-lanceolate, apex mostly obtuse; laminal cells quadrate or rounded, papillose, basal cells rectangular, hyaline, smooth, thin-walled, forming a distinct ovate group on both sides of nerve; nerve excurrent in arista, in smooth or denticulate hair-point, or in mucro or percurrent. Seta long; capsule cylindrical; peristome with 32 filamentous, spirally twisted teeth, basal membrane ± high.

- 1 Plants with axillary propagules or gemmae on leaves 2

- 1 Plants without axillary propagules or gemmae 5

- 2 Plants with foliose axillary propagules (fig. 42, 1-3) **S. laevipila** Brid.

S. pagorum (Milde) J.J.Amann

Plants to 2 cm tall. Leaves ovate, lingulate or spatulate, rounded or emarginate at apex, constricted at middle, margin narrowly recurved at middle, plane at base; marginal cells not differentiated or forming a border of 2-5 rows of slightly papillose and thick-walled cells, reaching the apex; nerve with several rows of stereids on dorsal side, excurrent in long, nearly smooth hair-point, brown at base. Propagules in dense groups in upper leaves, ovate or elliptical, papillose, with a hyaline apical cell. Peristome with high basal membrane, reticulate in helix, teeth spirally

twisted in 2-3 turns. Forms small to medium-sized, dense, brownish green turfs on bark of trees, in the lowlands and montane areas throughout the Peninsula and Mallorca. Esp, Prt, And, Bl.

2 Plants with globose gemmae on ventral side of leaf

3

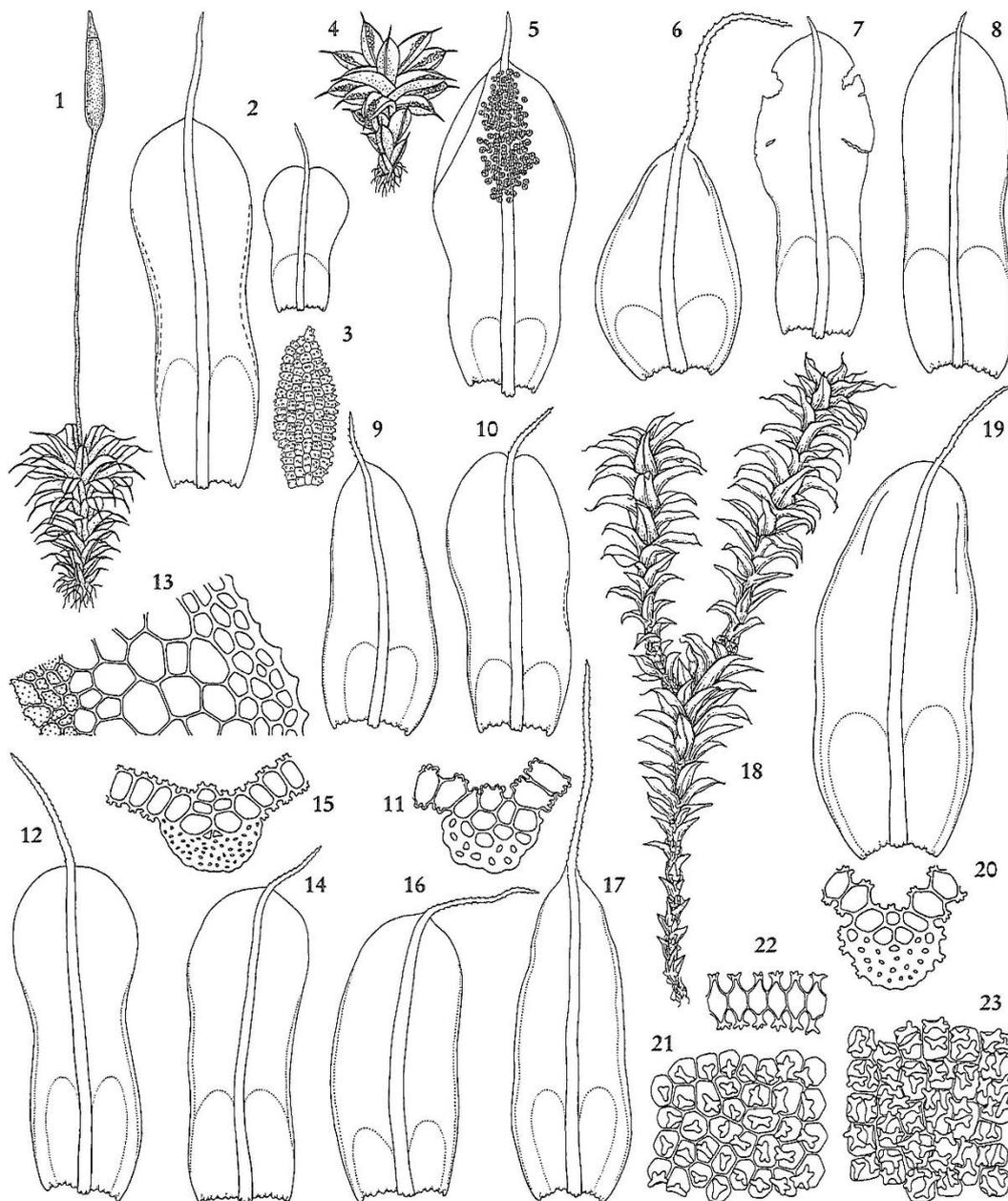


FIGURE 42. 1-3, *Syntrichia laevipila*: 1, habit; 2, leaves; 3, propagule. 4-5, *S. papillosa*: 4, habit; 5, leaf. 6, *S. caninervis* var. *caninervis*, leaf. 7, *S. fragilis*, leaf. 8, *S. sinensis*, leaf. 9, *S. norvegica*, leaf. 10-11, *S. virescens*: 10, leaf; 11, nerve section. 12, *S. montana* var. *montana*, leaf. 13-15, *S. princeps*: 13, stem section; 14, leaf; 15, nerve section. 16, *S. calcicola*, leaf. 17, *S. ruraliformis*, leaf. 18-20, *S. ruralis* var. *ruralis*: 18, habit; 19, leaf; 20, nerve section. 21-22, *S. papillosissima*: 21, median cells; 22, lamina section. 23, *S. subpapillosissima*, median cells. 18 (x2,5); 1, 4 (x4,5); 2, 5, 6, 7, 8, 9, 10, 12, 14, 16, 17, 19 (x16); 3 (x100); 11, 13, 15, 20, 22 (x200); 21, 23 (x300).

- 3 Nerve percurrent; gemmae on leaf lamina **S. latifolia** (Bruch ex Hartm.) Huebener
Tortula latifolia Bruch ex Hartm.
Plants small, about 1 cm tall. Leaves spatulate, constricted at middle, apex rounded or obtuse; cells with more than 4 papillae. Gemmae pluricellular. Mostly epiphytic, but also on rocks. Scattered in the Peninsula. Esp, Prt.
- 3 Nerve excurrent in hair-point; gemmae on nerve **4**
- 4 Laminal cells 1-2 simple papillae on the dorsal side (fig. 42, 4-5) **S. papillosa** (Wilson) Jur.
Tortula papillosa Wilson
Plants short, 0,2-1 cm tall. Leaves ovate-spathulate, constricted below middle, margin plane or incurved above; nerve broad, excurrent in smooth, hyaline hair-point; laminal cells with 1-2 papillae on dorsal side. Gemmae on younger leaves, irregularly globose, pluricellular. Forms dense, small turfs on bark of trees. Scattered in the lowlands and montane areas of greater part of the Peninsula. Esp, Prt, And.
- 4 Laminal cells 4-6 bifurcate papillae on both sides (fig. 42, 10-11) **S. virescens** (De Not.) Ochyra
Tortula virescens (De Not.) De Not.
Stem about 0,2-2,5 cm high. Leaves slightly twisted, oblong-spathulate, rounded or emarginate at apex, margin plane or slightly recurved to middle of leaf; nerve with 1-2 rows of stereids on dorsal side. Forms small turfs on stumps and rocks of the Mediterranean region. Esp, Prt, And.
- 5 Upper lamina totally or partially bistratose **6**
- 5 Upper lamina unistratose **7**
- 6 Leaves widely ovate or ovate-lingulate, with strongly recurved margin to apex; nerve strongly papillose at back **S. caninervis** Mitt.
Tortula caninervis (Mitt.) Broth.
Plants to 2 cm tall. Nerve excurrent in hyaline, strongly spinose hair-point, rarely in mucro, upper part strongly papillose at back, with high, usually more than 2,5 μ m, simple, bifurcate or branched papillae. Grows on dry, exposed, calcareous or gypsum soils, in arid areas of the southern, central and northeastern part of the Peninsula. Esp.
var. **caninervis**: Upper leaves regularly bistratose (fig. 42, 6).
var. **gypsophila** (J.J.Amann ex G.Roth) Ochyra: Upper leaves irregularly bistratose, middle leaves unistratose.
var. **abanchesii** (Luisier) R.H.Zander: Leaves mucronate, irregularly bistratose.
- 6 Leaves lingulate or lingulate-lanceolate, with narrowly recurved margin to 3/4 way up leaf; ; nerve slightly papillose at back **S. handelii** (Schiffn.) S. Agnew & Vondr.
Tortula handelii Schiffn.

Plants to 3 cm tall. Nerve excurrent in hyaline hair-point strongly spinose, cells with simple papillae on ventral side to 2,5 mm high. Grows on calcareous rocks. Very rare in the south of the Peninsula and in Mallorca. Esp, Bl.

7 Leaves fragile, mostly broken (fig. 42, 7) **S. fragilis** (Taylor) Ochyra

Tortula fragilis Taylor

Stem 0,5-3,5 cm high. Leaves spathulate, mucronate, margin plane above. It is distinguished from other close species by its fragile leaves, even the youngest ones. Forms cushions on shaded, siliceous rocks, in the montane areas of the Eastern Pyrenees. Esp, And.

7 Leaves mostly not broken **8**

8 Nerve excurrent in short hair-point or arista or in mucro **9**

8 Nerve excurrent in long hair-point **10**

9 Nerve excurrent in short hair-point or arista (fig. 42, 8) **S. sinensis** (Müll.Hal.) Ochyra

Plants 1-1,5 cm tall. Leaves lingulate, apex rounded, margin revolute to the middle, arista denticulate, reddish at base. Forms somewhat compact, glaucous cushions, reddish at base, on shaded, siliceous rocks, in the montane areas of the Eastern Pyrenees. Esp.

9 Nerve excurrent in mucro

S. montana Nees var. **calva** (Durieu & Sagot ex Bruch & Schimp.) J.J.Amann

Stem 1-2,5 cm high. Leaves spathulate or lingulate, constricted in the middle, margin recurved to 2/3 way up leaf; laminal cells 8-12 µm wide. Grows on rocks and soil of the southern part of the Peninsula. Esp.

10 Nerve excurrent in reddish brown hair-point (fig. 42, 9) **S. norvegica** F.Weber

Tortula norvegica (F.Weber) Lindb.

Plants large, to 6 cm tall. Leaves oblong, attenuate in reddish brown hair-point, sometimes hyaline at apex, margin recurved to 2/3-3/4 way up leaf. Forms lax, brownish cushions on calcareous rock ledges, in high mountain areas of the Pyrenees, Cantabrian Mountains and Sierra Nevada. Esp, And.

10 Nerve excurrent in hyaline hair-point **11**

11 Leaves constricted at middle **12**

11 Leaves not constricted at middle **16**

- 12 Nerve with 1-2 rows of stereids on dorsal side 13
- 12 Nerve with more than 2 rows of stereids on dorsal side 14
- 13 Laminal cells with 4-8 bifurcate, not pediculate papillae (fig. 42, 10-11) **S. virescens** (De Not.) Ochyra
Tortula virescens (De Not.) De Not.
 Stem about 0,2-2,5 cm high. Leaves slightly twisted, oblong-spathulate, rounded or emarginate at apex, margin plane or slightly recurved to middle of leaf. Forms small turfs on stumps and rocks of the Mediterranean region. Esp, Prt, And.
- 13 Laminal cells with one branched, stellate and pedicellate papilla
S. minor (Bizot) M.T.Gallego, J.Guerra, M.J.Cano, Ros & Sanchez-Moya
 Stem about 0,3-1 cm high. Leaves slightly twisted, oblong-spathulate, rounded or emarginate at apex, margin plane or slightly recurved to middle of leaf. Epiphyte. South of the Peninsula. Esp.
- 14 Hair-point smooth (fig. 42, 1-3) **S. laevipila** Brid.
Tortula pagorum (Milde) De Not.
 Plants to 2 cm tall. Leaves lingulate or spathulate, rounded or emarginate at apex, margin narrowly recurved at middle of leaf, plane at base, border of 2-5 rows of slightly papillose and thick-walled cells to apex or indistinct; nerve excurrent in long, nearly smooth hair-point, brownish at base, in section with several rows of stereids on dorsal side. Peristome with high basal membrane, reticulate in helix, teeth spirally twisted in 2-3 turns. Forms small, dense, brownish green turfs on bark of trees, in the lowlands and montane areas of the Peninsula and Mallorca. Esp, Prt, And, Bl.
- 14 Hair-point spinose 15
- 15 Plants dioicous; laminal cells less than 12 μm wide (fig. 42, 12) **S. montana** Nees var. **montana**
S. intermedia Brid.
 Stem 0,3-5 cm high, without central strand. Leaves patent or spreading, spathulate or lingulate, not squarrose, margin recurved to 2/3 way up leaf. Differs from *S. ruralis* in the leaf arrangement; from *S. calcicola* in the constriction at mid-leaf and the laminal cell size. Forms compact turfs on soils, exposed rocks and walls, mainly calcareous, in montane areas throughout the Peninsula and Mallorca. Esp, Prt, And, Bl.
- 15 Plants synoicous; laminal cells 12 μm wide or more (fig. 42, 13-15) **S. princeps** (De Not.) Mitt.
Tortula princeps De Not.
 Stem to 4 cm high, with central strand. Leaves lingulate or spathulate, margin slightly revolute to 3/4 way up leaf. Peristome with high basal membrane, teeth spirally twisted in 4 turns. Forms olive green or brownish turfs in humus-rich soils and on artificial walls and rocks. Scattered in the Peninsula and Mallorca. Esp, Prt, And, Bl.

- 16 Leaves patent, margin recurved to 2/3 way up; laminal cells more than 12 μm wide (fig. 42, 16)
S. calcicola J.J.Amann
Tortula calcicolens W.A.Kramer
 Stem 0,4-2,55 cm high. Leaves lingulate or spatulate; hyaline group of basal cells small, well differentiated. Forms dense, brownish turfs on calcareous soils and disintegrated rocks, mainly in montane areas and in the lowlands of the Mediterranean region of the Peninsula and Mallorca. Esp, Prt, And, Bl.
- 16 Leaves reflexed or squarrose, margin revolute from base to apex; laminal cells 12 μm wide or less **17**
- 17 Leaves gradually narrowed in acute or acuminate apex, tapering into hair-point; laminal cells with non-pedicellate papillae (fig. 42, 17)
S. ruraliformis (Besch.) Mans
S. ruralis var. **ruraliformis** (Besch.) Delogne, **Tortula ruraliformis** (Besch.) Grout
 Plants to 5 cm tall. Laminal cells with several, simple or bifurcate, non-pedicellate papillae. Distinguished from var. *ruralis* by its gradually acuminate leaves and by the hyaline margin at hair-point base. Forms extensive, brownish turfs on sandy soils, frequently in pine woods of montane areas. Widespread throughout the Peninsula, also in Mallorca. Esp, Prt, And, Bl.
- 17 Leaves with rounded or obtuse apex not tapering into hair-point; laminal cells with non- or pedicellate papillae **18**
- 18 Laminal cells with non-pedicellate papillae (fig. 42, 18-20)
S. ruralis (Hedw.) F.Weber & D.Mohr var. **ruralis**
Tortula ruralis (Hedw.) P.Gaertn., B.Mey. & Scherb.
 Plants to 5 cm tall. Leaves widely lingulate, recurved to near apex; laminal cells with several, simple or bifurcate papillae; laminal cells pluripapillose. Peristome with high basal membrane, teeth spirally twisted in 2 turns. Forms lax, brownish red cushions on rock ledges, walls and at tree bases, from the lowlands to the high mountains. Common throughout the Peninsula and Mallorca. Esp, Prt, And, Bl.
- 18 Laminal cells with pedicellate papillae **19**
- 19 Laminal cells unipapillose, papillae star-shaped, branched at apex (fig. 42, 21-22)
S. papillosissima (Copp.) Loeske
 Plants to 5(-8) cm tall. Leaves recurved to near apex, hair-point spinose. Grows on calcareous soils and rock ledges and artificial walls, in the central and southern part of the Peninsula. Esp, Prt.

19 Laminal cells pluripapillose, papillae bifurcate (fig. 42, 23)

S. subpapillosissima (Bizot & R.B.Pierrot ex W.A.Kramer) M.T.Gallego & J.Guerra

Plants to 5(-9) cm tall. Leaves recurved to near apex. Grows on soils and rocks, rarely epiphytic. Scattered throughout Mediterranean region of the Peninsula. Esp, Prt, And.

Timmiella (De Not.) Limpr.

Plants 0,5-2 cm tall. Stem simple or bifurcate. Leaves erecto-patent, oblong-lanceolate, crisped when dry, apex acute, margin incurved, dentate in the upper part; lamina bistratose, median cells quadrate, mamilllose, basal cells smooth, translucent; nerve percurrent. Capsule cylindrical, straight or curved, annulus large, revoluble, peeling off during the dehiscence or annulus lacking; peristome of 16 teeth divided to near base, teeth straight or twisted.

1 Plants paroicous; capsule without annulus (fig. 43, 1-2)

T. barbuloides (Brid.) Mönk.

Plants to 2 cm tall, isolated or forming loose turfs on wet, calcareous slopes and soils. Widespread in the lowlands, near coastal areas in the east, south and west of the Peninsula and in Mallorca, Menorca and Pithyusic Islands, rare inland. Esp, Prt, Bl.

1 Plants autoicous or dioicous; capsule with annulus

2

2 Plants dioicous; seta flexuose; peristome teeth straight

T. flexiseta (Bruch) Limpr.

Plants to 4-6 mm tall. Capsule with large, revoluble annulus. Grows on wet soils. Very rare, in the southwest of the Peninsula. Esp, Prt.

2 Plants autoicous; seta straight; peristome teeth twisted (fig. 43, 3)

T. anomala (Bruch & Schimp.) Limpr.

Plants to 2 cm tall. Capsule with large, revoluble annulus. Grows on exposed, acidic soils. Very rare, in the south and east of the Peninsula. Esp.

Tortella (Müll.Hal.) Limpr.

Stem 0,2-5 cm high. Leaves lanceolate to linear-lanceolate, crisped or curved when dry, margin plane or incurved at apex; lamina usually unistratose, laminal cells quadrate, papillose, basal cells smooth, hyaline, ascending up margin, usually the transition to papillose cells is abrupt and in a v-shape; nerve percurrent or excurrent in apiculus. Capsule cylindrical, straight or slightly inclined; peristome teeth 32, filiform, papillose, spirally twisted.

1 Cells on ventral surface of nerve elongate and smooth throughout the leaf length, clearly differentiated from the laminal cells 2

1 Cells on ventral surface of nerve quadrate and papillose, not differentiated from laminal cells 3

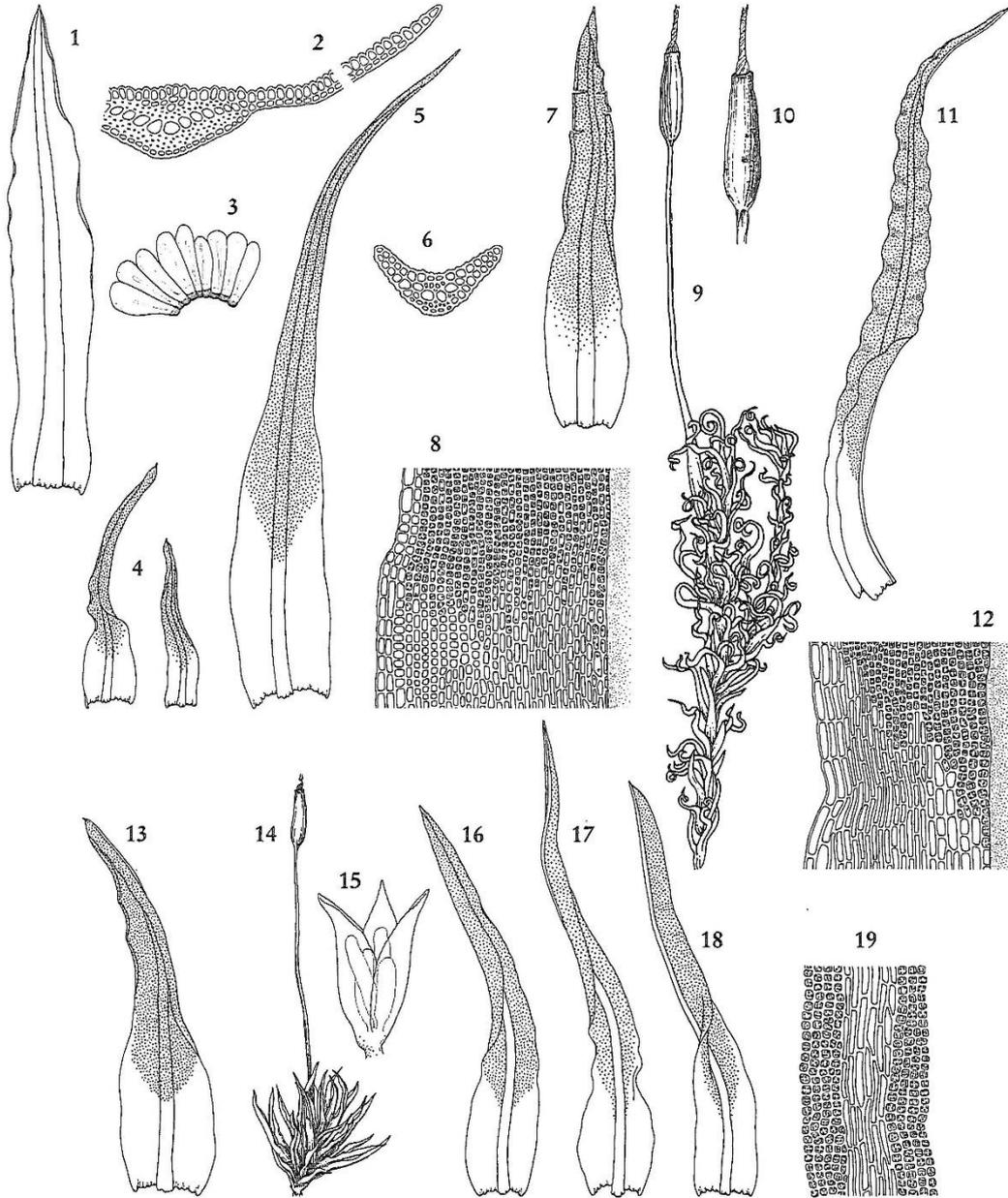


FIGURE 43. 1-2, *Timmiella barbulooides*: 1, leaf; 2, leaf section. 3, *T. anomala*, annulus. 4, *Tortella inflexa*, leaves. 5-6, *T. fragilis*: 5, leaf; 6, leaf section at apex. 7-8, *T. nitida*: 7, leaf; 8, basal cells. 9-12, *T. tortuosa* var. *tortuosa*: 9, habit when dry; 10, capsule; 11, leaf; 12, basal cells. 13, *T. flavovirens* var. *flavovirens*, leaf. 14-16, *T. humilis*: 14, habit; 15, perigonium; 16, leaf. 17, *T. densa*, leaf. 18-19, *T. inclinata*: 18, leaf; 19, nerve on ventral side. 9, 14 (x3,5); 10 (x7); 1, 4, 5, 7, 11, 13, 16, 17, 18 (x16); 15 (x40); 6, 8, 12, 19 (x110); 2, 3 (x140).

- 2 Plants growing in loose tufts; stem tomentose; laminal cells with papillae less than 5 μm high (fig. 43, 18-19) **T. inclinata** (R.Hedw.) Limpr.
Stem tomentose, often with small propaguliferous branches near apex, without central strand. Nerve excurrent. Capsule erect or slightly inclined. Forms dense turfs, 1-2 cm high, on sandy, calcareous soils and rock ledges. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.
Similar to *T. flavovirens*, but distinguished by the elongated ventral cells of the nerve.
- 2 Plants growing in dense tufts; stems scarcely tomentose; laminal cells with papillae 5-6 mm high (fig. 43, 17) **T. densa** (Lorentz & Molendo) Crundw. & Nyholm
Stem without central strand. Rhizoids few or lacking. Nerve percurrent or excurrent. Forms compact turfs, 2-3 cm high, on calcareous rocks in montane areas and high mountains, in the north of the Peninsula. Esp.
- 3 Autoicous, nearly always fruiting or at least with small lateral perigonia below the perichaetia; leaves with plane margins; leaf apex acute (fig. 43, 14-16) **T. humilis** (Hedw.) Jenn.
Plants ramose, stem 0,5-1 cm high, with tomentum. Leaf margin plane. Antheridia in small axillary branches. Seta yellow. Forms loose, light green turfs on humus-rich calcareous soils in pinewoods and evergreen oak forests. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 3 Dioicous, seldom fruiting, perigonia terminal; leaves with plane or incurved margins; leaf apex obtuse, acute, or longly acuminate, sometimes cucullate **4**
- 4 Leaves lingulate-lanceolate or oblong-lanceolate, with broadly acute to obtuse apex **5**
- 4 Leaves lanceolate, with narrowly acute or acuminate apex **8**
- 5 Transition between hyaline cells and chlorophyllose cells gradual; leaf apex fragile, not cucullate (fig. 43, 7-8) **T. nitida** (Lindb.) Broth.
Lamina very fragile, often erose near apex. Forms dense turfs, 1 cm high, on dry, exposed, calcareous rocks, in the lowlands of the eastern Mediterranean region and in Mallorca, Menorca and Pithyusic Island, rarer in montane areas and in the north and west of the Peninsula. Esp, Prt, And, Bl.
- 5 Transition between hyaline cells and chlorophyllose cells abrupt; leaf apex not fragile, often cucullate **6**
- 6 Upper and medial laminal more than 10 μm wide
T. flavovirens (Bruch) Broth. var. **glareicola** (T.A.Chr.) Crundw. & Nyholm
Grows on sandy soils. Scattered in the east and western part of the Peninsula. Esp, Prt.
- 6 Upper and medial laminal cells to 10 μm wide **7**

- 7 Papillae of upper and mid laminal cells to 6 mm high (fig. 43, 13)
T. flavovirens (Bruch) Broth. var. **flavovirens**
 Laminal cells having low papillae. Grows on sandy soils. It is the commonest species on coastal dunes and inland saline sandy grounds. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 7 Papillae of upper and mid laminal cells 6-9 mm high
T. flavovirens (Bruch) Broth. var. **papillosissima** Sérgio & Casas
 Laminal cells having high papillae Grows on stony soils in the east and southeast of the Peninsula. Esp.
- 8 Transition between hyaline cells and chlorophyllose cells abrupt **9**
- 8 Transition between hyaline cells and chlorophyllose cells gradual **13**
- 9 Leaf apex cylindrical, caducous, with constrictions, entirely papillose; upper leaf cells 10-14 mm wide
T. alpicola Dixon
 Leaves curled, contorted, occasionally crisped when dry. Forms dense or loose turfs to 1,5 cm tall. Grows on rocks. Rare, in Sierra Nevada. Esp.
- 9 Leaf apex plane, caducous or not, without constrictions, papillose or not; upper leaf cells 6-12 mm wide
10
- 10 Leaves erect-flexuose when dry; rigid, straight or slightly curved; margins plane or scarcely undulate; leaf apex caducous (fig. 43, 5-6)
T. fragilis (Hook. & Wilson) Limpr.
 Leaves rigid, straight or slightly curved when dry. Forms dense turfs, to 2 cm high, on damp, acidic rocks and soils and bases of stumps in high mountain areas of the Pyrenees and Sierra Nevada. Esp.
- 10 Leaves spirally twisted when dry; margins undulated; leaf apex caducous or not **11**
- 11 Leaf apex fragile; dorsal side of costa in the distal third covered by papillose cells; stems with central strand
T. fasciculata (Culm.) Culm.
 Grows on sandstones and at tree bases in Mediterranean woodlands. Scattered in the eastern half of the Peninsula. Esp.

11 Leaf apex fragile or not; dorsal side of costa in the distal third covered by smooth or scarcely papillose cells; stems usually without central strand 12

12 Leaf apex not fragile; margins usually strongly undulate; lamina unistratose; nerve with a ventral stereid band (fig. 43, 9-12) **T. tortuosa** (Hedw.) Limpr. var. **tortuosa**

Leaves with nerve excurrent in apiculus. Forms light green cushions, 1-5 cm high, on calcareous rocks and soils. Grows in calcareous rock crevices. Widespread in the lowlands and montane areas throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

12 Leaf apex fragile, usually broken and lost; margins weakly undulate; lamina sometimes irregularly bistratose; costa with or without a ventral stereid band

T. tortuosa (Hedw.) Limpr. var. **fragilifolia** (Jur.) Limpr.

Leaves truncate at tips, upper part circinate when dry, slightly undulate, unistratose with bistratose patches besides nerve. Widespread in the lowlands and montane areas throughout the Peninsula. Esp.

13 Stem with central strand; leaves longly acuminate, sometimes cucullate: marginal cells not differentiated (fig. 43, 4) **T. inflexa** (Bruch) Broth.

Leaves linear-lanceolate, strongly curled when dry, upper leaves with inflexed, incurved apex; transition to papillose cells gradual. Forms loose turfs on calcareous rocks in areas near sea-coast, in the east, south and southeast of the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

13 Stem without central strand; leaves shortly acuminate; marginal cells partially long: marginal cells differentiated **T. mediterranea** Kückinger, Lüth, O.Werner & Ros

On shaded limestone rocks. Very rare, in Mallorca. Bl.

Tortula Hedw.

Plants small, 0,2-3 cm tall. Leaves obovate, elliptical, ovate, lanceolate, lingulate or spathulate; laminal cells quadrate, rounded, hexagonal or rhomboidal, papillose, occasionally smooth, basal cells rectangular, thin-walled, hyaline, not forming a distinct group; nerve ending near apex, percurrent or excurrent in a mucro, in hyaline hair-point or in arista. Capsule cylindrical or ovoid, smooth; peristome short or long, teeth filiform, straight, curved or spirally twisted, basal membrane variable in length, low not projecting above mouth to very high.

1 Nerve ending below apex, percurrent or excurrent in mucro 2

- 1 Nerve excurrent in hyaline hair-point or in arista 8
- 2 Leaves bordered 3
- 2 Leaves not distinctly bordered 4
- 3 Laminal cells smooth or slightly papillose; border of 4-8 rows of rectangular or linear, pale, thick-walled, smooth cells, not reaching the apex (fig. 44, 1-3) **T. freibergii** Dixon & Loeske
Plants to 0,5 cm tall. Leaves obovate to spatulate, apex rounded to obtuse, mostly apiculate; nerve ending below apex or percurrent. Peristome with low basal membrane, hardly projecting above mouth, teeth spirally twisted. Grows on calcareous rocks and walls. Scattered in the Peninsula and Menorca. Esp, Prt, Bl.
- 3 Laminal cells strongly papillose; border of 3-4 rows of smooth or slightly papillose, quadrate or rectangular, pale, thick-walled cells, reaching the apex (fig. 44, 4-5) **T. solmsii** (Schimp.) Limpr.
Plants small, less than 0,5 cm tall. Leaves lingulate or spatulate. Peristome with low basal membrane, hardly projecting above capsule mouth, teeth spirally twisted. Grows on calcareous rocks and walls, near streams. Very rare, in northwestern part of the Peninsula. Esp, Prt.
- 4 Leaves lingulate 5
- 4 Leaves oblong-lanceolate, obovate, ovate or elliptical 6
- 5 Upper cells of leaf 7-10 x 5-7,5 µm; plants rare, dioicous; basal membrane of peristome low **T. bolanderi** (Lesq. & James) M.Howe
Plants 0,5-0,7 cm tall, irregularly crisped when dry. Leaves with rounded apices, occasionally acute. Forms loose turfs on acidic soils in Sierra Nevada. Esp, Prt.
- 5 Upper cells of leaf 12,5-15 x 10-12,5 µm; plants common, monoicous; basal membrane of peristome high (fig. 44, 6) **T. inermis** (Brid.) Mont.
Plants to 2 cm tall. Leaf apex rounded to acute. Peristome teeth spirally twisted. Forms compact turfs on dry, exposed, rocky soils and in rock crevices, in calcareous, montane areas of the Peninsula and Mallorca. Esp, Prt, And, Bl.
- 6 Leaf margin recurved from base to 1/2-1/3 (fig. 44, 7-9) **T. hoppeana** (Schultz) Ochyra
Desmatodon latifolius (Hedw.) Brid.
Plants to 2 cm tall. Leaves oblong-lanceolate, acute or obtuse; laminal cells quadrate or rounded, papillose, basal cells larger, hyaline. Capsule ovoid to cylindrical; peristome with very short basal membrane, teeth straight, filiform, irregularly divided, perforated. Forms dense turfs in grasslands on acidic substrata in high mountains. Esp, And.

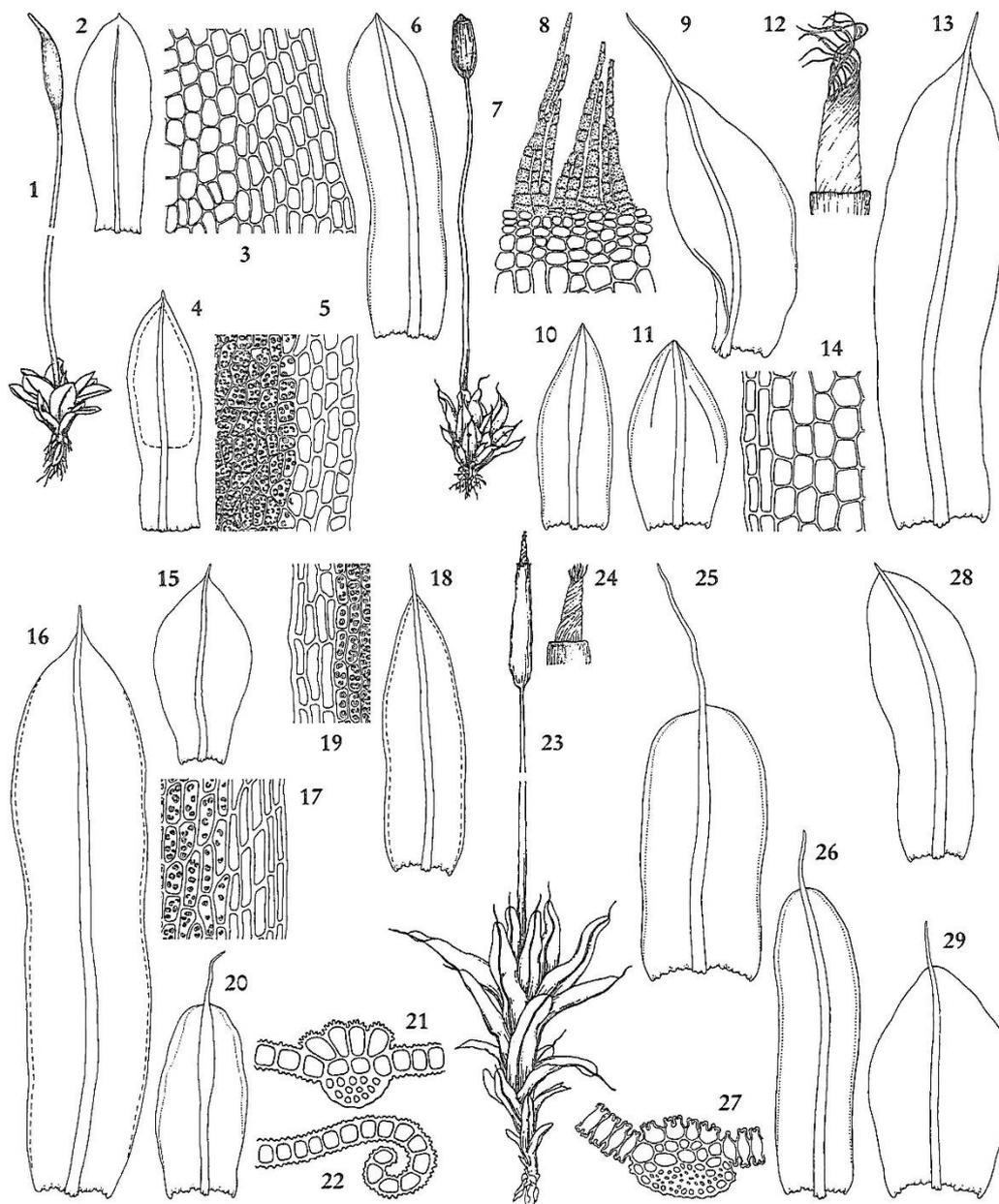


FIGURE 44. 1-3, *Tortula freibergii*: 1, habit; 2, leaf; 3, marginal cells. 4-5, *T. solmsii*: 4, leaf; 5, marginal cells. 6, *T. inermis*, leaf. 7-9, *T. hoppeana*: 7, habit; 8, peristome; 9, leaf. 10, *T. atrovirens*, leaf. 11, *T. revolvens*, leaf. 12-14, *T. mucronifolia*: 12, peristome; 13, leaf; 14, marginal cells. 15, *T. cuneifolia*, leaf. 16-17, *T. subulata*: 16, leaf; 17, marginal cells. 18-19, *T. marginata*: 18, leaf; 19, marginal cells. 20-22, *T. brevissima*: 20, leaf; 21, nerve section; 22, leaf margin section. 23-25, *T. muralis*: 23, habit; 24, peristome; 25, leaf. 26-27, *T. israelis*: 26, leaf; 27, nerve section. 28, *T. vahliana*, leaf. 29, *T. canescens*, leaf. 1, 7, 23 (x5,5); 2, 4, 6, 9, 10, 11, 12, 13, 15, 16, 18, 20, 24, 25, 26, 28, 29 (x16); 8 (x100); 3, 5, 14, 17, 19, 21, 22, 27 (x180).

7 Leaves oblong-lanceolate or obovate, concave (fig. 44, 10)

***T. atrovirens* (Sm.) Lindb.**

Plans small, about 0,5 cm tall. Leaves spirally twisted around stem when dry. Nerve widened in the upper part.

Peristome with short basal membrane, teeth irregularly divided, oblique or curved a half turn. Forms short, compact,

dark green to brownish turfs, on soils, walls and exposed rocks. Scattered in the lowlands of the whole Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 7 Leaves ovate or elliptical, strongly concave (fig. 44, 11) **T. revolvens** (Schimp.) G.Roth
Plants small, 0,5-1 cm tall. Leaves straight to spirally twisted around stem or appressed when dry, apex rounded to acute; nerve ending below apex, percurrent or excurrent in mucro, mostly widened in the upper part. Peristome teeth entire, spirally twisted to 1 turn. Forms compact turfs on calcareous, clayey soils and rocks in arid lowland areas. Scattered in the Peninsula and Pithyusic Islands. Esp, Bl.
- 8 Laminal cells smooth or nearly so **9**
- 8 Laminal cells papillose **10**
- 9 Leaves lingulate or spatulate, elongated; basal membrane of peristome high, longly projecting above capsule mouth (fig. 44, 12-14) **T. mucronifolia** Schwäger.
Plants to 1 cm tall or a little more. Leaf apex acute, border of narrow cells, not very distinct, margin recurved to 1/2-2/3 way up leaf; nerve excurrent in arista. Peristome teeth spirally twisted. Similar to *T. subulata*, but with larger laminal cells, 18-28 µm, smooth or slightly papillose. Forms turfs on soils and in rock crevices, chiefly calcareous, in Pyrenees montane areas. Esp, And.
- 9 Leaves obovate, short; basal membrane of peristome low, hardly projecting above capsule mouth (fig. 44, 15) **T. cuneifolia** (Dicks.) Turner
Stem to 1 cm high. Leaves curved when dry, concave, with narrow base; nerve excurrent in yellowish arista or hyaline hair-point. Peristome teeth spirally twisted. Isolated or forming loose turfs in glades in forests and on acidic slopes, in the lowlands and montane areas of the Peninsula and Menorca. Esp, Prt, Bl.
- 10 Leaves bordered **11**
- 10 Leaves not distinctly bordered **14**
- 11 Border of 3-4 rows of quadrate or rectangular cells (fig. 44, 4-5) **T. solmsii** (Schimp.) Limpr.
Plants small, less than 0,5 cm tall. Leaves lingulate or spatulate, margin plane; marginal cells smooth or slightly papillose, thick-walled, forming a border to apex. Peristome with low basal membrane, hardly projecting above capsule mouth, teeth spirally twisted. Grows on calcareous rocks and walls, near streams. Very rare, in the northwestern part of the Peninsula. Esp, Prt.
- 11 Border of 1-4 rows of narrow elongated cells **12**

- 12 Leaf margin bistratose **T. schimperi** M.J.Cano, Werner & J.Guerra
 Plants 0,5-1 cm tall. Leaves linear-lanceolate, acuminate, with a border of linear cells to near apex; margin irregularly denticulate in the upper part; laminal cells 13-20 µm, papillose; nerve excurrent in apiculus or in short arista. Peristome teeth spirally twisted. Grows on slopes and at bases of rocks and trees, in the north and northeast of the Peninsula. Esp, And.
- 12 Leaf margin unistratose **13**
- 13 Plants 1-3 cm tall; basal membrane very high, longly projecting above capsule mouth (fig. 44, 16-17)
T. subulata Hedw.
 Leaves oblong or ligulate, gradually acuminate, with distinct border; laminal cells 13-20 µm long, mostly very papillose; nerve excurrent in short or elongated arista. Peristome teeth spirally twisted in 2-3 turns. A very variable species in stem and arista length, leaf form, papillae and border length. Forms dense turfs on slopes and rock ledges in high mountains and montane areas of the Peninsula, Mallorca and Menorca. Esp, Prt, And, Bl.
- 13 Plants 0,2-0,4 cm tall; basal membrane low, hardly projecting above mouth of capsule (fig. 44, 18-19)
T. marginata (Bruch & Schimp.) Spruce
Desmatodon meridionalis Luisier
 Leaves lanceolate to lingulate, border to apex, of 2-4 rows of narrow, pale, thick-walled marginal cells; nerve excurrent in hyaline hair-point or in arista. Peristome teeth divided to base, spirally twisted. Grows on shady, calcareous walls and rocks of the lowlands in the Peninsula, Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 14 Nerve widened above, with high, papillose cells on ventral side (fig. 44, 20-22) **T. brevissima** Schiffn.
 Stem 0,2-0,5 cm high, often earth covered in such a way that only the leaf hair-points protrude. Leaves ovate, strongly concave, margin strongly revolute above; laminal cells very papillose. Peristome with low basal membrane, teeth filiform, twisted. Forms small turfs on ledges and bare patches on very arid, calcareous, rich-clay soils of the Peninsula. Esp, Prt.
- 14 Nerve not widened above, without high papillose cells on ventral side **15**
- 15 Leaf margin recurved from base to apex **16**
- 15 Leaf margin plane at apex **17**
- 16 Laminal cells with low papillae; very common species (fig. 44, 23-25) **T. muralis** Hedw.
 Plants small, rarely more than 1 cm tall. Leaves twisted when dry, lingulate or lingulate-spathulate, apex obtuse or rounded, often emarginate; marginal cells less papillose than the rest of laminal cells, yellowish, forming a border of

1-2 rows of cells; nerve excurrent in smooth, long hyaline hair-point. Peristome teeth spirally twisted in 2-3 turns, basal membrane low. Species very polymorphic: based on lamina form, hair-point length and plant size, different varieties have been described. Forms small, greyish cushions on calcareous rocks and walls, in the lowlands and montane areas of the Peninsula, Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 16 Laminal cells with high, conical papillae; uncommon species (fig. 44, 26-27)

T. israelis Bizot & F.Bilewsky

T. muralis Hedw. var. **baetica** Casas & R.Oliva

Similar to *T. muralis* in habit. Upper cells of nerve with conical, very high papillae on ventral side. Forms glaucous cushions on calcareous rocks and walls in the lowlands of the Mediterranean region. Esp, Prt.

- 17 Peristome teeth long, spirally twisted

18

- 17 Peristome teeth short, straight or slightly curved

19

- 18 Capsule longly cylindrical; peristome with low basal membrane, hardly projecting above capsule mouth (fig. 44, 28)

T. vahliana (Schultz) Mont.

Plants to 0,7 cm tall. Leaves twisted when dry, narrow, spatulate or lingulate, margin plane or slightly recurved to the middle; marginal cells less papillose than the rest of laminal cells, forming a slightly distinct border; nerve excurrent in short, yellowish arista. Peristome teeth divided nearly to base, spirally twisted. Forms small turfs on dry, calcareous soils, in the lowlands of the Peninsula and Mallorca and Pithyusic Islands. Esp, Prt, Bl.

- 18 Capsule shortly cylindrical; peristome with high basal membrane, longly projected above capsule mouth (fig. 44, 29)

T. canescens Mont.

Plants 0,2-0,5 cm tall. Leaves broad, elliptical-lanceolate or ovate-lanceolate, margin slightly recurved, frequently plane above; nerve excurrent in long hyaline hair-point; laminal cells 10-18 µm wide. Peristome teeth spirally twisted. Similar to *T. muralis* but with shorter and broader leaves and less recurved margin. Forms small turfs on exposed, clayey ledges in the lowlands and montane areas of the Peninsula. Esp, Prt, And.

- 19 Lid cells in straight rows; high mountain plants (fig. 44, 7-9)

T. hoppeana (Schultz) Ochyra

Desmatodon latifolius (Hedw.) Brid.

Plants to 2 cm tall. Leaves oblong-lanceolate, acute or obtuse; laminal cells quadrate or rounded, papillose, basal cells larger, hyaline; nerve percurrent or excurrent in smooth, long hyaline hair-point. Capsule ovoid to cylindrical; peristome with very short basal membrane, teeth straight, filiform, irregularly divided, perforated. Forms dense turfs in grasslands of acidic, high mountain areas of the Peninsula. Esp, And.

- 19 Lid cells in helicoidal rows; lowland plants

T. guepinii (Bruch & Schimp.) Broth.

Desmatodon guepinii Bruch & Schimp.

Plants to 0,5 cm tall. Leaves oblong or oblong-lanceolate; nerve excurrent in hair-point. Capsule ovoid-cylindrical; peristome teeth slightly spirally twisted, basal membrane low, hardly projecting above mouth of capsule. Grows on exposed, acidic soils of the south and central part of Peninsula. Esp, Prt.

Trichostomum Bruch

Plants 0,5-2 cm tall. Leaves erecto-patent, linear-lanceolate to lingulate, acute or obtuse, crisped when dry, margin plane or incurved, entire or crenulate; median cells rounded or hexagonal, papillose, obscure, basal cells rectangular, hyaline; nerve stout, excurrent in mucro or in apiculus or percurrent, with quadrate or rounded on ventral side and dorsal and ventral stereid bands. Seta yellow; capsule ellipsoidal or cylindrical, straight; lid rostrate; peristome teeth straight, irregularly divided, perforated or entire.

- 1 Leaves cucullate (fig. 45, 3-4) **T. crispulum** Bruch
Laminal cells 6-9 μm wide; nerve excurrent in mucro or ending near apex. Seta reddish at base; spores 12-17 μm . Forms compact, yellowish green turfs on exposed, calcareous soils and rocks in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 1 Leaves not cucullate (fig. 20, 5-8) **2**

- 2 Leaf margin entire; leaves neither fragile, nor sinuose, nor undulate; nerve excurrent in stout apiculus **T. brachydontium** Bruch

Leaf margin plane; laminal cells 8-10 μm wide. Seta yellowish; spores 15-20 μm . Forms compact, light green turfs, brownish below, on dry rocks and soils. Widespread in the lowlands and montane areas throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

Species very polymorphic in width and length of leaves and shape of peristome.

var. **brachydontium**: Leaves not cuspidate, margin entire (fig. 45, 5-8).

var. **littorale** (Mitt.) C.O.E.Jensen: Leaves with denticulate margin at base. Quite frequent.

var. **cuspidatum** (Braithw.) Sav.: Leaves cuspidate.

- 2 Leaf margin crenulate and notched; leaves fragile, sinuose and undulate; nerve mostly percurrent (fig. 45, 9-10) **T. tenuirostre** (Hook. & Taylor) Lindb.

* **Chionoloma tenuirostre** (Hook. & Taylor) M. Alonso, M.J.Cano & J.A.Jiménez, **Oxystegus tenuirostris** (Hook. & Taylor) A.J.E.Sm.

Leaves linear-lanceolate, curled when dry, margin plane; laminal cells quadrate or rounded, 8-10 μm , papillose, basal cells rectangular, smooth, apical cells translucent; nerve with long ventral cells in the upper half. Vegetative propagation frequent, by means of leaf apex fragmentation. Capsule cylindrical, straight; peristome teeth red,

irregularly perforated or divided, basal membrane lacking. Forms loose turfs, light green above, on wet rocks and soils in montane areas. Scattered in the Peninsula and Mallorca. Esp, Prt, And, Bl.

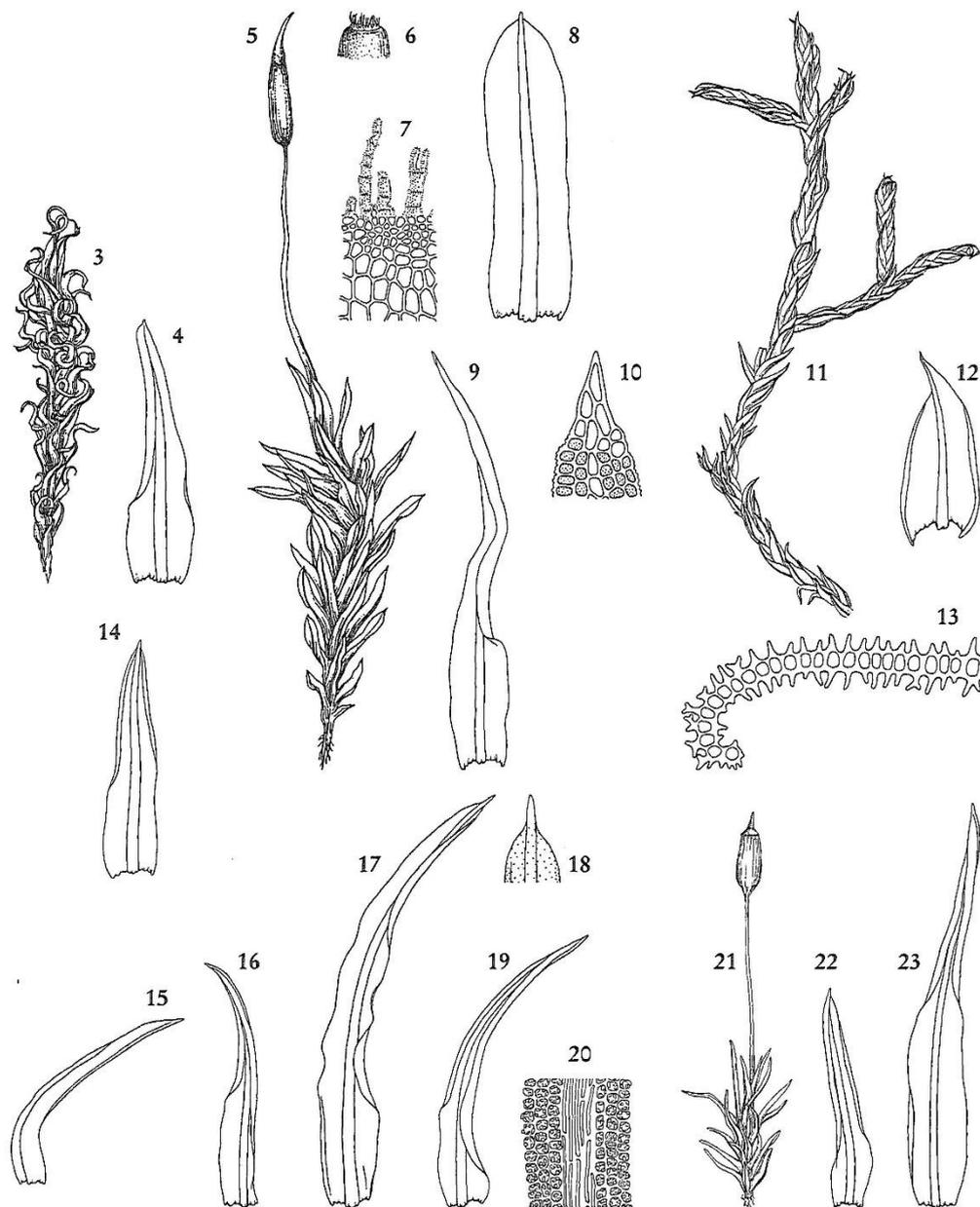


FIGURE 45. 3-4, *T. crispulum*: 3, habit when dry; 4, leaf. 5-8, *T. brachydontium* var. *brachydontium*: 5, habit; 6, upper part of capsule; 7, peristome; 8, leaf. 9-10, *T. tenuirostre*: 9, leaf; 10, leaf apex. 11-13, *Triquetrella arapilensis*: 11, habit when dry; 12, leaf on dorsal side; 13, leaf margin section. 14, *Weissia condensata* var. *condensata*, leaf. 15, *W. squarrosa*, leaf. 16, *W. brachycarpa*, leaf. 17-18, *W. rutilans*: 17, perichaetial leaf; 18, leaf apex. 19-20, *W. perssonii*: 19, leaf; 20, median cells. 21-23, *W. controversa* var. *controversa*: 21, habit; 22, leaf; 23, perichaetial leaf. 1, 3, 5, 11, 21 (x6); 2, 4, 6, 8, 9, 12, 14, 15, 16, 17, 19, 22, 23 (x18); 18 (x60); 7 (x100); 10, 13, 20 (x200).

Triquetrella Müll.Hal.

Plants 2-4 cm tall, with thin, yellowish green branches. Stem leaves closely arranged, tristichous, erecto-patent, appressed when dry, ovate-lanceolate, acuminate, acumen keeled, margin entire, revolute; median cells rounded polygonal, 6-8 μm wide, with 1 papilla on each side of cell to 12 μm high, simple or forked; nerve evanescent. Axillary, easily detached propaguliferous buds present (fig. 45, 11-13) **T. arapilensis** Luisier

Forms loose patches on dry sandy soils among acidic rocks. Common in the western half of the Peninsula, rarer in the central part. Esp, Prt.

Weissia Hedw.

Plants small. Leaves lanceolate to linear, crisped when dry, margin entire, incurved or plane; upper cells of lamina isodiametric, small, papillose, basal cells rectangular, hyaline; nerve excurrent. Seta long; capsule ovoid to cylindrical; lid rostrate; peristome with 16 short, straight, usually perforated teeth, or rudimentary or lacking, when peristome lacking often epiphragm present.

1 Peristome lacking 2

1 Peristome more or less well developed or rudimentary 4

2 Nerve to 60 μm wide near base (fig. 45, 16) **W. brachycarpa** (Nees & Hornsch.) Jur.
Plants to 1,5 cm tall. Leaves erecto-patent, margin often incurved. Perichaetial and upper leaves much longer than lower leaves. Seta variable in length; capsule ovoid to cylindrical, mouth covered by a membrane; spores more than 18 μm . Grows on dry, calcareous soils from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

2 Nerve more than 60 μm wide near base 3

3 Leaves erecto to erecto-patent, with incurved to involute margins in upper part

W. condensa (Voit) Lindb.

var. **condensa**: Plants to 1,5 cm tall. Leaf margin strongly incurved; upper cells of lamina with papillae to 5 μm high; nerve glossy at back. Autoicous. Spores up to 18 μm . Forms dense turfs on dry, calcareous soils in the lowlands, in the eastern half and the south of the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl (fig. 45, 14).

var. **armata** (Thér. & Trab.) M.J.Cano, Ros & J.Guerra (*W. papillosissima* Laz.): Plants to 0,5 cm tall. Leaves patent, margin slightly incurved; upper cells of lamina with papillae 8-10 μm high. Grows on arid, calcareous, often gypsum soils, mainly on coastal areas in the east and south of the Peninsula, rare inland and in Mallorca. Esp, Prt, Bl.

- 3 Leaves spreading to squarrose; leaf margin plane or partially and narrowly incurved in the upper part (fig. 45, 15) **W. squarrosa** (Nees & Hornsch.) Müll.Hal.
Plants about 0,5 cm tall, with the old part prostrate, with innovations from below perichaetium. Autoicous. Perichaetial leaves longer than stem leaves. Capsule cylindrical, with fragile walls, mouth covered by a membrane; spores more than 18 µm. Grows on exposed, acidic soils. Very rare, in the northeastern part of the Peninsula and in Menorca. Esp, Bl.
- 4 Margin plane; peristome rudimentary (fig. 45, 17-18) **W. rutilans** (Hedw.) Lindb.
Plants to 1 cm tall. Leaves erecto-patent, lanceolate; nerve stout, excurrent in long apiculus. Autoicous. Perichaetial leaves linear, longer than stem leaves. Seta yellow; capsule slightly striate; peristome teeth fugaceous, to 60 µm long, often caducous. Grows on wet, shady soils in the lowlands and montane areas. Scattered in the northern half of the Peninsula and in Menorca. Esp, Bl.
- 4 Margin strongly incurved; peristome more or less well developed **5**
- 5 Ventral cells of nerve elongated and smooth from base to apex (fig. 45, 19-20) **W. perssonii** Kindb.
Plants to 0,5 cm tall. Autoicous. Capsule ovoid to ellipsoidal, constricted at mouth; peristome teeth short, 20-50 µm long. Rare, near coast in the northwest of the Peninsula. Esp.
May be confused with *W. controversa*, which can have some elongated cells on ventral side of nerve, but in *W. perssonii* all cells on ventral side of nerve are elongated.
- 5 Ventral cells of nerve usually quadrate and papillose in the upper part **6**
- 6 Plants autoicous **W. controversa** Hedw.
Plants to 1 cm tall. Leaves patent to spreading, narrowly lanceolate or linear. Autoicous. Perichaetial leaves longer and narrower than stem leaves. Peristome teeth 100-120 µm long Grows on wet, ± shaded soils and in usually acidic rock crevices from the lowlands to montane areas. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.
var. **controversa**: Leaves with nerve 30-60 µm wide at base, greenish. Peristome well developed (fig. 45, 21-23).
var. **crispata** (Nees & Hornsch.) Nyholm: Leaves with nerve more than 60 µm wide at base, brownish. Peristome rudimentary.
- 6 Plants paroicous **W. wimmeriana** (Sendtn.) Bruch & Schimp.
Plants to 0,5 cm tall. Leaves patent, lanceolate, subulate. Paroicous. Peristome with short teeth, 40-80 µm long. Forms dense turfs in rock crevices in high mountains of the Pyrenees and Sierra Nevada. Esp, And.

O. Splachnales

Fam. Splachnaceae

Splachnum Hedw.

Stem to 2 cm high. Leaves ovate-lanceolate, longly acuminate, margin sharply toothed from apex to middle of leaf; laminal cells hexagonal or rhomboidal, more than 25 μm wide; nerve ending in apex. Seta straight, long; urn shortly cylindrical with pyriform apophysis, much wider than the urn, rugose when dry; columella emergent in mature capsules; peristome teeth 16, in pairs (fig. 46, 1-2)

***S. ampullaceum* Hedw.**

Light green turfs on dung in damp habits and peaty grasslands, in mountains of the north of the Peninsula. Esp.

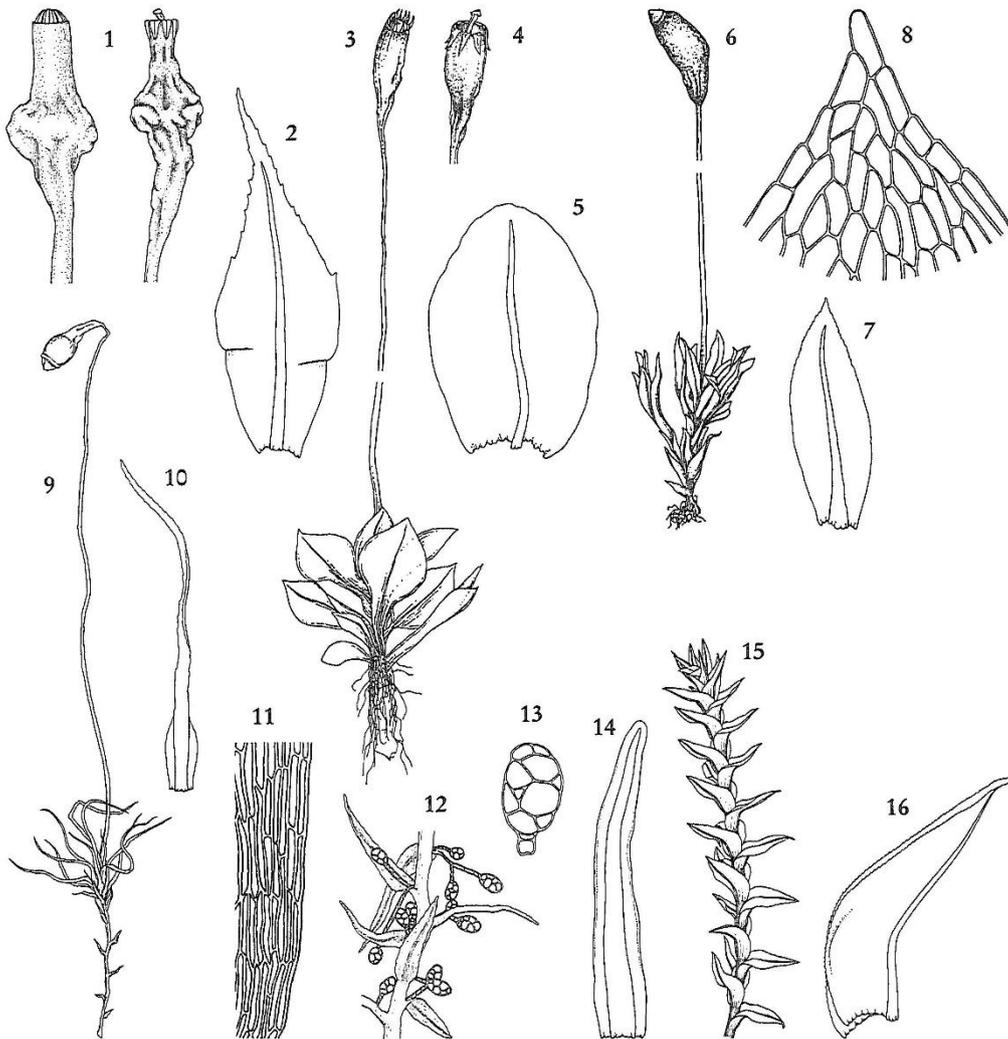


FIGURE 46. 1-2, *Splachnum ampullaceum*: 1, capsules when moist and when dry; 2, leaf. 3-4, *Tayloria tenuis*: 3, habit; 4, capsule when dry. 5, *T. froelichiana*, leaf. 6-8, *Amblyodon dealbatus*: 6, habit; 7, leaf; 8, leaf apex. 9-13, *Leptobryum pyriforme*: 9, habit; 10, upper leaf; 11, laminal cells; 12, axillary gemmae; 13, gemma. 14, *Meesia uliginosa*, leaf. 15-16, *Meesia triquetra*: 15, habit; 16, leaf. 3, 6, 15 (x4,5); 9 (x5); 1, 4 (x8); 2, 5, 7, 10, 14, 16 (x16); 12 (x20); 13 (x80); 8, 11 (x140).

Tayloria Hook.

Stem to 2 cm high, with purple rhizoids below. Leaves crowded at the stem tip, obovate-spathulate; laminal cells hexagonal, more than 20 μm wide. Capsule cylindrical, erect or slightly inclined, symmetrical, brownish red, neck as long as urn, gradually tapered towards seta; seta straight, long, flexuose; peristome teeth reflexed when dry and columella emergent or not in mature capsule.

- 1 Leaves obovate, with obtuse, apiculate apex, margin dentate; spores 10-12 μm , pale yellow, smooth (fig. 46, 3-4) **T. tenuis** (Dicks.) Schimp.

T. serrata (Hedw.) Bruch & Schimp. var. **tenuis** (Dicks.) Bruch & Schimp.

Forms loose turfs on rotten stumps and herbivore dung, in permanently wet sites, in the high mountains of the Pyrenees. Esp, And.

- 1 Leaves elliptical or oblong, with rounded apex, margin entire; spores 30-40 μm , dark brown, papillose (fig. 46, 5) **T. froelichiana** (Hedw.) Mitt. ex Broth.

Very rare, grows on humus-rich soils in the high mountains of the Pyrenees. Esp.

Fam. Meesiaceae

Amblyodon P.Beauv.

Stem about 1 cm high. Leaves oblong-lanceolate, acute, margin entire or denticulate near apex; upper laminal cells longly hexagonal, 15-30 μm wide, smooth; nerve percurrent, stout, occupying, at least 1/2 of leaf base width. Seta straight; capsule pyriform, curved, asymmetrical, inclined to horizontal, neck shorter than urn; peristome double, exostome shorter than endostome, basal membrane short and without cilia; spores 40 μm (fig. 46, 6-8) **A. dealbatus** (Hedw.) P.Beauv.

Plants isolated or forming very loose, light green or yellowish turfs on flushed or peaty soils, in high mountains of the Pyrenees and Sierra Nevada. Esp, And.

Leptobryum (Bruch & Schimp.) Wilson

Stem to 2 cm high. Leaves long, narrow, linear, subulate, flexuose, dentate at apex; laminal cells 8-10 times as long as wide; nerve occupying 1/3 width of leaf base. Rhizoids mostly with pyriform, brown gemmae. Capsule pyriform, inclined or pendulous, neck as long as urn (fig. 46, 9-13) **L. pyriforme** (Hedw.) Wilson

Forms loose, pale green turfs on wet soils, especially in nitrophilous sites (greenhouses and commercial flower fields). Scattered in the northern and eastern part of the Peninsula. Esp, Prt.

Meesia Hedw.

Plants small to large. Leaves erect or squarrose, ovate-lanceolate or lingulate, apex obtuse or acute, margin entire or dentate; laminal cells shortly rectangular, 10-15 µm wide, smooth; nerve stout, ending near apex. Capsule pyriform, asymmetrical, curved, neck as long as urn; peristome double, exostome shorter than endostome, the latter with short basal membrane and rudimentary cilia.

- 1 Leaves not tristichous, erect, lingulate to linear-lanceolate; nerve occupying 1/2-3/4 of leaf base width (fig. 46, 14) **M. uliginosa** Hedw.
Stem 1-2 cm high. Leaves with rounded apex, margin recurved, entire; laminal cells narrowly rectangular, smooth, 7-10 µm wide, basal cells longer. Forms light green turfs on wet soils, in high mountains, in the Pyrenees. Esp, And.
- 1 Leaves tristichous, squarrose from an erect base, triangular-lanceolate; nerve occupying less than 1/3 of leaf base width (fig. 46, 15-16) **M. triquetra** (L. ex Jolycl.) Ångstr.
Stem 3-10 cm high. Leaves with sheathing base, keeled above, with acute apex, margin plane, totally dentate. Grows on peaty soils. Rare, in the Pyrenees and the Spanish Central Range. Esp.

O. Orthotrichales

Fam. Orthotrichaceae

By F. Lara

Codonoblepharon Schwägr.

Plants small, dark green, forming cushions or patches; stem erect with whitish tomentum. Leaves flexuose, frequently incurved when dry, obovate-lanceolate, acute; laminal cells 13-23 wide, smooth. Gemmae cylindrical, produced on rhizoids and old leaves. Autoicous. Capsule long exserted, pyriform when wet, ellipsoidal or cylindrical, strongly 8 ribbed when dry; peristome double, exostome teeth in pairs, reflexed when dry. Calyptra cucullate, smooth, glabrous (fig. 49, 12-14)

C. forsteri (Dicks.) Goffinet

Zygodon forsteri (Dicks.) Mitt.

Plants glossy, up to 1,4 cm high. Grows on stumps, horizontal branches, forks, bark scars and bases of trees. Scattered localities, usually in the lowlands and montane areas, in the Peninsula. Esp, Prt.

Lewinskya F.Lara, Garilleti & Goffinet

Plants mostly medium-sized forming loose cushions. Stem mostly branched. Leaves erect or erecto-patent, lanceolate or ovate-lanceolate, apex acute to acuminate, margin recurved; upper cells rounded, usually papillose, basal cells elongate, with incrassate and sinuose or nodulose walls, alar cells occasionally differentiated; nerve ending near apex. Gemmae absent. Monoicous. Seta short or long, vaginula glabrous or hairy; capsule frequently exserted, cylindrical to urceolate, often smooth or faintly ribbed when dry; stomata superficial; peristome usually double, exostome of 8 pair of teeth, rarely 16 divided teeth; calyptra campanulate or conical, glabrous or hairy; spores usually more than 20 µm in diameter.

- 1 Capsule exserted **2**
- 1 Capsule immersed or emergent **4**
- 2 Peristome rudimentary **L. iberica** (F.Lara & Mazimpaka) F.Lara, Garilleti & Goffinet
Orthotrichum ibericum F.Lara & Mazimpaka
Plants to 4,5 cm tall. Leaves erect or erect-appressed when dry, leaves lanceolate to ovate-lanceolate, margin recurved to revolute, apex acute or shortly acuminate or apiculate, almost plane. Capsule narrowly cylindrical, smooth except near mouth (8 very short, orange to dark brown ribs), with strongly contracted mouth when dry, gradually tapering at base; calyptra oblong-conical, hairy. Epiphyte, in the lowlands and montane areas of the central-western part of the Peninsula and rarer in the south. Esp, Prt.
- 2 Peristome well-developed, **3**
- 3 Exostome teeth erect to spreading when dry **L. laevigata** (J.E. Zetterst.) F.Lara, Garilleti & Goffinet
Orthotrichum laevigatum J.E.Zetterst.
Plants to 2 cm tall. Propaguliferous, flagelliform branches sometimes present. Leaves lanceolate to ovate-lanceolate, apex acute or obtuse, margin recurved. Capsule narrowly cylindrical, smooth, gradually tapering at base; calyptra oblong-conical, hairy. Forms olive green cushions on acidic rocks, in high mountains of the central and southern part of the Peninsula. Esp.
- 3 Exostome teeth revolute when dry, in contact at apex with exothecium
L. speciosa (Nees) F.Lara, Garilleti & Goffinet
Orthotrichum speciosum Nees
Plants to 3 cm tall, olive green. Leaves lanceolate, apex acute or shortly acuminate, margin recurved. Capsule narrowly cylindrical, smooth in central and lower parts, with 8 narrow, short ribs below mouth; calyptra conical or fusiform, with golden hairs. Epiphytic, in montane areas of the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 4 Exostome teeth rudimentary; urn when dry puckered at mouth (fig. 48, 19-21)

L. acuminata (H.Philib.) F.Lara, Garilleti & Goffinet

Orthotrichum acuminatum H.Philib.

Plants to 1,5 cm tall, olive green. Leaves acuminate, margins recurved to revolute. Seta very short; capsule immersed, ellipsoidal or ovoid, slightly ribbed when dry, ribs short, contracting the mouth; endostome segments 8, wide, incurved when moist. Epiphyte, in the lowlands and montane areas. Distributed throughout of the Mediterranean Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 4 Exostome teeth well-developed; urn when dry not contracted at mouth

5

- 5 Exostome teeth erect or spreading when dry, translucent; leaf lamina partially bistratose (fig. 48, 16-18)

L. rupestris (Schleich. ex Schwägr.) F.Lara, Garilleti & Goffinet

Orthotrichum rupestre Schleich. ex Schwägr.

Plants robust, to 4 cm tall, olive green. Leaves lanceolate or ovate-lanceolate, apex acuminate, acute or obtuse, margin recurved. Capsule immersed or fully emergent, short cylindrical or ovoid, with 8 faint or prominent ribs in the upper part when dry; exostome teeth yellowish, endostome lacking or weak; calyptra oblong, strongly hairy, hairs long, exceeding the apex of the calyptra. Forms dense or loose tufts on rocks, also on trees, in the lowlands and montane areas, throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 5 Exostome teeth reflexed when dry, in contact at apex with exothecium, opaque; leaf lamina unistratose 6

- 6 Exostome teeth 16; endostome of 16 segments wide, irregularly crenulate (fig. 48, 24-25)

L. striata (Hedw.) F.Lara, Garilleti & Goffinet

Orthotrichum striatum Hedw.

Plants to 3 cm tall. Leaves lanceolate or ovate-lanceolate, acuminate, margin recurved. Seta very short; capsule smooth, ovoid, immersed to emergent; calyptra widely oblong, hairy. Forms dense or loose, olive green tufts, epiphyte, rarely on siliceous rocks. Widespread and very common throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 6 Exostome teeth 8 or 16; without endostome or with 8 or 16, linear, not crenulate segments

7

- 7 Endostome usually lacking or with 8 rudimentary segments; urn smooth or with short and faint ribs

L. shawii (Wilson) F.Lara, Garilleti & Goffinet

Orthotrichum shawii Wilson

Plants up to 4 cm tall. Leaves lanceolate, acuminate or acute, with recurved margins. Capsule urceolate or ovoid, smooth or scarcely striate, exostome white-yellowish, opaque; exostome teeth 8, irregularly divided; calyptra with

yellowish, papillose hairs. Forms small, dark olive green cushions on trunks in wet locations, in montane areas in the north of the Peninsula and in Mallorca. Esp, Prt, Bl.

7 Endostome of 8 thin segments as long as teeth; urn usually with conspicuous ribs **8**

8 Exostome of more than 8 teeth, since the pairs of teeth easily split (occasionally some pairs remaining intact) **9**

8 Exostome of 8 teeth, all the pairs remaining intact **10**

9 Capsule mouth star shaped, exostome teeth irregularly recurved and twisted when dry (fig. 48, 26)

L. tortidontia (F.Lara, Garilleti & Mazimpaka) F.Lara, Garilleti & Goffinet

Orthotrichum tortidontium F.Lara, Garilleti & Mazimpaka

Plants up to 2,5 cm tall. Leaves lanceolate, acuminate or acute, margin recurved, frequently one margin incurved near apex. Capsule emergent, cylindrical, hardly constricted below mouth when dry, scarcely ribbed; exostome of 8 pairs of teeth easily splitting to 16, pale yellow, twisted when dry and fragile (apical part soon falling off). Forms olive green cushions, epiphyte in montane dry forests of the eastern part of the Iberian Peninsula. Esp.

9 Capsule mouth rounded, exostome teeth regularly recurved when dry

L. lamyana F.Lara, Garilleti, Draper & Mazimpaka

Plants up to 4.5 cm tall. Leaves lanceolate or ovate-lanceolate, acuminate, margin recurved or revolute. Capsule immersed, cylindrical or slightly constricted below mouth, strongly ribbed in the upper half; exostome of 8 pairs of teeth easily splitting to 16, pale yellow, generally not twisted. Forms dark olive green cushions, epiphyte in montane *Abies pinsapo* Boiss forests in southernmost Iberian Peninsula. Esp.

10 Exostome teeth recurved when dry but touching the exothecium only by the tip; calyptra with numerous, long hairs

L. breviseta (F.Lara, Garilleti & Mazimpaka) F.Lara, Garilleti & Goffinet

Orthotrichum speciosum var. **brevisetum** F.Lara, Garilleti & Mazimpaka

Plants up to 3 cm tall. Leaves lanceolate, apex acuminate, margin recurved. Capsule emergent with 8 long ribs; calyptra oblong-conical, with yellow-greenish hairs. Epiphytic, in montane areas of the southeastern part of the Peninsula. Esp.

10 Exostome teeth reflexed when dry, laying attached to the exothecium; calyptra with scarce short hairs (fig. 48, 29-31) **11**

11 Exothecial bands narrow, 2–3 rows of cells near capsule mouth (sometimes 4-6 below); exostome teeth rarely cancellate at apex **L. affinis** (Brid.) F.Lara, Garilleti & Goffinet

Orthotrichum affine Schrad. ex Brid.

Plants to 4 cm tall. Leaves lanceolate, apex usually short apiculate, often asymmetrical. Capsule usually shortly emergent, cylindrical or somewhat constricted below mouth, ribbed from mouth to base, ribs slender, thinner than furrows; calyptra scarcely to moderately hairy. Forms loose or dense tufts, epiphytic, rarely saxicolous, in wet forests of montane areas, occasionally in the lowlands. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 11 Exothecial bands broad, 4 rows of cells near capsule mouth (often 6–8 below); exostome teeth cancellate at apex

L. fastigiata (Bruch ex Brid.) Vigalondo, F.Lara & Garilleti

Orthotrichum fastigiatum Bruch ex Brid.

Plants to 2 cm tall. Leaves ovate-lanceolate, apex acute to short acuminate, often asymmetrical. Capsule usually emergent, urceolate, constricted below mouth, strongly ribbed from mouth to base, ribs strong, as wide or wider than the furrows; calyptra scarcely hairy. Forms dense tufts, epiphytic, widespread throughout the Peninsula and in Mallorca. Esp, Prt.

Nyholmiella Holmen & E. Warncke

Plants small, forming short tufts. Stem mostly branched. Leaves appressed or erect when dry, erecto-patent when moist, concave, lanceolate, ovate-lanceolate, elliptical, apex obtuse or rounded, margin erect or incurved; upper cells rounded, papillose, basal cells rectangular, smooth; nerve ending near apex. Gemmae abundant, mainly on ventral side of leaves, filamentous or cylindrical, branched. Dioicous. Seta very short, vaginula glabrous; capsule immersed or emergent, stomata superficial; peristome double; calyptra conical, glabrous (fig. 47, 1-2)

N. obtusifolia (Brid.) Holmen & E. Warncke

Orthotrichum obtusifolium Brid.

Plants to 1 cm, olive green, brownish below. Leaf cells with 1(2) thick central papilla, simple or frequently branched. Epiphytic, from the lowlands to mid mountains. Scattered in the centre and eastern half of the Peninsula. Esp, Prt, And.

NOTE: **Nyholmiella gymnostoma** (Bruch ex Brid.) Holmen & E. Warncke was found once in south-central part of the Iberian Peninsula. It is characterized by the leaves with involute margins, apex cucullate and cells of the lamina with 2(3) simple papillae on each surface.

Orthotrichum Hedw.

Plants generally small forming tufts or cushions. Stem mostly branched. Leaves erect, sometimes twisted when dry, lanceolate to oblong, apex acute to rounded, sometimes piliferous, entire or denticulate, margin recurved, rarely plane; upper cells rounded, usually papillose, basal cells rectangular, smooth, alar cells not

differentiated; nerve ending near apex. Gemmae frequent, on leaves, filamentous or cylindrical. Monoicous. Seta short or long, vaginula glabrous or hairy; capsule immersed, emergent or exerted, cylindrical to urceolate, with 8 ribs (exothecial bands), rarely 16; stomata immersed; peristome usually double, exostome of 8 pair of teeth, rarely 16 completely divided teeth; calyptra campanulate or conical, glabrous or hairy; spores usually less than 20 µm in diameter.

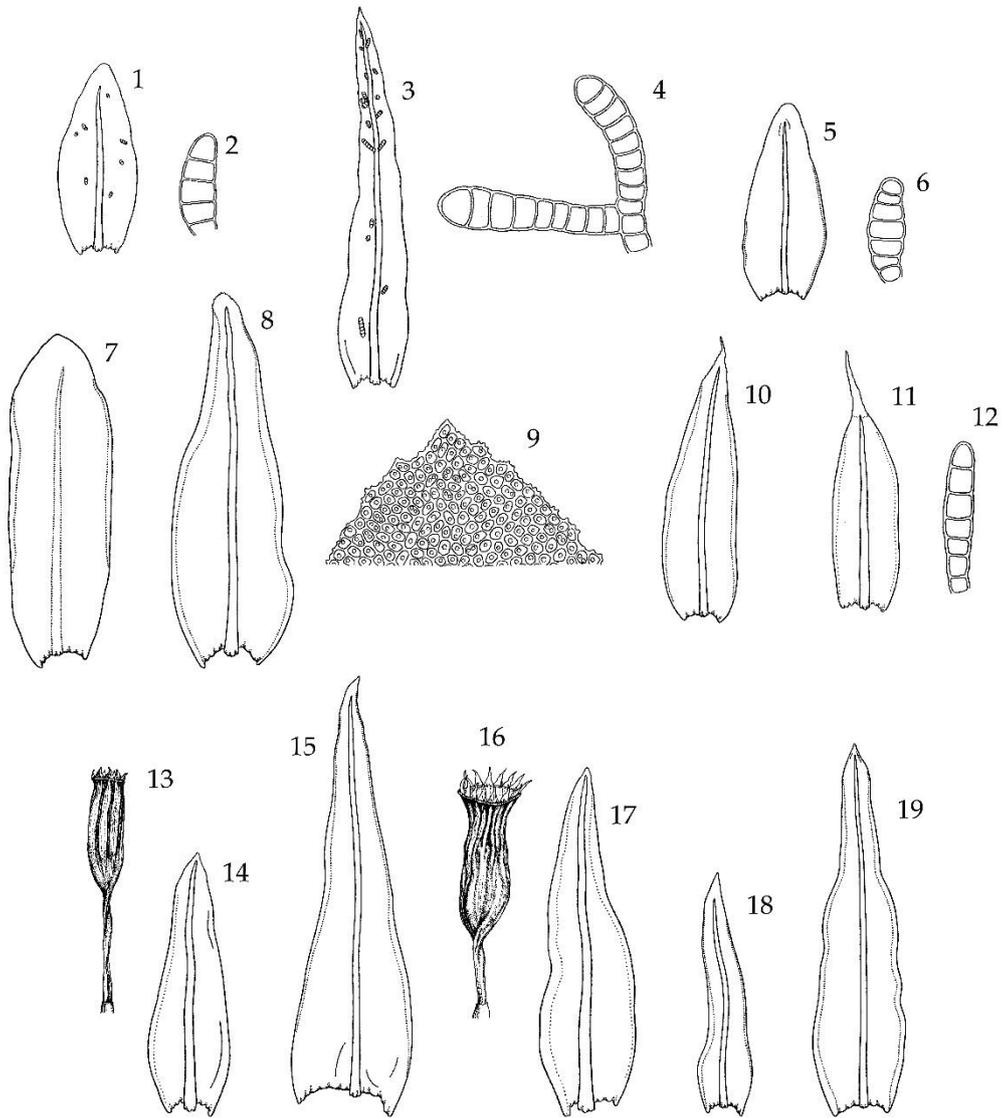


FIGURE 47. 1-2, *Nyholmiella obtusifolia*: 1, leaf; 2, gemma. 3-4, *Pulviger a lyellii*: 3, leaf; 4, gemma. 5-6, *Orthotrichum macrocephalum*: 5, leaf; 6, gemma. 7, *O. sprucei*, leaf. 8-9, *O. rivulare*: 8, leaf; 9, leaf apex. 10, *O. vittii*, leaf. 11-12, *O. diaphanum*: 11, leaf; 12, gemma. 13-14, *O. anomalum*: 13, capsule when dry; 14, leaf. 15-17, *O. cupulatum*: 15, capsule when dry; 16, leaf. 17, capsule when dry. 18, *O. pulchellum*, leaf. 19, *O. columbicum*, leaf. 13, 16 (x10); 1, 3, 5, 7, 8, 10, 11, 14, 15, 17, 18, 19 (x16); 2, 4, 6, 12 (x140); 9 (x160).

- | | | |
|---|--------------------------------------|---|
| 1 | Leaves with hyaline apices to 0,4 mm | 2 |
| 1 | Leaves without hyaline apices | 3 |

- 2 Leaves with long hyaline apices; exostome teeth 16 (fig. 47, 11-12) **O. diaphanum** Schrad. ex Brid.
Plants up to 1 cm tall, olive green, grey green or dark brownish. Leaves concave-keeled, acumen long, plane, entire or dentate; upper cells of leaf loose, bulging, thin-walled. Capsule emergent, pale yellowish, slightly sulcate, stomata variably covered; exostome teeth 16, whitish, spreading to recurved when dry, endostome segments 16. Gemmae frequent, cylindrical, frequently ramified. Forms tufts or cushions, epiphytic and on concrete walls, rarely on acidic rocks. Widespread and frequent from the lowlands to high mountains of the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 2 Leaves with short hyaline apices, often hardly visible; exostome teeth 8 (fig. 47, 10)
O. vittii F.Lara, Garilleti & Mazimpaka
Plants up to 1 cm tall, olive green. Leaves keeled, acumen short, plane, slightly dentate, fragile; upper cells of leaf firm, not bulging, thick-walled. Capsule emergent, yellowish with well-marked ribs, orange-ribbed, stomata variably covered; exostome of 8 pairs of teeth, orange, recurved when dry, endostome segments 16, yellowish and frequently appendiculate, joining adjacent segments. Gemmae frequent, cylindrical, sometimes ramified. Forms small cushions or turfs, epiphytic, preferring *Juniperus thurifera* L., in montane areas. Scattered in the centre and eastern half of the Peninsula. Esp.
- 3 Exostome teeth erect or spreading when dry; mostly saxicolous plants **4**
- 3 Exostome teeth recurved or reflexed when dry; mostly epiphytic plants **6**
- 4 Capsule fully exserted, cylindrical (fig. 47, 13-14) **O. anomalum** Hedw.
Plants to 2 cm tall. Leaves ovate-lanceolate, apex acute or acuminate. Seta orange, about 3-4 mm long, vaginula glabrous or slightly hairy; capsule cylindrical, with 8 long ribs alternating with 8 shorter ones; peristome single or double; calyptra hairy, orange, blackish-tipped. Forms glaucous, whitish, olive green to brownish tufts on calcareous rocks, more rarely epiphytic, from the lowlands to high mountains. Widespread in the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 4 Capsule immersed or emergent, urceolate or short cylindrical **5**
- 5 Leaf lamina unistratose, sometimes some bistratose spots in the upper part (fig. 47, 16-17)
O. cupulatum Hoffm. ex Brid.
Plants to 3,5 cm tall. Leaves ovate-lanceolate to oblong-lanceolate, apex acute or obtuse, margin recurved. Capsule ovoid or ellipsoidal, with 8 long ribs alternating with 8 shorter ones, immersed to emergent; frequently with prostheme; exostome teeth without trabeculae; endostome often missing or rudimentary; calyptra campanulate or conical, slightly plicate and with several hairs; spores 12-16 µm. Forms dense, glaucous, dark green or blackish brown tufts on exposed, basic rocks, rarely epiphytic, from the lowlands to high mountains. Esp, Prt, And, Bl.

The papillosoity of the laminal cells and the shape of the capsule neck are very variable characters. Plants with longly emergent capsule, endostome well-developed, calyptra glabrous belongs to var. **riparium** Huebener. Scattered localities in the north of the Peninsula and in Mallorca.

- 5 Leaf lamina bistratose in upper part **O. bistratosum** (Schiffn.) J.Guerra
Plants to 2,5 cm tall, blackish. Leaves lanceolate, apex acute, sometimes acuminate, margin recurved. Capsule ovoid, constricted below mouth when old, with 8 long ribs alternating with 8 shorter ones, immersed; rarely with prostome; exostome teeth with basal trabeculae; endostome often missing or rudimentary; calyptra oblong-conical, not plicate and with several hairs; spores 15-20 µm. Grows on basic rocks, rarely on acidic rocks or epiphytic, in montane areas and high mountains of the eastern half of the Peninsula. Esp.
- 6 Capsule exserted **7**
- 6 Capsule immersed to emergent **8**
- 7 Exostome orange-red; exothecial bands of 2 rows of cells (fig. 47, 18) **O. pulchellum** Brunt.
Plants to 1 cm tall. Leaves somewhat crisped and flexuose when dry, lanceolate or linear-lanceolate. Capsule long to shortly exserted, pale yellow; endostome segments 16, red-orange; calyptra campanulate, slightly plicate, with obscure longitudinal bands, not covering the capsule base, glabrous. Epiphyte in humid forest from oceanic mountainous areas. Scattered in the north of the Peninsula. Esp.
- 7 Exostome teeth yellow to whitish-yellow; exothecial bands of 4-6 rows of cells (fig. 47, 19)
O. columbicum Mitt.
O. consimile *auct., non* Mitt.
Plants to 1 cm tall. Leaves flexuose and slightly contorted when dry, linear-lanceolate to ovate lanceolate. Capsule long exserted; endostome segments 16, pale yellow; calyptra conical, ± plicate, covering the whole capsule, glabrous. Epiphyte in deciduous woods, in the north and northwestern part of the Peninsula. Esp, Prt.
- 8 At least some leaves oblong-lanceolate with apex blunt-dentate or rounded-mucronate; plants hydrophilous, on rocks or at base of riparian trees **9**
- 8 Leaves lanceolate or if oblong-lanceolate without apex blunt-dentate or rounded-mucronate; plants not obviously hydrophilous, usually epiphytic on different situations **10**
- 9 Upper cells of leaf 16-25 µm wide, smooth; leaf apex entire, rounded or obtuse, usually mucronate (fig. 47, 7) **O. sprucei** Mont.

Plants to 1,5 cm tall. Leaves oblong to oblong-lanceolate; laminal cells smooth. Capsule urceolate; exostome of 8 pairs of recurved teeth; calyptra glabrous. Gemmae frequent, shortly cylindrical. Grows at base of riparian trees and on rocks of the river banks. Scattered localities in the northern half of the Peninsula. Esp, Prt.

- 9 Upper cells of leaf around 10 µm wide, papillose; leaf apex irregularly dentate, rounded or obtuse, sometimes acute (fig. 47, 8-9) **O. rivulare** Turner

Plants to 3,5 cm tall. Leaves oblong-lanceolate to lanceolate; laminal cells papillose. Capsule short cylindrical to urceolate when dry; exostome of 8 pairs of recurved teeth; calyptra glabrous. Gemmae rare, long cylindrical. Forms cushions on tree roots and tree bases, occasionally on rocks, near streams in montane areas of the northern half of the Peninsula. Esp, Prt.

- 10 Upper leaves with plane margin **O. consobrinum** Cardot

Plants to 1 cm tall, dark olive green. Leaves lanceolate. Capsule shortly emergent, urceolate when dry; exostome of 8 pairs of recurved teeth, applied to exothecium when dry; calyptra glabrous, not covering the capsule base. Epiphytic. Very rare in the north of the peninsula. Esp.

- 10 Upper leaves with recurved margin **11**

- 11 Leaf apex apiculate (fig. 48, 15) **O. philibertii** Venturi

Plants to 0,8 cm tall. Leaves lanceolate or oblong-lanceolate. Calyptra campanulate, with short, thick, papillose hairs. Forms dense, dark green tufts on evergreen oaks in the lowlands. Gemmae frequent, cylindrical or clavate. Scattered in the Mediterranean area of the Peninsula and in Mallorca. Esp, Prt, Bl.

- 11 Leaf apex not apiculate, rounded or gradually narrowed **12**

- 12 Leaves concave, with obtuse to rounded apex; capsule mouth star-shaped when dry (fig. 47, 5-6)

O. macrocephalum F.Lara, Garilleti & Mazimpaka

Plants to 1 cm tall. Leaves erect, oblong, lingulate or lanceolate-lingulate, with recurved margins. Capsule shortly emergent, cylindrical, not constricted below mouth when dry. Gemmae on both sides of leaf, cylindrical to filamentous. Forms compact cushions, epiphyte in montane areas. Scattered in the Mediterranean part of the Peninsula, often in man-made environments. Esp.

- 12 Leaves not as above; capsule mouth rounded when dry **13**

- 13 Exothecial bands of 2 rows of differentiated cells **14**

- 13 Exothecial bands of 4 or more rows of differentiated cells **15**

- 14 Endostome of 16 segments, frequently appendiculate **O. scanicum** Gronvall
O. lewinskyae F.Lara, Garilleti & Mazimpaka
Plants to 1,3 cm tall. Leaves somewhat flexuose, linear-lanceolate or ovate-lanceolate, apex obtuse or shortly acute, sinuose, irregularly denticulate, frequently channelled. Capsule cylindrical, not constricted below mouth when dry; exostome teeth 8 pairs, regularly recurved, brown, splitting in mature capsules; endostome papillose. Forms small, loose, pale green tufts, epiphyte on trunks, rarer on calcareous rocks. Scattered in the Peninsula. Esp, Prt.
- 14 Endostome of 8 segments, not appendiculate **O. patens** Bruch ex Brid.
Plants to 1 cm tall, olive green. Leaves slightly sinuose when dry, lanceolate; apex acute to obtuse. Capsule wide and short cylindrical, not constricted below mouth when dry, abruptly tapered at base; exostome of 8 pairs of recurved teeth. Epiphyte, forming small tufts in the lowlands. Rare, scattered in the north of the Peninsula. Esp.
- 15 Leaves of male branches lingulate, smaller than those of female branches; some segments of endostome erect when dry; spores 18-24 μm (fig. 48, 8) **O. rogeri** Brid.
Plants up to 1 cm tall, olive green. Leaves oblong to ovate lanceolate; apex acute or obtuse. Capsule cylindrical or urceolate when dry, gradually attenuated to very long neck; exostome orange, with recurved teeth when dry; endostome hyaline, with long, linear segments, as long as exostome teeth; calyptra conical, glabrous or with a few hairs; spores 18-24 μm . Forms dense cushions as epiphyte in the Pyrenees. Esp.
- 15 Leaves of male branches similar to those of female branches; segments of endostome incurved when dry; spores to 20 μm **16**
- 16 Stomata near the neck of capsule, half to completely covered by exothecial cells **17**
- 16 Stomata in the middle or upper half of capsule, half or slightly covered by exothecial cells **21**
- 17 At least some leaves with apex channelled (fig. 48, 12-14) **O. tenellum** Bruch ex Brid.
Plants to 1,5 cm tall, olive green to brownish. Leaves with apex variable, frequently blunt, denticulate or channelled. Capsule cylindrical to ellipsoidal, when dry constricted below mouth, gradually narrowed to seta, deeply sulcate; calyptra with hairs thin and slightly papillose, scattered in the upper half. Mostly with filamentous gemmae. Grows in cushions as epiphyte, rarely on siliceous rocks, in the lowlands and montane areas. Widely distributed throughout the Mediterranean part of the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 17 Leaf apex acuminate or acute, not channelled **18**
- 18 Vaginula glabrous or sparsely hairy **19**

- 19 Laminal cells slightly papillose, with simple, low papillae; calyptra hairy at apex

O. comosum F.Lara, R. Medina & Garilleti

Plants up to 0,9 cm tall, dark green. Leaves lanceolate to ovate-lanceolate; apex acute, rarely denticulate; lamina with bistratose spots. Capsule emergent, cylindrical, constricted below mouth when empty, gradually attenuated at base; calyptra oblong-conical. with comal tuft of stout and papillose hairs. Forms small cushions as epiphyte in the lowlands and montane areas, mainly in the south and western part of the Peninsula. Esp, Prt.

- 19 Laminal cells strongly papillose, with acute or branched papillae; calyptra sparsely hairy or glabrous

O. alpestre Bruch & Schimp.

Plants up to 2 cm tall, somewhat tomentose. Leaves lanceolate to ovate-lanceolate. Capsule urceolate when dry, gradually attenuate at base; calyptra papillose, usually with scattered papillose hairs. Forms dense, yellowish green to olive green tufts on siliceous rocks and epiphyte, in montane areas and high mountains. Scattered in the north of the Peninsula and in Sierra Nevada. Esp, And.

- 20 Leaves with acute apex; vaginula with long, papillose hairs; calyptra dark-tipped (fig. 48, 2-3)

O. stramineum Hornsch. ex Brid.

Plants up to 1,9 cm tall, olive green. Leaves lanceolate or ovate-lanceolate. Capsule cylindrical to urceolate, with 8 complete ribs, gradually narrowed into a very long neck; calyptra with few, slightly papillose hairs. Epiphyte, rarely on rocks, forming tufts. Widespread in forests of the northern half of the Peninsula, rare in the south, and in Mallorca. Esp, Prt, And, Bl.

- 20 Leaves with bluntly acute apex, frequently channelled; vaginula with short, smooth hairs; calyptra orange-tipped (fig. 48, 1)

O. stellatum Brid.

Plants up to 0,8 cm tall. Leaves lanceolate to oblong-lanceolate. Capsule urceolate when dry, strongly constricted below mouth when dry, abruptly narrowed at base, in upper half with 8 orange, strong ribs. Forms olive green to brown, small turfs on trees in the north of the Peninsula. Very rare. Esp.

- 21 Exostome of 8 pairs of teeth, splitting to 16 irregularly recurved teeth (fig. 48, 7)

O. hispanicum F.Lara, Garilleti & Mazimpaka

Plants up to 1,2 cm tall, dull olive green. Leaf lanceolate, slightly keeled, apex entire, acute. Capsule urceolate when dry, strongly constricted below mouth, emergent, pale yellowish; endostome strongly papillose; calyptra conical-oblong, slightly plicate, glabrous or with a few hairs near apex. Sometimes with gemmae on old leaves. Grows in small cushions as epiphyte, in montane areas of the northern half of the Peninsula and in Mallorca. Esp, Bl.

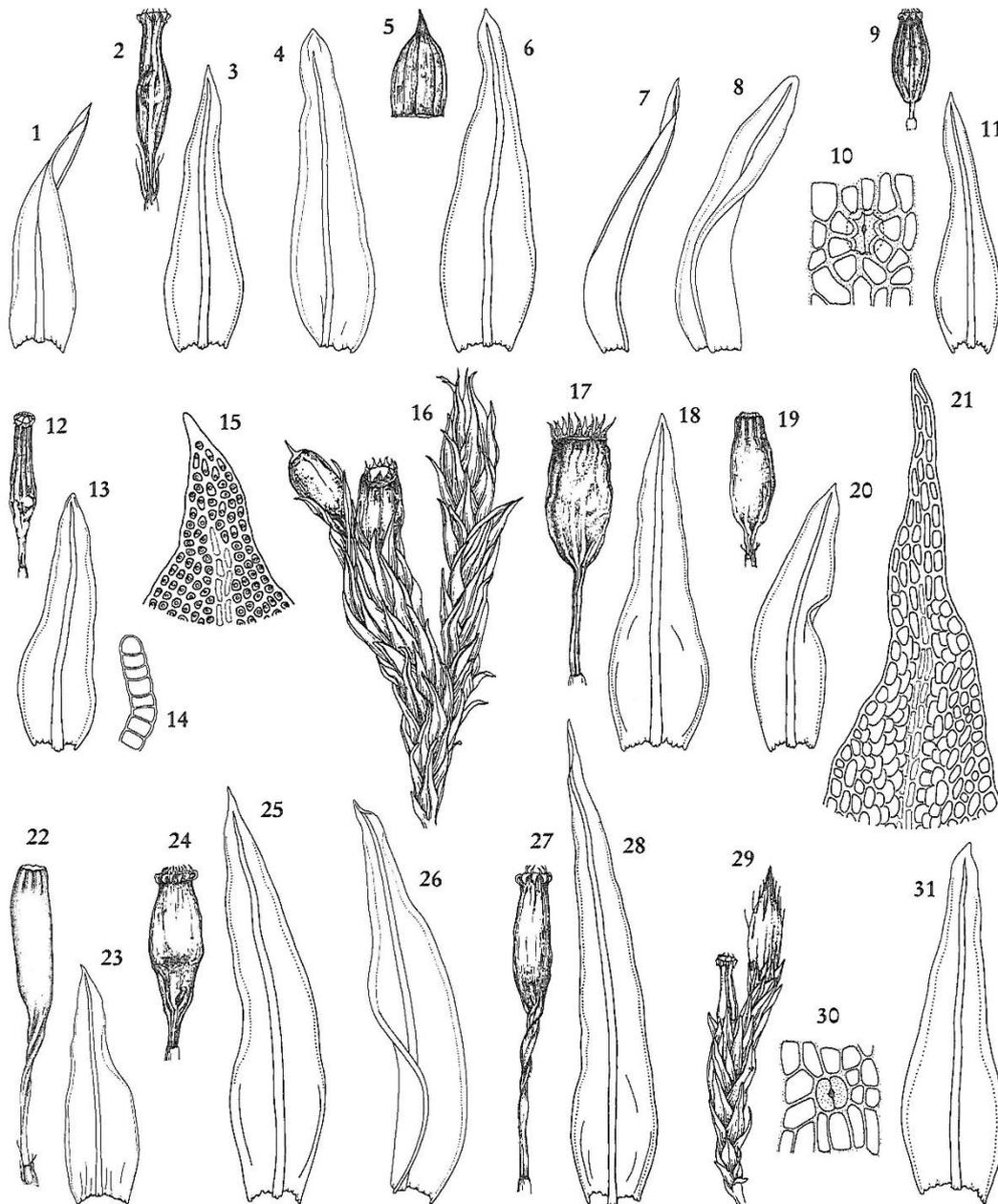


FIGURE 48. 1, *Orthotrichum stellatum*, leaf. 2-3, *O. stramineum*: 2, capsule when dry; 3, leaf. 4, *O. casasianum*, leaf. 5-6, *O. pallens*: 5, calyptra; 6, leaf. 7, *O. hispanicum*, leaf. 8, *O. rogeri*, leaf of a female shoot. 9-11, *O. pumilum*: 9, capsule when dry; 10, immersed stoma; 11, leaf. 12-14, *O. tenellum*: 12, capsule when dry; 13, leaf; 14, gemma. 15, *O. philibertii*, leaf apex. 16-18, *Lewinskya rupestris*: 16, habit; 17, capsule when dry; 18, leaf. 19-21, *L. acuminata*: 19, capsule when dry; 20, leaf; 21, upper leaf apex. 22-23, *L. iberica*: 22, capsule when dry; 23, leaf. 24-25, *L. striata*: 24, capsule when dry; 25, leaf. 26, *L. tortidontia*, leaf. 27-28, *L. speciosa*: 27, capsule when dry; 28, leaf. 29-31, *L. affinis*: 29, habit; 30, superficial stoma; 31, leaf. 16, 29 (x6); 2, 5, 9, 12, 17, 19, 22, 24, 27 (x10); 1, 3, 4, 6, 7, 8, 11, 13, 18, 20, 23, 25, 26, 28, 31 (x16); 21 (x100); 14, 15 (x140); 10, 30 (x160).

22 Capsule ovoid or short urceolate, abruptly narrowed into seta

O. schimperi Hammar

Plants up to 0,9 cm tall. Leaves widely ovate-lanceolate or oblong-lanceolate; apex acute or obtuse, sometimes mucronate, mucro of 1-2 hyaline cells. Gemmae frequent, cylindrical. Seta very short; capsule immersed or emergent, stomata in the middle of capsule; exostome teeth orange; endostome segments smooth, to 2/3 of the exostome length; calyptra widely campanulate, plicate, naked or with few, short, scattered hairs. Epiphyte, occasionally saxicolous, forms loose, dark green tufts in the lowlands and montane areas. Widespread throughout the Mediterranean part of the Peninsula. Esp, Prt.

22 Capsule cylindrical, gradually narrowed into seta 23

23 Leaves usually acute at apex; capsule immersed or shortly emergent (fig. 48, 9-11)

O. pumilum Sw. ex anon.

Plants up to 1 cm tall, olive green. Leaves lanceolate or oblong-lanceolate; apex acute or acuminate, rarely rounded, sometimes with a mucro of 1-2 hyaline cells. Capsule cylindrical, scarcely constricted below mouth when dry, gradually attenuated at base; endostome segments 8, sometimes with additional intermediate segments, smooth or papillose; calyptra oblong-conic, slightly plicate, naked. Epiphyte in the lowlands and montane areas, mainly in the northern and eastern parts of the Peninsula. Esp, And.

23 Most leaves blunt or rounded at apex; capsule emergent or almost exerted 24

24 Leaf apices frequently cucullate; endostome segments strongly incurved, all of similar length (fig. 48, 4)

O. casasianum F.Lara, Garilleti & Mazimpaka

Plants to 1 cm tall. Leaves somewhat flexuose when dry, lanceolate or ovate-lanceolate, apices concave, obtuse and with a small 1(2)-celled mucro. Capsule pale brown, with neck of the same colour, cylindrical-urceolate with ventricose base when dry, with 8 ribs that do not reach the base; calyptra conic-oblong, glabrous. Forms small, irregular, olive green cushions or patches, epiphyte in riparian woods on the banks of rivers, in the southern Basque lowlands. Very rare. Esp.

24 Leaf apices plane, not concave; endostome segments slightly incurved, the intermediary shorter than principals (fig. 48, 5-6)

O. pallens Bruch. ex Brid.

Plants to 1,2 cm tall, olive green. Leaves oblong-lanceolate or ovate-lanceolate. Capsule pale brown, with neck paler than urn, emergent or almost exerted, with 8 brownish ribs; calyptra conic-oblong, glabrous. Forms compact turfs, epiphyte, in montane areas. Widespread and relatively frequent in the eastern half of the Peninsula and in Mallorca. Esp, And, Bl.

Plenogemma Plášek, Sawicki & Ochyra

Plants to 2 cm tall. Leaves lanceolate or lingulate, scarcely widened at base, margin plane, narrowly recurved in middle part, strongly crisped when dry; upper laminal cells rounded or elliptical, with incrassate,

papillose walls, basal cells rectangular to linear, at margin differentiated in 1-6 rows of rectangular cells, with thickened, transverse walls; nerve percurrent or excurrent in a stout mucro. Clusters of gemmae at tips of upper leaves. Dioicous. Sporophytes very rare, with exserted capsules; stomata superficial (fig. 49, 1-2)

P. phyllantha (Brid.) Sawicki, Plášek & Ochyra

Ulota phyllantha Brid.

Gemmae ellipsoidal, brown, commonly produced from the excurrent part of nerve. Forms yellowish-green to reddish brown cushions on trees. Very rare, in the north and northwestern part of the Peninsula. Esp.

Pulviger Plášek, Sawicki & Ochyra

Plants medium-sized to large, forming brownish green tufts or loose cushions. Stem mostly branched. Leaves erect or erecto-patent, lanceolate or linear-lanceolate, lamina unistratose, apex acute to acuminate, margin mostly plane; upper cells rounded, usually papillose, basal cells rectangular to linear, with incrassate and sinuose walls; nerve ending near apex. Gemmae on leaves, rarely on rhizoids, usually very abundant, cylindrical or filamentous, orange brown or reddish brown. Dioicous. Male plants smaller in all parts. Vaginula hairy; capsule immersed or emergent, ovoid, cylindrical and ribbed when dry; stomata superficial; peristome double, exostome of 16 divided teeth, whitish or yellowish, recurved, endostome of 16 orange stout segments; calyptra conical with reddish bands, hairy; spores to 38 µm in diameter (fig. 47, 3-4)

P. lyellii (Hook. & Taylor) Plášek, Sawicki & Ochyra

Orthotrichum lyellii Hook. & Taylor

Plants to 3,5 cm tall, frequently with powdery appearance due to the abundant gemmae on leaves. Epiphyte, from the lowlands to high mountains. Widespread throughout Peninsula and in Mallorca. Esp, Prt, And, Bl.

Ulota D.Mohr

Plants 0,5-2 cm tall, forming tufts or patches. Leaves lanceolate, frequently with wide and concave base, usually curved or crisped when dry, margin plane or variably recurved; upper laminal cells small, rounded or not, papillose, basal cells linear, at margin differentiated in 1-15 rows of rectangular cells, with thickened transverse walls; nerve percurrent. Without propagules. Monoicous. Capsule cylindrical or pyriform, exserted, straight, with 8 longitudinal striae; peristome double, teeth in pairs; calyptra campanulate, usually strongly hairy.

1 Leaves not crisped 2

1 Leaves crisped when dry 4

- 2 Capsule pyriform when empty, smooth with puckered mouth when dry (fig. 49, 3-4) **U. coarctata** (P.Beauv.) Hammar
- Plants to 2,5 cm tall. Leaves straight to curved, not crisped when dry. Capsule inflated, whitish or pale brown and only ribbed just below the mouth when dry; segments rudimentary or lacking, exostome teeth whitish, straight when dry. Forms small, dull green or yellowish-green tufts on trees in moist forests, in the lowlands and montane areas of the north and northwestern part of the Peninsula. Esp.
- 2 Capsule not as above, furrowed in most of its length when dry and empty **3**
- 3 Plants forming creeping patches; endostome rudimentary or lacking **U. drummondii** (Hook. & Grev.) Brid.
- Plants 1-2 cm tall. Rhizoids on lower part of erect stem, and along ventral face of prostrated stems. Leaves erect, flexuose or curved, not crisped when dry; lanceolate to oblong-lanceolate with widened base, margins predominantly plane. Capsules long exerted, when dry fusiform or ellipsoidal-cylindrical, strongly ribbed, star shaped at mouth; exostome of 8 pairs of teeth easily splitting, yellowish to whitish, erect to irregularly recurved when dry. Epiphyte, forms patches on branches of trees and shrubs in humid montane forest in the north of the Peninsula. Very rare. Esp.
- 3 Plants forming tufts or cushions; endostome of 8 well developed segments **4**
- 4 Leaves straight or slightly curved, not crisped when dry, with narrowly recurved margins (fig. 49, 5) **U. hutchinsiae** (Sm.) Hammar
- Plants 1-2 cm tall usually forming cushions. Leaves rigid, imbricate, straight or scarcely curved when dry, lanceolate, gradually widened at base; upper cells strongly incrassate with small lumen. Capsules long exerted, cylindrical when dry. Forms dark green to brownish tufts on siliceous rocks, rarely on trunks, by streams in woods, in the lowlands and montane areas of the northern half of the Peninsula. Esp, Prt.
- 4 Leaves slightly to strongly crisped, with margins predominantly plane **5**
- 5 Capsule fusiform when empty, not constricted below mouth when dry **U. bruchii** Hornsch. ex Brid.
- U. crispa** var. **norvegica** (Grönvall) A.J.E.Sm. & M.O.Hill
- Plants to 3 cm tall, dark green. Leaves moderately or slightly crisped when dry, lanceolate with widened base; 3-10 rows of rectangular basal cells along margins. Capsules long exerted, strongly ribbed, star shaped at mouth; exostome of 8 pairs of teeth easily splitting, endostome teeth striate at base. Epiphyte, forms loose green tufts on trees, from the lowlands and montane areas. Scattered in the northern half of the Peninsula, common in the extreme north and northwest. Esp, Prt.
- 5 Capsule cylindrical, campanulate or urceolate when empty, more or less constricted below mouth when dry **6**

6 Capsule not or only slightly constricted below mouth when dry

7

6 Capsule strongly constricted below mouth when dry

8

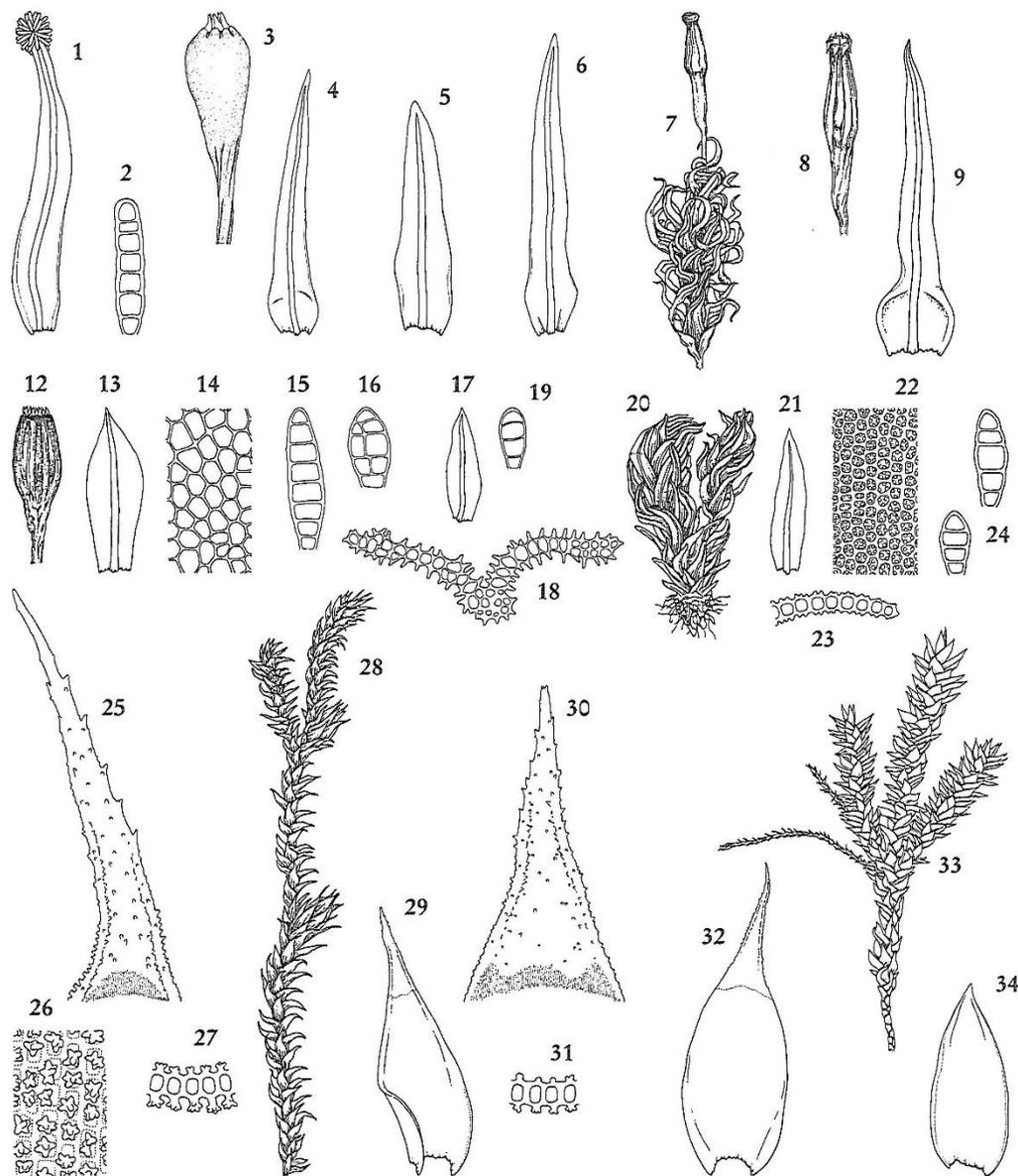


FIGURE 49. 1-2, *Plenogemma phyllantha*: 1, leaf; 2, gemma. 3-4, *Ulota coarctata*: 3, capsule when dry; 4, leaf. 5, *U. hutchinsiae*, leaf. 6, *U. calvescens*, leaf. 7-9, *U. crispata*: 7, habit when dry; 8, capsule when dry; 9, leaf. 12-14, *Codonoblepharon forsteri*: 12, capsule; 13, leaf; 14, median cells. 15, *Zygodon conoideus*, gemma. 16, *Z. viridissimus*, gemma. 17-19, *Z. catarinoides*: 17, leaf; 18, leaf section; 19, gemma. 20-24, *Z. rupestris*: 20, habit; 21, leaf; 22, median cells; 23, leaf margin section; 24, gemmae. 25-27, *Hedwigia stellata*: 25, leaf apex; 26, cells on dorsal side of leaf; 27, lamina section. 28-31, *H. ciliata* var. *ciliata*: 28, habit; 29, leaf; 30, leaf apex; 31, lamina section. 32, *H. ciliata* var. *leucophaea*, leaf. 33-34, *H. integrifolia*: 33, habit; 34, leaf. 28, 33 (x3); 7, 20 (x6); 3, 8, 12 (x12); 1, 4, 5, 6, 13, 17, 21, 29, 32, 34 (x16); 25, 30 (x70); 2, 15, 16, 19, 24 (x140); 9, 14, 18, 22, 23 (x180); 26, 27, 31 (x200).

- 7 Leaves strongly crisped when dry, abruptly narrowed from a concave base **U. intermedia** Schimp.
Plants to 3,5 cm tall. Leaf base with 2-16 rows of rectangular basal cells along margins. Capsule long exserted, cylindrical to ellipsoidal when dry and empty; exothecial bands mostly 2-4 cells wide; endostome segments incurved when dry, uniseriate with strong transverse walls. Forms olive green to dark green cushions on trees. Scattered in the north and northwestern part of the Peninsula. Esp, Prt.
- 7 Leaves slightly crisped when dry, gradually narrowed from a flat or slightly concave base **U. crispula** Bruch
Plants to 4,2 cm tall. Leaf base with 1-10 rows of rectangular basal cells along margins. Capsule little to moderately exserted, shortly cylindrical to obconic when dry and empty; exothecial bands 2-4 cells wide; endostome segments variably bent when dry, uniseriate or irregularly biseriate with thin transverse walls. Epiphyte, rarely on calcareous rocks, forms olive green, brownish red below, tufts on trees, from the lowlands and montane areas. Scattered in the northern half of the Peninsula, common in the extreme north and northwest. Esp, Prt.
- 8 Leaves with submarginal band of elongate cells ascending from base to the lower third of the lamina (fig. 49, 6) **U. calvescens** Wilson
Plants to 2,2 cm tall. Leaves gradually widened at base, strongly crisped when dry; leaf base with 2-9 rows of rectangular basal cells along margins. Capsule long exserted, exostome of 8 teeth pairs easily splitting. Calyptra variably hairy, sometimes glabrescent. Forms cushions on trees. Scattered localities in the western part of the Peninsula and in Algeciras mountains. Esp, Prt.
- 8 Leaves without submarginal bands of elongate cells (fig. 49, 7-11) **U. crispa** (Hedw.) Brid.
Plants to 3,3 cm tall. Leaves abruptly widened at base, strongly crisped when dry; leaf base with 5-19 rows of rectangular basal cells along margins. Capsule long exserted, exostome of 8 teeth pairs remaining intact in old capsules. Calyptra variably hairy. Epiphyte, forming small to large cushions on trees in moist woods, especially in forest in montane areas. Common in the north of the Peninsula, scattered in the central part. Esp, Prt, And.

Zygodon Hook. & Taylor

Plants small, olive green or brownish. Leaves erect, flexuose or homomalous when dry, lanceolate to oblong-lanceolate; upper laminal cells rounded or hexagonal, papillose, basal cells rectangular, hyaline; nerve ending near apex or excurrent in apiculus. Gemmae common, in leaf axils or on stems, pluricellular, fusiform or ellipsoidal. Dioicous. Capsule long exserted, cylindrical, ovoid or ellipsoid when dry, striate; peristome double, rudimentary or lacking, teeth in pairs. Calyptra cucullate, smooth, glabrous.

- 1 Lamina partially or completely bistratose, rarely 3-stratose in patches in upper part; upper and median leaf cells with 1-2(3) high, branched papillae (fig. 49, 17-19)

Z. catarinói C. Garcia, F.Lara, Sérgio & Sim-Sim

Z. bistratus Calabrese & J. Muñoz

Plants to 1cm tall, sometimes shining. Leaves erect appressed, lanceolate to narrowly lanceolate, with 1-3 smooth, hyaline cells at apex. Capsule ellipsoidal to oblong-cylindrical; peristome lacking. Forms yellowish green or olivaceous small, dense tufts, epiphyte, on tree trunks in different types of Mediterranean forests. Widespread in the southern, south-eastern and central part of the Peninsula, scattered in the north. Esp, Prt.

- 1 Lamina unistratose; upper and median leaf cells with 3-6 low and simple papillae **3**

- 3 Nerve excurrent in stout, acute mucro **Z. stirtonii** Schimp.

Plants to 0,7 cm tall. Rhizoids reddish brown. Leaves appressed, curved, lanceolate. Forms green or brownish green tufts, epiphyte, on *Quercus ilex* subsp. *ilex* near estuary shore. Very rare, in the north of the Peninsula. Esp.

- 3 Nerve ending below apex **4**

- 4 Gemmae fusiform or cylindrical, 7-9 cells long, without longitudinal walls; peristome double (fig. 49, 15)

Z. conoideus (Dicks.) Hook. & Taylor

Plants to 1 cm tall. Leaves elliptical to lanceolate, apex acute. Gemmae 25-32 µm wide. Capsule ovoid, with long neck. Forms green or yellowish-green tufts on bark, in the lowlands and montane areas. Scattered in the northern half of the Peninsula. Esp, Prt.

- 4 Gemmae ovoid or shortly ellipsoidal, 4-6 cells long, with or without longitudinal walls; peristome lacking **5**

- 5 Gemmae 32-41 µm wide, with longitudinal walls (fig. 49, 16) **Z. viridissimus** (Dicks.) Brid.

Plants to 1,5 cm tall, with reddish brown or yellowish brown tomentum. Leaves curved when dry, elongate-lanceolate to lanceolate. Capsule ellipsoidal. Forms green or dark-green tufts on trees, rocks and walls. Widespread in the north and western half of the Peninsula. Esp, Prt.

- 5 Gemmae 24-31 µm wide, without longitudinal walls (fig. 49, 20-24) **Z. rupestris** Schimp. ex Lorentz

Z. baumgartneri Malta, **Z. viridissimus** var. **rupestris** C. Hartm

Plants to 1,7 cm tall, with brown tomentum. Leaves curved, lanceolate, apex with 1-3 hyaline cells. Capsule ellipsoidal. Epiphyte, rarely on rocks, forming soft, slender, yellowish green brownish green tufts on tree trunks, from the lowland to montane areas up to 1250 m. Widespread in the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

O. Hedwigiales

Fam. Hedwigiaceae

Hedwigia P.Beauv.

Plants to 8 cm tall. Stem erect or procumbent with erect branches. Leaves imbricate when dry, erecto-patent to spreading when moist, ovate-lanceolate, concave, with elongate hyaline or coloured point, margin recurved; laminal cells thick-walled, strongly papillose, basal cells longer, narrower and porose; nerve lacking. Perichaetial leaves ciliate. Capsule obovoid, nearly globose or ovoid, immersed to slightly emergent; peristome lacking.

- 1 Leaves with coloured point; leaf margin recurved from base to apex (fig. 49, 33-34)

H. integrifolia P.Beauv.

* **Braunia imberbis** (Sm.) N.Dalton & D.G.Long, **Hedwigidium integrifolium** (P.Beauv.) Dixon

Plants to 3 cm long, yellowish green, brownish below. Stem procumbent, with straight branches. Leaf margin entire; laminal cells incrassate, porose, papillose, shortly rectangular, basal cells longly rectangular, sinuose. Flagelliform branchlets sometimes present. Grows on shaded sandstone in the lowlands and montane areas of the north of the Peninsula. Esp.

- 1 Leaves with hyaline point; leaf margin plane or recurved to 2/3 way up of leaf

2

- 2 Leaves longitudinally plicate

H. striata (Wilson ex Hook.) John Whitehead & J.Fergusson ex Hobk. & Porritt

Plants to 3,5 cm tall. Leaves with dentate hyaline-point. Forms dense, whitish cushions on siliceous, shaded rocks, rarely epiphyte, from the lowlands to the high mountains. Mainly in the western parts of the Peninsula. Esp, Prt.

- 2 Leaves not plicate

3

- 3 Upper laminal cells with 1 pedicellate, branched papillae (fig. 49, 25-27)

H. stellata Hedenäs

Plants to 5 cm tall. Leaves with denticulate hyaline-point. Forms lax, whitish cushions on siliceous rocks in montane areas. Widespread throughout the Peninsula but more frequent in the western part. Esp, Prt, And.

- 3 Upper laminal cells with 2-4 not pedicellate, branched or bifurcate papillae (fig. 49, 28-32)

H. ciliata (Hedw.) P.Beauv.

Plants to 10 cm tall. Leaves with spinosely toothed hyaline-point. Forms dense, whitish cushions on siliceous or poorly basic rocks, in montane areas. Widespread throughout the Peninsula but more frequent in the western and northeastern parts. Esp, Prt, And.

var. **ciliata**: Leaves with short hyaline point, narrow at base (fig. 49, 28-31).

var. **leucophaea** Bruch & Schimp. (**Hedwigia emodica* Hampe ex Müll.Hal.): Leaves with long and hyaline point, wide at base, is common in the Pyrenees (fig. 49, 32).

O. Bryales

Fam. Catosciaceae

Catoscopium Brid.

Plants 1-1,5(4) cm tall. Leaves erect, lanceolate, margin entire; laminal cells rectangular, 6-8 µm wide, smooth, cells towards nerve narrower; nerve percurrent. Seta long, straight; capsule horizontal to inclined, to 1 mm in diameter, globose, smooth, glossy, black; lid conical; exostome slightly developed, endostome lacking or rudimentary (fig. 50, 1-3)

C. nigratum (Hedw.) Brid.

Forms compact turfs on calcareous rocks by streams, in high mountains of the Central Pyrenees. Esp, And.

Fam. Bartramiaceae

Anacolia Schimp.

Plants erect or decumbent. Stem with dense, reddish tomentum. Leaves erecto-patent, ovate-lanceolate, subulate, plicate at base, margin denticulate, recurved in the lower half; lamina totally or partially bistratose towards apex, median cells rectangular, ± papillose; nerve stout, excurrent.

- 1 Median cells of lamina 2,5-6 µm wide, with abundant, prominent papillae; upper leaf margin uniformly bistratose (fig. 50, 4-5) **A. webbii** (Mont.) Schimp.

Plants 4-5 cm tall. Grows on exposed, acidic rocks, from the lowlands to high mountains, in the south and west of the Peninsula. Esp, Prt.

- 1 Median cells of lamina 6-12 µm wide, with low papillae; upper leaf margin partially bistratose

A. menziesii (Turner) Paris

Plants 0,8-5,5 cm tall. Forms dense turfs on acidic rock ledges and by streams, in montane areas, scattered in the north and southeast of the Peninsula. Esp.

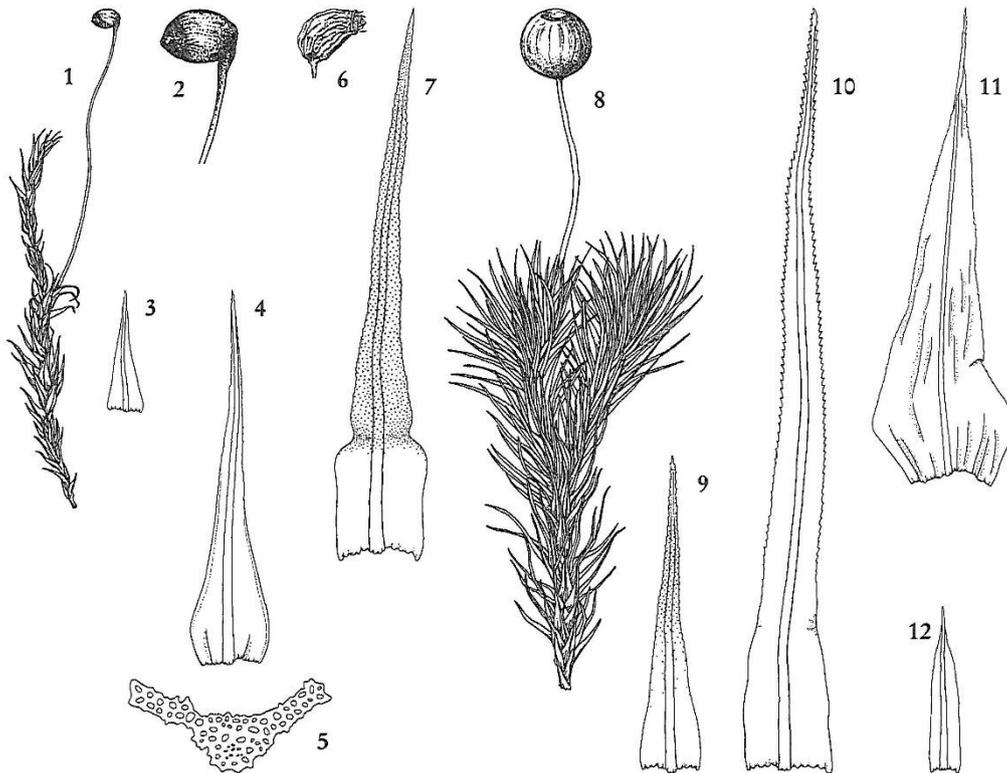


FIGURE 50. 1-3, *Catoscopium nigratum*: 1, habit; 2, capsule; 3, leaf. 4-5, *Anacolia webbii*: 4, leaf; 5, leaf section. 6-7, *Bartramia ithyphylla*: 6, capsule when dry; 7, leaf. 8-9, *B. aprica*: 8, habit; 9, leaf. 10, *B. pomiformis*, leaf. 11, *Breutelia chrysocoma*, leaf. 12, *Conostomum tetragonum*, leaf. 6, 8 (x4); 1 (x4,5); 2 (x12); 3, 4, 7, 9, 10, 11, 12 (x16); 5 (x200).

Bartramia Hedw.

Plants green to glaucous, on siliceous substrata. Stem simple or bifurcate, tomentose at base. Leaves erecto-patent to spreading, linear-lanceolate to lanceolate, falciform or attenuate in long, rigid, flexuose or crisped upper part, with \pm sheathing base, margin plane, dentate; laminal cells quadrate to rectangular, thick-walled, mamilliose, basal cells longer, smooth or prorate; nerve percurrent to excurrent. Capsule globose, striate, symmetrical or with oblique mouth; peristome double or single.

- 1 Leaves with wide, glossy sheathing base, abruptly narrowed in long subula; upper laminal cells narrowly rectangular (fig. 50, 6-7) ***B. ithyphylla*** Brid.

Plants 1-5 cm tall. Leaf nerve slightly mamilliose at back. Forms lax, glaucous green turfs in wet grasslands and acidic rock crevices, in montane areas and high mountains in the northern half of the Peninsula, rarer in the south. Esp, Prt, And.

1 Leaves lanceolate, gradually tapering into long point, dull at base; upper laminal cells quadrate or rectangular 2

2 Leaves straight, rigid when dry; nerve mamilllose on both sides; capsule symmetrical; peristome single (fig. 50, 8-9) **B. aprica** Müll.Hal.

Forms cushions or turfs, 1-3 cm high, on slopes and in siliceous rock crevices, in the east, south and west of the Peninsula, sporadic in the rest, and in Mallorca and Menorca. Esp, Prt, Bl.

2 Leaves flexuose or crisped when dry; upper part of nerve dentate at back; capsule with oblique mouth; peristome double 3

3 One sporophyte per perichaetium; seta more than 7 mm, straight; capsule exerted (fig. 50, 10)

B. pomiformis Hedw.

Forms green to brownish turfs, to 6(10) cm high, on wet slopes and in rock crevices, mainly on acidic substrata, in the lowlands and montane areas. Widespread throughout the Peninsula. Esp, Prt, And.

3 More than one sporophyte per perichaetium; seta less than 4 mm, curved; capsule hidden among leaves

B. halleriana Hedw.

Plants to 13 cm high. Leaves sometimes secund. Forms glaucous green turfs in calcareous or siliceous rock crevices and on wet, shaded stony slopes, in montane areas and high mountains. Distributed in the north of the Peninsula. Esp.

Breutelia (Bruch & Schimp.) Schimp.

Plants erect or prostrate, yellowish green, brownish below. Stem to 10 cm high, irregularly branched, densely tomentose. Leaves spreading, lanceolate, acuminate, longitudinally plicate, margin plane or slightly recurved, denticulate; cells rectangular, prorate, basal cells narrowly rectangular or linear; nerve ending in apex. Seta short, cygneous. Capsule pendulous, globose, deeply furrowed when dry, peristome double (fig. 50, 11)

B. chrysocoma (Hedw.) Lindb.

Forms lax turfs on wet, shaded slopes in the north of the Peninsula. Esp.

Conostomum Sw. ex F.Weber & D.Mohr

Stem 1-5 cm high, tomentose. Leaves rigid, imbricate, lanceolate, triangular-lanceolate or oblong, acuminate, imbricate, denticulate at apex, arranged in 5 rows, margin plane; median cells rectangular, narrow, 5-10 μm wide, smooth or nearly so; nerve excurrent. Capsule inclined, asymmetrical, sub-globose, striate; peristome single, teeth joined at apex forming a cone (fig. 50, 12) **C. tetragonum** (Hedw.) Lindb.

Forms small, dense, dark green to glaucous patches in rock crevices and on rock ledges, in high mountains of the Central Pyrenees and Cantabrian Mountains. Esp, And.

Philonotis Brid.

Stem erect, tomentose below or with scarce rhizoids, fertile shoots with whorled innovations below the female inflorescences. Leaves of sterile shoots lanceolate to ovate-lanceolate, acute to acuminate, often falciform or secund, margin plane or recurved, dentate; laminal cells rectangular, mamillate or smooth; nerve percurrent to excurrent. In some species, fertile male stems have leaves appressed and different in shape to the sterile or the female ones. Capsule globose, striate, inclined; peristome double. Autoicous or dioicous. Plants hydrophilous or hygrophilous, growing on exposed rocks and soils.

In some cases, the presence of perigonal leaves is essential for a reliable determination.

- 1 Laminal cells smooth or with distal mamillae; leaf margin with simple teeth **2**

- 1 Laminal cells with proximal mamillae, often also with distal mamillae at apex; leaf margin with geminate or simple teeth **4**

- 2 Upper cells of leaf smooth or with some distal mamillae; basal cells smooth; upper cells 3-4:1 (fig. 51, 6-8) **P. capillaris** Lindb.
P. arnellii Husn.
Plants filiform, 0,5-2 cm high. Leaves ovate-lanceolate, not plicate at base, apex acuminate to longly acuminate, margin plane or narrowly recurved; nerve excurrent, smooth. Usually with axillary bulbils. Dioicous. Forms lax patches on slopes and very moist soils. Scattered in the Peninsula. Esp, Prt, And.

- 2 Laminal cells all with distal mamillae; basal cells smooth; upper cells 6:1 **3**

- 3 Leaves densely arranged, rigid; median and basal cells 4-10 μm wide, 6-8:1 (fig. 51, 1-2) **P. rigida** Brid.
Plants 1-2 cm high. Leaves narrowly triangular-lanceolate, not or slightly plicate at base, apex longly acuminate, margin recurved or plane; nerve excurrent, smooth or slightly papillose at apex. Mostly with axillary bulbils. Autoicous. Forms dense turfs on slopes, peaty soils and seeping or wet acidic rocks, in the lowlands and montane areas. Scattered in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 3 Leaves loosely arranged, not rigid; median and basal cells 10-16 μm wide, 3-4:1 (fig. 51, 3-5) **P. marchica** (Hedw.) Brid.
Plants 1-3 cm high. Leaves lanceolate to triangular, apex acute to acuminate, margin plane; nerve percurrent or slightly excurrent, smooth or slightly papillose. Axillary ovate bulbils present. Dioicous. Forms lax turfs by irrigation

channels, on slopes and seeping rocks, from the lowlands to high mountains. Scattered in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

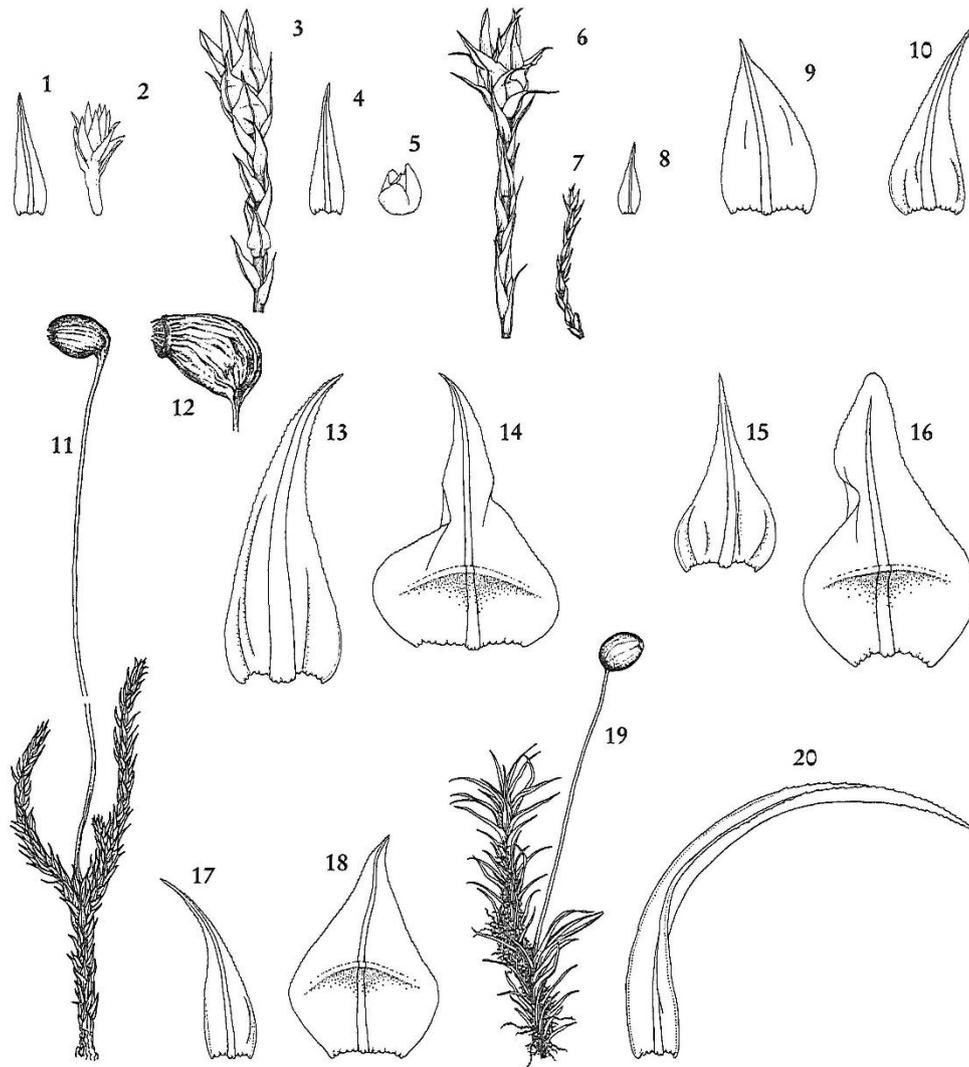


FIGURE 51. 1-2, *Philonotis rigida*: 1, leaf; 2, axillary bulbil. 3-5, *P. marchica*: 3, perigonium; 4, leaf; 5, axillary bulbil. 6-8, *P. capillaris*: 6, perigonium; 7, propagule; 8, leaf. 9, *P. caespitosa*, leaf. 10, *P. seriata*, leaf. 11-14, *P. calcarea*: 11, habit; 12, capsule when dry; 13, leaf; 14, perigonal leaf. 15-16, *P. fontana*: 15, leaf; 16, perigonal leaf. 17-18, *P. tomentella*: 17, leaf; 18, perigonal leaf. 19-20, *Plagiopus oederianus*: 19, habit; 20, leaf. 11 (x2); 19 (x3); 12 (x4); 3, 6, 7 (x8); 1, 4, 8, 9, 10, 13, 14, 15, 16, 17, 18, 20 (x16); 2 (x20); 5 (x26).

- 4 Leaves non-plicate at base, with simple teeth, occasionally with some geminate teeth (fig. 51, 9)

***P. caespitosa* Jur.**

Plants to 5 cm high. Leaves ovate-lanceolate, erecto-patent, apex acute or acuminate, margin usually plane; nerve slightly excurrent, smooth. Forms turfs on very moist slopes, by streams and springs, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

- 4 Leaves plicate at base, with geminate teeth 5
- 5 Nerve 80-200 μm wide at base 6
- 5 Nerve 40-100 μm wide at base 7
- 6 Leaves arranged in five spiral rows; lamina and nerve strongly papillose at back; perigonal leaves obtuse (fig. 51, 10) **P. seriata** Mitt.
Plants to 7,5 cm tall. Leaves ovate-lanceolate or triangular-lanceolate, apex acute or acuminate, margin usually plane or slightly recurved; nerve percurrent, reddish; median and basal cells 2-3:1, with central mamilla. Perigonal leaves erect, short. Forms tall turfs, by streams and in wet grasslands and on peaty soils, in high mountains. Common in the north of the Peninsula and in Sierra Nevada, rarer in Spanish Central Range. Esp, Prt, And.
- 6 Leaves not arranged in spiral rows; lamina and nerve smooth or slightly papillose at back; perigonal leaves acute (fig. 51, 11-14) **P. calcarea** (Bruch & Schimp.) Schimp.
Plants robust, to 10 cm tall, light green. Leaves ovate-lanceolate, apex acute or acuminate, margin usually plane or recurved; nerve percurrent; median and basal cells 4:1, with central mamilla. Forms tall turfs by basic streams and springs from the lowlands to high mountains. Widespread throughout the Peninsula in Mallorca. Esp, Prt, And, Bl.
- 7 Leaves acuminate in short point; nerve percurrent or slightly excurrent; inner perigonal leaves with obtuse apex and nerve ending below apex (fig. 51, 15-16) **P. fontana** (Hedw.) Brid.
Plants robust, to 10 cm tall. Leaves ovate or ovate-lanceolate, apex acuminate, margin recurved at base; nerve shortly excurrent; median and basal cells 3:1. Forms tall, light green to dark green turfs on rocks, by waterfalls and neutral or slightly acidic streams. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 7 Leaves acuminate in long point; nerve longly excurrent; inner perigonal leaves with acute apex and nerve percurrent or excurrent (fig. 51, 17-18) **P. tomentella** Molendo
Stem densely tomentose to near apex. Leaves lanceolate to ovate-lanceolate apex acuminate, margin recurved; nerve longly excurrent; median and basal cells 3:1. Forms dense turfs, to 5 cm high, on very wet or peaty soils, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

Plagiopus Brid.

Stem simple or branched, triangular in section, covered by dense, orange to dark brown tomentum. Leaves lanceolate, acuminate, patent, twisted when dry, margin recurved, dentate in the upper half; laminal cells quadrate to shortly rectangular, thick-walled, papillose-striate, basal cells rectangular; nerve percurrent or

excurrent. Capsule globose, slightly inclined, striate, with oblique mouth; peristome double (fig. 51, 19-20)

P. oederianus (Sw.) H.A.Crum & L.E.Anderson

Forms dense, dark green cushions, 3-5 cm high, in calcareous rock crevices, on humiferous or grasslands soils and at base of trees, in montane areas and high mountains, in the north of the Peninsula, very rare in the south. Esp, And.

Fam. Bryaceae

Anomobryum Schimp.

Plants small, to 1,5 cm tall, julaceous, filiform or clavate, glossy light green. Leaves imbricate, ovate, obtuse or apiculate, very concave or nearly plane, margin entire; median cells 4-10 times longer than wide, vermicular or rhomboidal, thick-walled, basal cells rectangular; nerve extending little more than half way up, or percurrent or excurrent in short apiculus. Capsule ovoid, oblong or pyriform, inclined to horizontal, neck half length of urn; peristome double.

- 1 Leaves appressed, ovate or oblong-lanceolate; median cells linear-vermicular, 40-90 x 3-8 μm long (fig. 52, 1-3)

A. julaceum (Schrad. ex P.Gaertn., B.Mey. & Scherb.) Schimp.

Plants slender, filiform, to 2 cm tall, julaceous. Forms loose or dense turfs on acidic slopes and rocks, in damp or seeping, shaded sites. Scattered from the lowlands to high mountains of the Peninsula. Esp, Prt, And.

var. **julaceum**: Leaves strongly concave; nerve extending half way up leaf or percurrent (fig. 52, 1-3).

var. **concinnatum** (Spruce) J.E. Zetterst. (* *Anomobryum concinnatum* (Spruce) Lindb.): Leaves slightly concave and nerve percurrent or excurrent in short apiculus.

- 1 Leaves erecto-patent, broadly ovate to oblong; median cells vermicular-rhomboidal, 40-80 x 6-18 μm long (fig. 52, 4-5)

A. lusitanicum (I.Hagen ex Luisier) Thér.

Plants to 3,5 mm tall, \pm clavate. Rhizoidal gemmae filiform, green or brown, 30-240 μm , of 1 row of 2-15 smooth cells. Capsule ovoid to pyriform, neck half length of urn; spores 8-10(-12) μm , smooth or nearly so. Grows in exposed, granitic rock crevices and by streams, in the western part of the Peninsula. Esp, Prt.

Bryum Hedw.

Leaves crowded at stem apex or regularly arranged along the stem, lanceolate, ovate-lanceolate or spatulate; median cells hexagonal or rhomboidal, basal cells quadrate to rectangular, marginal cells often narrower and forming an obscure to distinct border; nerve percurrent to excurrent, mostly in a long, filiform point. Capsule pyriform to cylindrical, often pendulous; peristome double, exostome of 16 teeth with transverse

articulations, endostome joined to a basal membrane 1/3-1/2 peristome length, and of 16 ± perforated segments alternating with long, nodulose, appendiculate or rudimentary cilia. Plants dioicous, synoicous or autoicous.

- | | | |
|---|---|---|
| 1 | Leaf base widely and longly decurrent (fig. 52, 6) | B. weigelii Spreng.
* Ptychostomum weigelii (Biehler) J.R.Spence |
| | Leaves distant, regularly arranged along the stem, ovate, acute; laminal cells 16-22 µm wide; nerve percurrent. Forms lax, light green to reddish turfs to 5 cm high, on rocks by streams or on waterlogged soils, in montane areas and high mountains in the north of the Peninsula and in Sierra Nevada. Esp, And. | |
| 1 | Leaf base not or only slightly decurrent | 2 |
| 2 | Apical cells of leaf hyaline (fig. 52, 7-8) | B. argenteum Hedw.
B. argenteum var. lanatum (P.Beauv.) Hampe |
| | Plants julaceous. Leaves widely ovate, concave, apiculate; nerve faint, ending below apex to percurrent, occasionally excurrent in short apiculus. Axillary bulbils often present, greenish to whitish, ovoid, to 900 µm long, with primordia from the base. Forms dense, glossy, silver turfs to 2 cm high on disturbed soils, walls, slopes and by roadsides, from coastal areas to high mountains. Widespread throughout the Peninsula and Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl. | |
| 2 | Leaf cells all coloured | 3 |
| 3 | Leaf margin stout, 2-4-stratose (fig. 52, 9) | B. donianum Grev.
* Ptychostomum donianum (Grev.) Holyoak & N.Pedersen |
| | Leaves elliptical, denticulate at apex; laminal cells 25-60 x 13-20 µm; nerve stout, excurrent in denticulate apiculus. Capsule cylindrical; spores 8-14 µm. Forms lax turfs to 2 cm high, in grasslands, on slopes and bases of exposed or shaded rocks in pinewoods, by streams and evergreen oak forests, on coastal areas, in the lowlands and in montane areas of the Peninsula, Mallorca and Menorca. Esp, Prt, Bl. | |
| 3 | Leaf margin unistratose or partially bistratose | 4 |
| 4 | Leaves with unistratose margin | 5 |
| 4 | Leaves with partially bistratose margin | 39 |

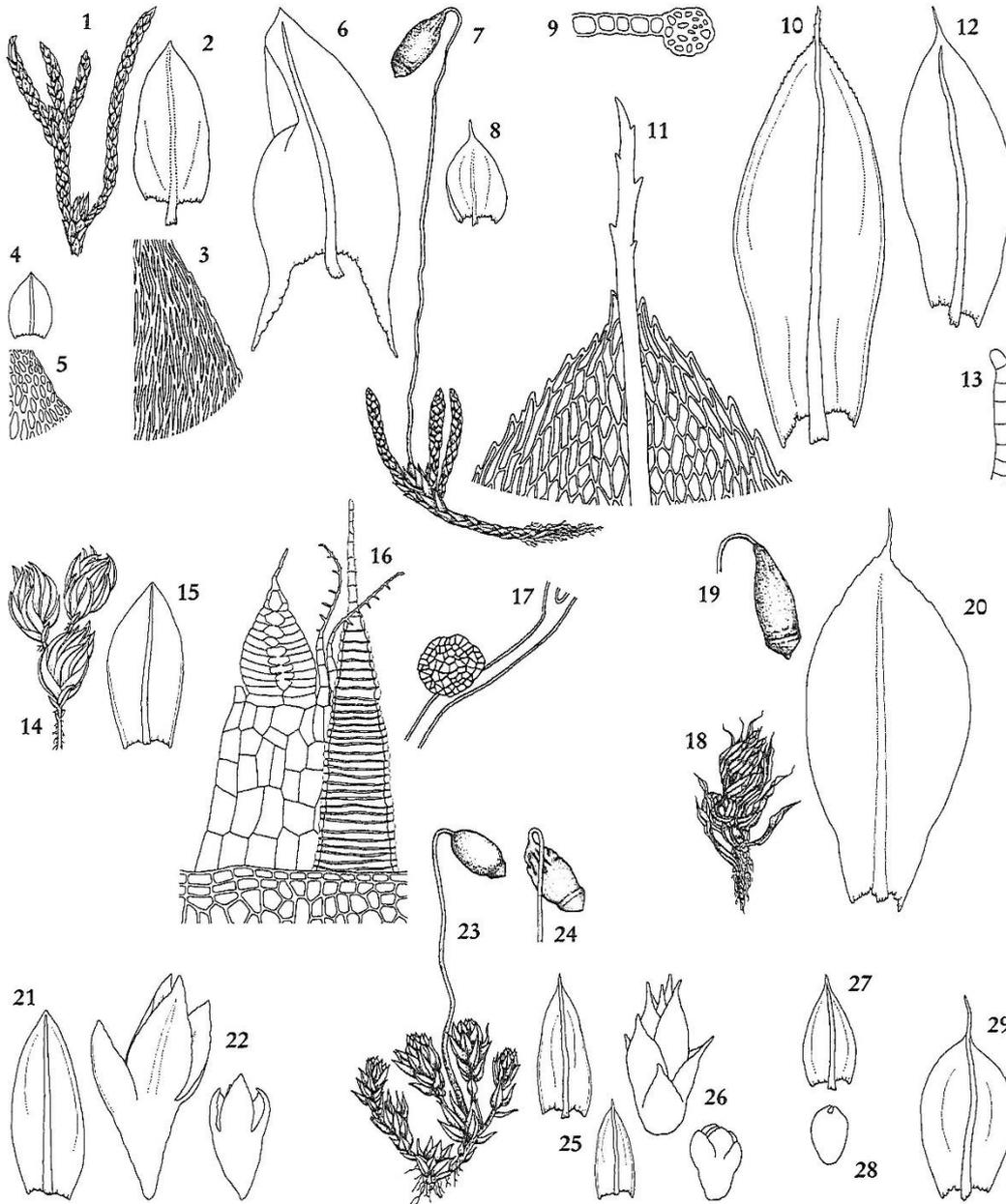


FIGURE 52. 1-3, *Anomobryum julaceum* var. *julaceum*: 1, habit; 2, leaf; 3, median cells. 4-5, *A. lusitanicum*: 4, leaf; 5, median cells. 6, *Bryum weigelii*, leaf. 7-8, *B. argenteum*: 7, habit; 8, leaf. 9, *B. donianum*, leaf margin section. 10-11, *B. canariense*: 10, leaf; 11, leaf apex. 12-13, *B. moravicum*: 12, leaf; 13, axillary gemma. 14-15, *B. minii*: 14, habit; 15, leaf. 16-17, *B. torquescens*: 16, peristome; 17, rhizoidal gemma. 18-20, *B. capillare*: 18, habit when dry; 19, capsule; 20, leaf. 21-22, *B. gemmiparum*: 21, leaf; 22, bulbils. 23-26, *B. dichotomum*: 23, habit; 24, capsule when dry; 25, leaves; 26, bulbils. 27-28, *B. gemmilucens*: 27, leaf; 28, bulbil. 29, *B. elegans*, leaf. 1, 7, 14, 18, 19, 23, 24 (x5); 2, 4, 6, 8, 10, 12, 15, 20, 21, 25, 27, 29 (x16); 22, 26, 28 (x40); 13, 17 (x60); 16 (x80); 11 (x100); 3, 5 (x120); 9 (x160).

- | | | |
|---|---------------------------------|---|
| 5 | Plants with axillary bulbils | 6 |
| 5 | Plants without axillary bulbils | 9 |

- 6 Bulbils attenuate at base, with primordia from the middle; nerve ending in or below apex; plants glossy, growing by streams (fig. 52, 21-22) **B. gemmiparum** De Not.
Leaves ovate, concave, obtuse or sub-acute. Bulbils 1-2 per axil, greenish, to 300-800 μm long. Occasionally with rhizoidal light reddish gemmae. Forms \pm dense turfs, 2-4 cm high, on wet soils and rocks by streams, from coastal to montane areas. Widespread throughout the Peninsula and Mallorca and Menorca. Esp, Prt, Bl.
- 6 Bulbils \pm ovoid to pyriform, with primordia from base or only at apex; nerve excurrent; plants slightly glossy, growing on dry soils (*B. bicolor* complex) **7**
- 7 Bulbils ovoid, 1 per axil, with acute primordia, rarely obtuse or rounded, from base to apex (fig. 52, 23-26) **B. dichotomum** Hedw.
B. barnesii J.B. Wood ex Schimp., **B. bicolor** Dicks., **B. dunense** A.J.E. Sm. & H. Whitehouse, **B. versicolor** A. Braun ex Bruch & Schimp.
Leaves widely ovate or ovate-lanceolate, obtuse to acute; nerve excurrent in apiculus or arista; basal cells green. Bulbils yellowish green to green, to 400 μm long. Rhizoidal gemmae frequent. Capsule ovoid, reddish, occasionally with rugose neck. Species very variable, forming lax or compact, pale green or yellowish green turfs, brownish below, to 2 cm high, on exposed, sandy or rocky soils, walls and by roadsides. Widespread throughout the Peninsula, but commoner in the Mediterranean region, and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 7 Bulbils ovoid to pyriform, 1-5 per axil, with finger-like primordia or primordia lacking **8**
- 8 Bulbils obconic, yellow, greenish or orange, not glossy, to 400 μm long, with narrow, finger-like primordia restricted to upper part of bulbil **B. gemmiferum** R.Wilczek & Demaret
Leaves ovate, with acute or apiculate apex, margin recurved; nerve percurrent or excurrent. Capsule ellipsoidal, pendulous. Forms yellowish green turfs, to 1,5 cm high, on wet or moist soils, slopes and walls. Distributed in the Peninsula and in Menorca. Esp, Prt, And, Bl.
- 8 Bulbils ellipsoidal to pyriform, glossy, lemon yellow or orange to reddish, 120-230 μm long, primordia lacking or dentiform (fig. 52, 27-28) **B. gemmilucens** R.Wilczek & Demaret
Leaves ovate to ovate-lanceolate, acute, cucullate, margin plane; nerve percurrent to excurrent. Forms small turfs, to 1 cm high, on disturbed soils and by roadsides, on coastal areas in the east, south and southeast of the Peninsula and in Mallorca. Esp, Prt, Bl.
- 9 Leaves widest at or above middle **10**
- 9 Leaves widest below middle **14**

- 10 Stem with filamentous axillary gemmae; nerve ending near apex or percurrent (fig. 52, 12-13) **B. moravicum** Podp.
- * **Ptychostomum moravicum** (Podp.) Ros & Mazimpaka, **B. laevifilum** Syed
- Leaves elliptical, apiculate, flexuose when dry, margin plane or slightly recurved at base, denticulate at apex, border of 1-3 rows of cells. Axillary gemmae abundant, finely papillose, brownish. Dioicous. Forms lax, yellowish green turfs, to 2 cm high, on soils, rocks, walls and trunks, in montane areas and high mountains, in the northern half of the Peninsula, rarer in the lowlands and in the south. Esp, Prt, And.
- 10 Stem without filamentous axillary gemmae; nerve excurrent **11**
- 11 Leaves imbricate when dry, arranged along stem; leaves rounded or widely elliptical, strongly concave (fig. 52, 29) **B. elegans** Nees
- * **Ptychostomum elegans** (Nees in Brid.) Holyoak
- Leaves orbicular to widely elliptical, obtuse, margin plane, entire, border of 2-3 rows of cells; nerve excurrent in arista. Forms compact turfs, to 3 cm high, on wet or dry, exposed, basic rocks, rarely at base of trees, in montane areas to high mountains. Distributed in northern half of the Peninsula and in Sierra Nevada. Esp, And.
- 11 Leaves twisted when dry, rosulate; leaves obovate or elliptical, plane or slightly concave, **12**
- 12 Leaves arranged in 2-3 successive comal tufts along the stem; leaf margin not differentiated in the upper part (fig. 52, 10-11) **B. canariense** Brid.
- B. provinciale** H.Philib.
- Leaf margin dentate at apex, recurved in the lower half; laminal cells 40-70 x 11-18 µm, porose; nerve reddish brown, excurrent in denticulate point 150-400 µm long. Occasionally with globose, reddish rhizoidal gemmae. Capsule cylindrical, neck, 1/3 capsule length. Forms lax turfs in calcareous, humus-rich soils in *Q. rotundifolia* Lam. forest and *Pinus sylvestris* L., *P. salzmannii* Dunal forest, in coastal areas, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, Bl.
- 12 Leaves arranged in one comal tuft; several rows of linear cells forming a well differentiated border **13**
- 13 Plants dioicous; leaves strongly twisted when dry; rhizoidal gemmae red to brown, same colour than rhizoids (fig. 52, 18-20) **B. capillare** Hedw.
- * **Ptychostomum capillare** (Hedw.) Holyoak & N.Pedersen
- This species is very polymorphic. Leaves ovate-oblong or spatulate, abruptly narrowed into cuspidate or piliferous point, border of 3-7 rows of narrow cells; nerve excurrent. Capsule cylindrical to longly pyriform, inclined to pendulous; endostome with wide perforations and long, appendiculate cilia. Forms dense turfs, to 2 cm high, on soils,

walls, rocks, wet and shaded sites and tree trunks, from the lowlands to high mountains, in the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 3 Plants synoicous; leaves irregularly twisted when dry; rhizoidal gemmae bright reddish, different colour than rhizoids (fig. 52, 16-17) **B. torquescens** Bruch & Schimp.

* **Ptychostomum torquescens** (Bruch & Schimp.) Ros & Mazimpaka

Leaves obovate or elliptical, acute, margin recurved, denticulate at apex, border of 2-4 rows of cells, nerve excurrent in arista of about 500 µm; laminal cells hexagonal, 11-21 µm wide. Rhizoids pale brown, often with abundant spherical gemmae. Capsule cylindrical, glossy, brown to reddish brown. Forms lax turfs, to 2 cm high, on exposed dry rocks, arable or rocky soils and sandy ledges, usually on calcareous substrata, in the lowlands and montane areas. Distributed in the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 14 Plants with rhizoidal gemmae **15**

- 14 Plants without rhizoidal gemmae **25**

- 15 Plants glossy, with metallic sheen, reddish, sometimes blackish; leaves appressed when dry (fig. 53, 5)

B. alpinum Huds. ex With.

* **Imbribryum alpinum** (Huds. ex With.) N. Pedersen

Leaves applied, slightly concave, margin plane or narrowly recurved; median cells narrowly rhomboidal to linear, 8-12 µm wide, thick-walled. Rhizoidal gemmae 100-140 µm wide. Capsule pyriform, reddish, neck, 1/3 capsule length. Forms dense, glossy, dark red or green turfs, by streams and on wet, seeping, acidic soils and rocks, from coastal areas to high mountains, in the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

- 15 Plants without metallic sheen, usually green to brownish; leaves erect, slightly twisted when dry **16**

- 16 Leaves concave, with obtuse or rounded apex (fig. 53, 1) **B. muehlenbeckii** Bruch & Schimp.

* **Imbribryum muehlenbeckii** (Bruch & Schimp.) N. Pedersen

Leaves concave, margin plane, with indistinct border, recurved at base; nerve stout, reddish, ending below apex. Occasionally with ± spherical, reddish rhizoidal gemmae, not protuberant. Forms dense, green to brownish red turfs, to 4 cm high, on waterlogged or seeping, acidic slopes, soils and rocks, in montane areas and high mountains, in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

- 16 Leaves plane, with acute **17**

- 17 Rhizoidal gemmae less than 100 µm in diameter **18**

- 17 Rhizoidal gemmae more than 100 µm in diameter **20**

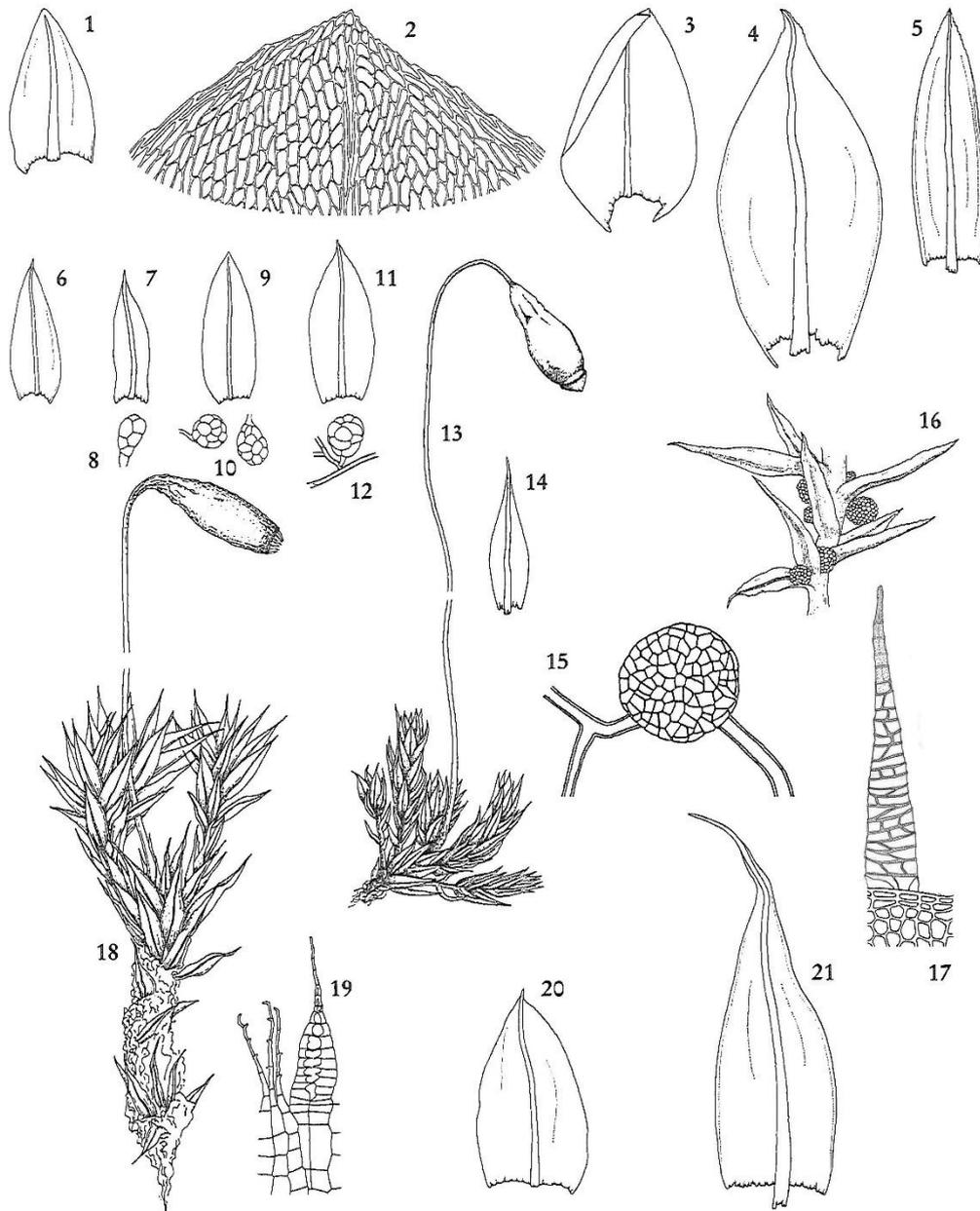


FIGURE 53. 1, *Bryum muehlenbeckii*, leaf. 2-4, *B. B. pseudotriquetrum* var. *pseudotriquetrum*: 2, leaf apex; 3, 4, leaf; 5, *B. alpinum*, leaf. 6, *B. mildeanum*, leaf. 7-8, *B. sauteri*: 7, leaf; 8, rhizoidal gemma. 9-10, *B. valparaisense*: 9, leaf; 10, rhizoidal gemmae. 11-12, *B. klinggraeffii*: 11, leaf; 12, rhizoidal gemma. 13-15, *B. radiculosum*: 13, habit; 14, leaf; 15, rhizoidal gemma. 16, *B. rubens*, axillary gemmae. 17, *B. algovicum*, exostome. 18-19, *B. pallescens*: 18, habit; 19, endostome. 20, *B. funckii*, leaf. 21, *B. caespiticium*, leaf. 18 (x4); 13 (x5); 1, 3, 4, 5, 6, 7, 9, 11, 14, 20, 21 (x16); 16 (x20); 12, 15 (x60); 17, 19 (x80); 8, 10 (x100); 2 (x120).

18 Rhizoidal gemmae spherical, with protuberant cells, bright reddish (fig. 53, 11-12)

B. klinggraeffii Schimp.

Plants to 1 cm tall. Rhizoids light brown. Leaves lanceolate to ovate-lanceolate, apex acute to acuminate; nerve excurrent. Forms dense greenish brown to yellowish green turfs in wet hollows in sandy or clayey soils, by streams, in montane areas. Scattered in the Peninsula. Esp, Prt, And.

18 Rhizoidal gemmae spherical to pyriform, with not protuberant cells, brownish red to yellowish **19**

19 Rhizoidal gemmae brownish to yellowish, spherical or sub-spherical, rarely pyriform, 2-4 cells wide (fig. 53, 9-10) **B. valparaisense** Thér.

B. pyriferum Crundw. & H. Whitehouse

Rhizoids brown, papillose or smooth. Rhizoidal gemmae yellow or brownish, often rounded, 40-60 x 30-40 µm, with cells 15-20 µm wide. Leaves erecto-patent when moist, oblong, lanceolate to ovate-lanceolate, margin entire or denticulate near apex; nerve percurrent or excurrent; median cells 40-80 x 9-13 µm. Dioicous. Forms loose yellowish green to light green turfs on wet soils, usually near streams, in the lowlands and montane areas. Rare, in the south of the Peninsula. Esp, Prt.

19 Rhizoidal gemmae brownish to reddish brown, pyriform, 1-2 cells wide (fig. 53, 7-8)

B. sauteri Bruch & Schimp.

Plants with papillose, red-brown rhizoids. Rhizoidal gemmae brown or reddish brown, 60-100 x 40-60 µm, with cells 20-35 µm wide. Leaves oblong to ovate-lanceolate, acuminate or acute; nerve stout, excurrent in apiculus or in arista. Forms dense turfs on wet, exposed soils and slopes in montane areas. Sporadic, in the north of the Peninsula. Esp, Prt.

20 Leaves bordered, with 2-3 rows of cells; upper an median laminal cells 15-22 µm wide **21**

20 Leaves unbordered; upper an median laminal cells 5-16 µm wide **22**

21 Rhizoidal gemmae to 250 µm wide, mostly on rhizoids located at in the leaf axils, with protuberant cells (fig. 53, 16) **B. rubens** Mitt.

* **Ptychostomum rubens** (Mitt.) Holyoak & N.Pedersen

Leaves ovate-lanceolate to elliptical-acute, margin plane or slightly recurved, border yellow, of 1-3 rows of narrow, long thick-walled cells. Rhizoidal gemmae 180-260 µm wide, red crimson. Forms loose or dense turfs, to 1 cm high, in openings, exposed slopes and nitrophilous soils, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.

21 Rhizoidal gemmae more than 250 µm wide, never axillary, with slightly or non-protuberant cells

B. bornholmense Wink. & R. Ruthe

* **Ptychostomum bornholmense** (Wink. & R.Ruthe) Holyoak & N.Pedersen

Leaves elliptical to ovate-lanceolate, margin plane, border distinct, sometimes yellow. Rhizoidal gemmae on long rhizoids, 160-300 µm wide, orange to reddish. Capsule cylindrical. Forms dense turfs on slopes, rock ledges and by roadsides. Scattered in the Peninsula. Esp.

- 22 Rhizoids vivid violet **B. ruderale** Crundw. & Nyholm
 Leaves triangular, lanceolate or ovate-lanceolate, with acute apex; nerve stout, green, reddish or brownish, excurrent in smooth or denticulate apiculus. Rhizoidal gemmae red, occasionally purple, brown in old plants. Forms lax turfs on dry, basic, exposed soils, in the lowlands and montane areas. Scattered in the Peninsula. Esp, Prt, And.
- 22 Rhizoids yellowish, brownish or orange **23**
- 23 Rhizoidal gemmae yellowish, rarely orange, with protuberant cells **B. tenuisetum** Limpr.
 * **Imbribryum tenuisetum** (Limpr.) D.Bell & Holyoak
 Rhizoidal gemmae 110-200 µm wide. Leaves lanceolate to ovate-lanceolate, acute, denticulate at apex, margin recurved; nerve stout, excurrent in apiculus or arista, reddish when old. Forms green to yellowish green lax turfs on wet, exposed, saline soils in the Mediterranean region lowlands. Very rare, in the east of the Peninsula. Esp, Prt.
- 23 Rhizoidal gemmae brownish to reddish, with smooth or slightly protuberant cells **24**
- 24 Leaf basal cells toward nerve quadrate or shortly rectangular; upper and median laminal cells 5-12 µm wide (fig. 53, 13-15) **B. radiculosum** Brid.
 Rhizoidal gemmae spherical, brownish or reddish brown, with not protuberant cells. Leaves ovate-lanceolate, acute or acuminate, denticulate at apex, plane or slightly recurved. Capsule ovoid-cylindrical, reddish, blackish when old. Forms dense, compact green to yellowish green turfs on calcareous, exposed walls, rocks and soils, rarely on saline soils, in the lowlands and montane areas of the Mediterranean region. Distributed throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 24 Leaf basal cells toward nerve rectangular; upper an median laminal cells 10-15 µm wide **B. subapiculatum** Hampe
 * **Imbribryum subapiculatum** (Hampe) D.Bell. & Holyoak
 Rhizoidal gemmae spherical, reddish or reddish orange, with not protuberant cells. Leaves oblong-lanceolate, with acute apex, margin plane or slightly recurved. Forms lax, yellowish green turfs, to 1 cm high, on exposed soils in the lowlands and montane areas. Scattered in the Peninsula. Esp, Prt.
- 25 Nerve ending near apex to shortly excurrent or mucronate (less than 200 µm long) **26**
- 25 Nerve excurrent in arista usually more than 200 µm long **32**
- 26 Leaves mainly ovate-oblong, widely ovate, orbicular or widely elliptical, with obtuse apex **27**
- 26 Leaves mainly ovate-lanceolate or triangular-lanceolate, with acute apex **30**

- 27 Nerve excurrent in short point; leaves strongly concave (fig. 53, 20) **B. funkii** Schwägr.
 * **Ptychostomum funkii** (Schwägr.) J.R.Spence
 Plants bulbiform. Stem with basal innovations. Leaves imbricate, reddish at base, keeled, margin plane, border indistinct; nerve excurrent in mucro or in short arista less than 200 μm long. Laminal cells slightly porose. Forms lax, yellowish green or whitish green turfs, to 3 cm high, on calcareous rock crevices, in montane areas and high mountains. Scattered in the Peninsula. Esp, And.
- 27 Nerve ending below apex or percurrent; leaves plane or slightly concave **28**
- 28 Leaves rosulate, apical leaves twisted around stem; marginal laminal cells in 4-5 rows, thick-walled (fig. 52, 14-15) **B. minii** Podp.
 * **Ptychostomum minii** (Machado-Guim.) Sérgio
 Leaves ovate to ovate-oblong. Capsule pyriform to cylindrical, with neck shorter than urn; exostome orange at base, colourless at apex. Forms dense turfs on open, wet or seeping, acidic soils, in the lowlands and montane areas. Scattered in the Peninsula. Esp, Prt.
- 28 Leaves not rosulate, apical leaves not twisted around stem; marginal laminal cells in 1-3 rows, thin-walled **29**
- 29 Leaves bordered, with 2-8 rows of linear, thick-walled marginal cells (fig. 53, 2-4) **B. pseudotriquetrum** (Hedw.) P. Gaertn., B. Mey. & Scherb.
 * **Ptychostomum pseudotriquetrum** (Hedw.) J.R.Spence & H.P.Ramsay
 Species very polymorphic. Plants to 10 cm tall. Stem tomentose. Leaves straight, lanceolate to ovate, decurrent, margin wide, recurved, plane and denticulate at apex; nerve reddish, percurrent or excurrent in apiculus. Capsule ovoid to pyriform; exostome teeth yellow or orange, with hyaline apex, endostome segments widely perforated. Forms dense, dark green to yellowish green turfs by streams and torrents, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca. Esp, And, Prt, Bl.
- 29 Leaves unbordered, with 1-2 rows of rectangular, thin-walled marginal cells (fig. 53, 1) **B. muehlenbeckii** Bruch & Schimp.
 * **Imbribryum muehlenbeckii** (Bruch & Schimp.) N. Pedersen
 Leaves widely ovate or ovate-oblong, concave, with obtuse to rounded apex, margin plane, recurved at base; nerve stout, reddish. Occasionally with \pm spherical, reddish rhizoidal gemmae. Forms dense, greenish to reddish yellow turfs, to 4 cm high, on waterlogged or seeping, acidic slopes, soils and rocks, in montane areas and high mountains, in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.
- 30 Plants glossy, with metallic sheen, reddish, sometimes blackish (fig. 53, 5) **B. alpinum** Huds. ex With.

- * **Imbribryum alpinum** (Huds. ex With.) N.Pedersen
- Leaves applied, slightly concave, margin plane or narrowly recurved; median cells narrowly rhomboidal to linear, 8-12 µm wide, thick-walled. Rhizoidal gemmae 100-140 µm wide. Capsule pyriform, reddish, neck, 1/3 capsule length. Forms dense, glossy, dark red or green turfs, by streams and on wet, seeping, acidic soils and rocks, from coastal areas to high mountains, in the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.
- 30 Plants without metallic sheen, usually green to brownish 31
- 31 Leaves widely bordered; margin strongly recurved (fig. 53, 4)
- B. pseudotriquetrum** (Hedw.) P. Gaertn., B. Mey. & Scherb.
- * **Ptychostomum pseudotriquetrum** (Hedw.) J.R.Spence & H.P.Ramsay
- Species very polymorphic. Plants to 10 cm tall. Stem tomentose. Leaves straight, lanceolate to ovate, decurrent, margin wide, recurved, plane and denticulate at apex; nerve reddish, percurrent or excurrent in apiculus. Capsule ovoid to pyriform; exostome teeth yellow or orange, with hyaline apex, endostome segments widely perforated. Forms dense, dark green to yellowish green turfs by streams and torrents, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca. Esp, And, Prt, Bl.
- 31 Leaves unbordered; margin plane or recurved at base (fig. 53, 6) **B. mildeanum** Jur.
- * **Imbribryum mildeanum** (Jur.) J.R.Spence
- Leaves ovate to ovate-lanceolate, concave, with acute apex, margin plane at apex, recurved below; nerve reddish at least at base, excurrent in short point. Forms lax, glossy yellow green turfs, to 4 cm tall, on siliceous soils, by streams or in periodically flushed sites, in the lowlands and montane areas. Scattered in the north of the Peninsula and Sierra Nevada. Esp, Prt, And.
- 32 Leaf margin plane 33
- 32 Leaf margin recurved 34
- 33 Leaves widely ovate, strongly concave; basal cells toward nerve rectangular, 40-90 x 20-50 µm; nerve 75-130 µm wide at base (fig. 53, 20) **B. funckii** Schwägr.
- * **Ptychostomum funckii** (Schwägr.) J.R.Spence
- Plants bulbiform. Stem with basal innovations. Leaves imbricate, reddish at base, keeled, margin plane, border indistinct; nerve excurrent in mucro or in short arista less than 200 µm long. Laminal cells slightly porose. Forms lax, yellowish green or whitish green turfs, to 3 cm high, on calcareous rock crevices, in montane areas and high mountains. Scattered in the Peninsula. Esp, And.
- 33 Leaves triangular to ovate-triangular, slightly concave; basal cells toward nerve quadrate or shortly rectangular, 15-30 x 12-15 µm; nerve 45-62 µm wide at base **B. kunzei** Hornsch.

* **Ptychostomum kunzei** (Hornsch.) J.R.Spence

Stem reddish. Leaves forming comal tuft, with acuminate or acute apex, margin plane, border not differentiated, nerve excurrent in arista 120-400 µm long. Laminal cells not porose. Forms dense, green or yellowish turfs, to 1 cm high, on calcareous rock crevices, in montane areas and high mountains. Scattered in the Peninsula. Esp, Prt.

- 34 Exostome with vertical or oblique lines joining transverse articulations (fig. 53, 17)

B. algovicum Sendtn. ex Müll.Hal.

* **Ptychostomum compactum** Hornsch.

Leaves forming comal tuft, ovate, ovate-elliptical or triangular, with acute or acuminate apex, margin recurved from base to apex, border of 5 rows of cells; laminal cells hexagonal, about 15 µm wide; nerve stout, excurrent, red at base. Capsule pyriform; spores 22-36 µm. Endostome partially joined to exostome. Forms dense, yellowish green or green turfs to 1,5 cm high on rock crevices, wet slopes and soils, in the lowlands and montane areas. Distributed in the north of the Peninsula and in Sierra Nevada. Esp.

- 34 Exostome without vertical or oblique lines joining transverse articulations

35

- 35 Endostome partially joined to exostome; cilia rudimentary or lacking **B. archangelicum** Bruch & Schimp.

* **Ptychostomum inclinatum** (Sw. ex Brid.) J.R.Spence, **B. imbricatum** (Schwägr.) Bruch & Schimp.

Leaves ovate-lanceolate or triangular, acuminate, margin recurved from base to apex, border wide, of 3-5 rows of cells; laminal cells 12-15 µm wide; nerve stout, reddish at base, excurrent. Capsule pyriform, constricted at mouth, neck 1/3 of urn length. Forms dense, green to yellowish green turfs, to 1,5 cm high, on acidic, wet soils and in rock crevices, in montane areas and high mountains, in the north of the Peninsula and in Sierra Nevada. Esp, And.

- 35 Endostome not joined to exostome; cilia long

36

- 36 Plants dioicous; leaves triangular or ovate-triangular (fig. 53, 21)

B. caespiticium Hedw.

* **Ptychostomum imbricatum** (Mull. Hal.) Holyoak & N.Pedersen

Stem with innovations. Leaves erect, in comal tufts, margin recurved, border indistinct; laminal cells 8-13 µm, basal cells reddish. Capsule pyriform, neck nearly half of the urn length; spores 12-15 µm. Forms compact, green to yellowish or brownish turfs, to 1,5 cm high, on exposed, calcareous or siliceous soils, wet slopes and rock crevices, from coastal areas to high mountains. Widespread throughout the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 36 Plants usually monoicous; leaves ovate, ovate-lanceolate or elliptical

37

- 37 Endostome segments with narrow perforations, cilia nodulose, not appendiculate

B. intermedium (Brid.) Blandow

* **Ptychostomum intermedium** (Brid.) J.R.Spence

Leaves in comal tufts, ovate to widely ovate-lanceolate, acuminate, red at base, border of 2-3 rows of cells; nerve stout, excurrent in smooth or denticulate point. Capsule pyriform. Exostome orange at base, with yellow or brownish yellow teeth; spores 18-24 μm . Forms dense, green or yellowish green turfs on wet, to 2 cm high, usually calcareous slopes, in montane areas and high mountains, in the Pyrenees and Cantabrian mountains. Esp.

37 Endostome segments with wide perforations, cilia slightly nodulose, longly appendiculate **38**

38 Spores 17-25 μm , papillose; stem simple or densely branched; plants to 10 cm long, tomentose (fig. 53, 18-19) **B. pallescens** Schleich. ex Schwägr.

* **Ptychostomum pallescens** (Schleich. ex Schwägr.) J.R.Spence

Leaves at stem apex ovate to ovate-lanceolate, red at base, acuminate, margin recurved from base to apex, border of 3-5 rows of cells; laminal cells 40-60 x 14-18(-22) μm ; nerve stout at base, noticeably narrower above, excurrent. Capsule inclined to horizontal, longly pyriform, neck nearly to half of the urn length; exostome pale yellow at base, with yellow teeth, endostome pale yellow. Forms compact turfs, on wet soils, walls and calcareous or siliceous rocks, near streams, in montane areas and high mountains. Widespread in the Peninsula. Esp, And, Prt.

38 Spores 12-15 μm , smooth; stem slightly branched; plants to 1 cm long, not tomentose

B. creberrimum Taylor

* **Ptychostomum creberrimum** (Taylor) J.R.Spence & H.P.Ramsay

Leaves crowded at stem apex, ovate-lanceolate, acuminate, margin recurved from base to apex, border wide; laminal cells 12-16 μm wide; nerve stout, excurrent in long point. Capsule cylindrical to pyriform, neck 1/3 of the urn length; exostome orange at base, with yellow teeth. Forms dense, green to yellowish green turfs, on wet soils, walls and in rick crevices, in montane areas and high mountains. Scattered in the Peninsula. Esp, And.

39 Leaves widely ovate, acute, concave (fig. 54, 9)

B. schleicheri DC.

* **Ptychostomum schleicheri** (DC.) J.R.Spence ex D.Bell & Holyoak

Laminal cells hexagonal, 14-25 μm wide; nerve yellow to brown, percurrent or excurrent. Capsule pyriform, constricted at mouth. Forms loose, light green turfs, to 4 cm high, on wet soils, peaty soils and by streams and lakes, in high mountains in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

39 Leaves ovate-lanceolate to triangular-lanceolate, plane or slightly concave

40

40 Leaves ovate-triangular, with wide base (fig. 54, 1-3)

B. turbinatum (Hedw.) Turner

* **Ptychostomum turbinatum** (Hedw.) J.R.Spence

Leaves not reddish at base. with yellowish border, sometimes bistratose; laminal cells about 18 μm wide, longly hexagonal; nerve brownish, \pm stout, percurrent to excurrent. Forms soft turfs, to 4 cm high, on wet, acidic or basic soils, peaty soils and by streams, in montane areas and high mountains. Distributed in the northern half of the Peninsula and in Sierra Nevada. Esp.

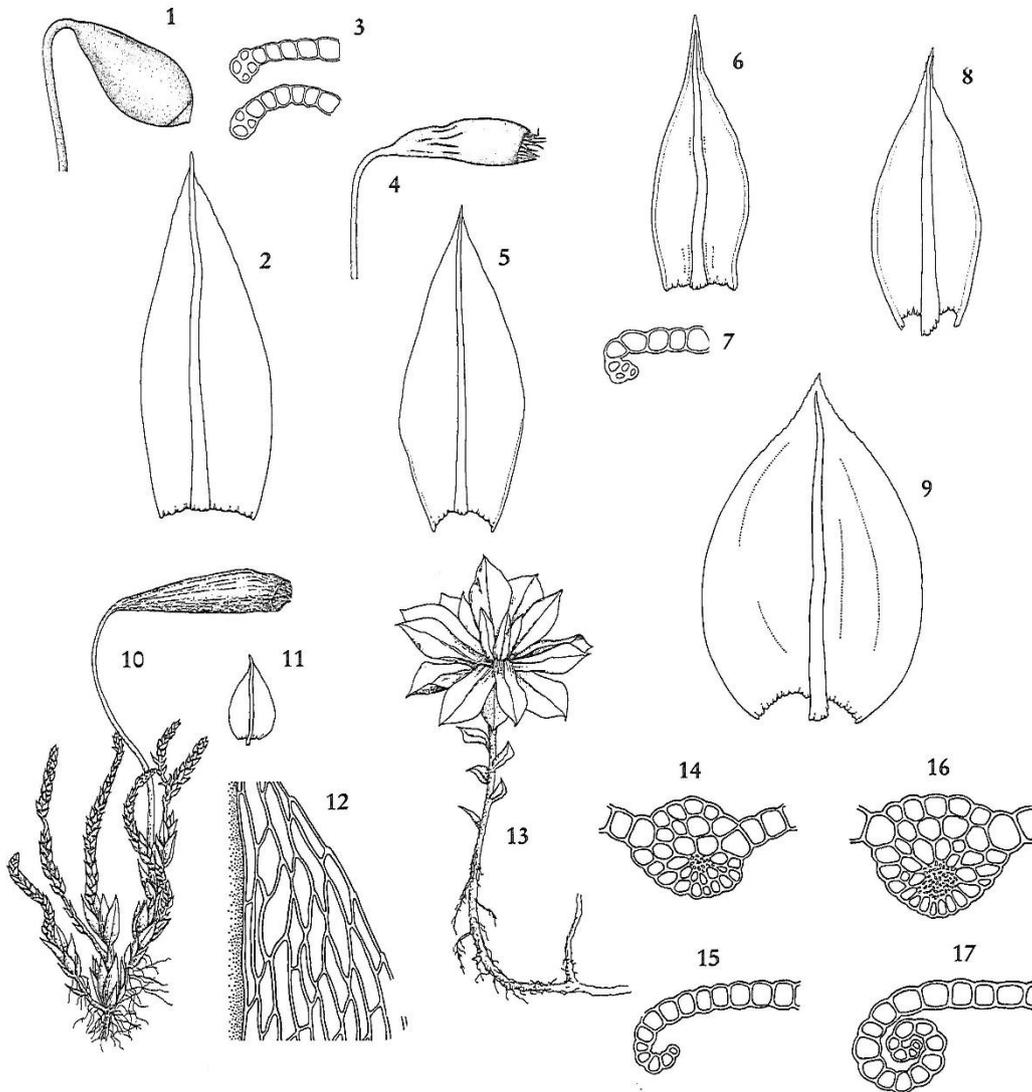


FIGURE 54. 1-3, *B. turbinatum*: 1, capsule; 2, leaf; 3, leaf margin sections. . 4-5, *B. uliginosum*: 4, capsule; 5, leaf. 6-7, *B. arcticum*: 6, leaf; 7, leaf margin section. 8, *B. pallens*, leaf. 9, *B. schleicheri*, leaf. 10-12, *Plagiobryum zieri*: 10, habit; 11, leaf; 12, laminal cells. 13-15, *Rhodobryum roseum*: 13, habit; 14, nerve section; 15, leaf margin section. 16-17, *R. ontariense*: 16, nerve section; 17, leaf margin section. 13 (x2); 10 (x4); 1, 4 (x5); 2, 5, 6, 8, 9, 11 (x16); 14, 15, 16, 17 (x100); 12 (x120); 3, 7 (x160).

41 Exostome teeth with articulations joined by longitudinal lamellae; plants synoicous (fig. 54, 6-7)

B. arcticum (R. Br.) Bruch & Schimp.

* *Ptychostomum arcticum* (R.Br.) J.R.Spence ex Holyoak & N.Pedersen

Leaves ovate-lanceolate, acuminate; nerve green or brownish, percurrent. Capsule pyriform, constricted at mouth. Forms short, reddish turfs on calcareous rocks and in wet rock crevices, in montane areas, in the north of the Peninsula. Esp (Extinct).

41 Exostome teeth with articulations not joined by longitudinal lamellae; plants dioicous or autoicous 42

42 Endostome with short or rudimentary cilia; plants autoicous (fig. 54, 4-5)

B. uliginosum (Brid.) Bruch & Schimp.

* **Ptychostomum cernuum** (Hedw.) Hornsch.

Stem to 2,5 cm high, with rhizoids along the stem. Leaves ovate-lanceolate to elliptical, acuminate; excurrent in a short apiculus. Capsule neck as long as urn; endostome hyaline. Forms loose, dark green turfs on seeping, acidic soils, slopes and in rock crevices, in montane areas and high mountains, in the Pyrenees. Esp.

42 Endostome with cilia as long as segments; plants dioicous (fig. 54, 8)

B. pallens Sw. ex anon.

* **Ptychostomum pallens** (Sw.) J.R.Spence

Plants not tomentose. Leaves elliptical to ovate-lanceolate, margin recurved, irregularly bistratose; nerve percurrent or shortly excurrent in apiculus; laminal cells 20-30 µm wide. Forms dense, dark green to wine-coloured turfs to 2 cm high, on wet or seeping, acidic soils and rocks and by streams, from the lowlands to high mountains. Distributed in the north of the Peninsula and in Sierra Nevada. Esp, And.

Plagiobryum Lindb.

Plants 1-3 cm tall, branched. Leaves ovate to ovate-lanceolate; laminal cells longly hexagonal to longly rhomboidal, lax; nerve percurrent to excurrent. Seta curved or sigmoid; capsule exerted, gibbous, mouth oblique, neck attenuate, as long as urn; peristome double, exostome shorter than endostome, cilia rudimentary.

1 Plants julaceous, whitish above, reddish below; leaves ovate or elliptic, concave, imbricate; nerve percurrent (fig. 54, 10-12)

P. zieri (Hedw.) Lindb.

* **Ptychostomum zieri** (Hedw.) Holyoak & N.Pedersen

Median elongate-hexagonal or rectangular, cells of lamina 16-24 µm wide, marginal cells narrower. Capsule horizontal. Grows in wet crevices of calcareous rocks, in the high mountains of the Pyrenees. Esp.

1 Plants hardly julaceous, reddish brown; leaves ovate-lanceolate, almost flat, not imbricate; nerve excurrent

P. demissum (Hook.) Lindb.

* **Ptychostomum demissum** (Hook.) Holyoak & N.Pedersen

Median cells of lamina hexagonal to rectangular, 16-18 µm wide, marginal cells narrower. Capsule pendulous. Grows on wet soils. Very rare in the high mountains of the Pyrenees. Esp.

Rhodobryum (Schimp.) Limpr.

Plants rhizomatous, with erect branches. Leaves crowded in terminal rosette, spatulate, dentate at apex, margin of narrow cells, recurved to revolute; median cells rhomboidal or hexagonal, 24-36 µm wide, basal cells rectangular; nerve percurrent to excurrent. Capsule pendulous, ellipsoidal, with short neck.

- 1 Rosette of 16-21 leaves; leaf margin narrowly recurved; nerve ending below apex, with a small stereid group, dorsal epidermis bistratose (fig. 54, 13-15) **R. roseum** (Hedw.) Limpr.
Plants to 7 cm tall, dark green. Leaves 5-9 mm long. Forms loose turfs on shady soils, in montane areas of the north of the Peninsula. Esp.

- 1 Rosette of 18-52 leaves; leaf margin strongly revolute; nerve percurrent or excurrent, with a numerous group of stereids, dorsal epidermis unistratose (fig. 54, 16-17) **R. ontariense** (Kindb.) Kindb.
Plants to 5 cm tall, light green. Leaves 5-7 mm long. Forms lax turfs on shady, humus-rich soils, in montane areas of the northern part of the Peninsula. Esp.

Fam. Mielichhoferiaceae

Epipterygium Lindb.

Stem reddish, 0,8-1,4 cm high. Leaves broadly oblong-elliptic, dimorph (larger lateral leaves and smaller dorsal leaves), margin plane, entire or denticulate at apex; median cells longly hexagonal, 18-40 µm wide, 3-4 rows of marginal cells, narrower and thick-walled; nerve extending half way up. Capsule pyriform to ovoid, horizontal to inclined, abruptly narrowed into short neck (fig. 55, 1-3) **E. tozeri** (Grev.) Lindb.

Plants gregarious or forming loose turfs on damp, acidic slopes, rotting trunks, by streams, in grasslands and rock crevices. Scattered from coastal areas to high mountains, in the Iberian Peninsula, Menorca and Pithyusic Islands. Esp, Prt, Bl.

Mielichhoferia Nees & Hornsch.

Stem slender, 1-3 cm high, branched, forming dense turfs on heavy-metal-containing rocks and soils. Leaves imbricate, ovate to lanceolate, ± denticulate at apex; cells rhomboidal, long, thin-walled or thick-walled, basal cells rectangular; nerve percurrent. Capsule exerted, pyriform, straight, horizontal or pendulous, with distinct neck; peristome single, consisting of exostome with papillose teeth, endostome lacking or rudimentary. Dioicous.

- 1 Nerve in cross section with 1 layer of large ventral cells; median cells 10-20 μm wide, thin-walled (fig. 55, 4-5) **M. elongata** (Hoppe & Hornsch. ex Hook) Hornsch.

Stem to 1,2 mm high. Leaves ovate-lanceolate. Forms light green or glaucous turfs, glossy above, brown below in damp, shaded sites on metal-enriched substrates. Rare in the Central Pyrenees. Esp.

- 1 Nerve in cross section with 2 layers of large ventral cells; median cells 7-10 μm wide, thick-walled (fig. 55, 6-8) **M. mielichhoferiana** (Funck) Loeske

Stem to 3 mm high. Leaves triangular-lanceolate. Forms light green turfs, glossy above, golden or brown below in damp, shaded sites on metal-enriched substrates, in montane areas and high mountains of the Pyrenees, also very localized in the west of the Peninsula. Esp, Prt, And.

Pohlia Hedw.

Plants variable in size, 1-10 cm tall. Stem branched or not. Leaves ovate to lanceolate, longer and narrower towards stem tip, apex acute or acuminate, rarely obtuse, denticulate above; laminal cells narrow, linear to longly hexagonal; nerve percurrent to excurrent. Capsule pendulous, ovoid to ellipsoidal, with short or long neck; peristome double, endostome with basal membrane and cilia sometimes rudimentary.

- 1 Stem without axillary bulbils **2**

- 1 Stem with axillary bulbils **11**

- 2 Leaf base longly and narrowly decurrent (fig. 55, 9) **P. ludwigii** (Spreng. ex Schwägr.) Broth.
Leaves more or less distant, erecto-patent when wet, concave and ovate, ovate-elliptical or ovate-lanceolate, acute to obtuse, sometimes cucullate; laminal cells longly rhomboidal, margin denticulate at apex. Dioicous. Very rare, forms dark green turfs on damp soils, mainly in snow-beds in high mountains in the Pyrenees. Esp.

- 2 Leaf base slightly decurrent or not decurrent **3**

- 3 Median cells of lamina long and narrow, 5-14(-16) μm wide **4**

- 3 Median cells of lamina wide, 14-25 μm wide **9**

- 4 Plants \pm glaucous, glossy, with metallic sheen when dry (fig. 55, 10) **P. cruda** (Hedw.) Lindb.

Plants 2-4 cm tall. Leaves erecto-patent to spreading when dry, flat, narrowly elliptical to lanceolate; laminal cells elongated. Perichaetial leaves strongly differentiated, long and narrow. Dioicous, paroicous or synoicous. Forms lax, light green or glaucous turfs on dry or wet soils, slopes, sandy soils or rotting stumps and in acidic rock crevices, in montane areas and high mountains of the Peninsula. Esp, Prt, And.

- 4 Plants not distinctly glossy when dry, mostly without metallic sheen 5
 5 Plants dioicous 6

- 5 Plants paroicous 7

- 6 Leaves appressed to erect when dry, carinate, upper leaves ovate-lanceolate, sometimes lanceolate

P. bolanderi (Lesq.) Broth.

Plants 0,5-4 cm tall. Leaves lanceolate to ovate-lanceolate, with acute apex, margin slightly denticulate. Perichaetial leaves slightly differentiated, longer and narrower than stem leaves. Forms compact, yellowish to brownish turfs on wet, acidic soils, sometimes in snow-beds, in high mountains. Scattered throughout the Peninsula.

var. **seriata** A.J.Shaw: Leaves arranged in 4-5 ranks, strongly keeled. Perichaetial leaves ovate-lanceolate to ovate. Esp, And.

var. **bolanderi**: Leaves not arranged in ranks, slightly keeled. Perichaetial leaves linear-lanceolate. Esp, Prt.

- 6 Leaves erecto-patent to spreading when dry, flat, upper leaves linear-lanceolate (fig. 55, 13)

P. lescuriana (Sull.) Ochi

Plants to 1,2 cm tall, green to yellowish brown, somewhat glossy. Rhizoidal gemmae spherical to pyriform, yellowish brown to reddish. Leaves linear-lanceolate to lanceolate, acute, denticulate at apex; median cells rhomboidal, 6-8 μm wide. Forms loose turfs on wet soils in montane areas and high mountains. Scattered throughout the Peninsula. Esp, Prt.

- 7 Laminal cell 125-165 μm long, thin-walled (fig. 55, 11) **P. longicolla** (Hedw.) Lindb.

Plants to 3 cm tall, bright light green, somewhat glossy. Leaves erect, densely arranged along stem, longly lanceolate, apex often twisted through 180°. Forms loose turfs on wet, acidic soil and in rock crevices, in high mountains of the Pyrenees. Esp, Prt, And.

- 7 Laminal cell 50-110 μm long, thick-walled 8

- 8 Laminal cells 7-10 μm wide; endostome widely perforated (fig. 55, 15) **P. nutans** (Hedw.) Lindb.

Stem 1,5-4 mm high, tomentose and with innovations at base. Capsule pyriform, horizontal to pendulous, narrower below mouth. Forms loose, glossy, yellowish, rarely green turfs, on wet slopes and ledges by streams and peatlands, in montane areas and high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

- 8 Laminar cell 5-6,5 μm wide; endostome not perforated or narrowly so (fig. 55, 12) **P. elongata** Hedw.
Plants to 2 cm tall, light green. Capsule narrowly ovoid or pyriform. Forms loose turfs on soils and acidic rock crevices, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.
var. **elongata**: Stem to 2 cm high. Neck 1/2 of the capsule length. Paroicous (fig. 55, 12).
var. **greenii** (Brid.) A.J.Shaw: Stem to 1 cm high. Urn shortly ovoid; neck less than 1/3 of the capsule length. Paroicous. Frequent in high mountains.
var. **acuminata** (Hornsch.) Huebener: Stem to 2 cm high. Neck 1/2 of the capsule length. Dioicous.
- 9 Leaf apex rounded, obtuse, sometimes cucullate (fig. 55, 14) **P. obtusifolia** (Vill. ex Brid.) L.F.Koch
Plants 1-2 cm tall. Leaves widely ovate, carinate. Forms dense, glossy pale green to brownish turfs in crevices, on slopes and rock ledges in high mountains. Very Rare in the Pyrenees and the Iberian Range. Esp, And.
- 9 Leaf apex acute, not cucullate **10**
- 10 Plants dark green to brownish, to 10 cm tall; leaves ovate; gemmae lacking (fig. 55, 16-17)
P. wahlenbergii (F.Weber & D.Mohr) A.L.Andrews
Leaf margin denticulate in the upper part. Capsule ovoid or shortly pyriform. Forms lax turfs on seeping, acidic or basic soils and rock crevices, from the lowlands to the high mountains, in the Peninsula and Mallorca. Esp, Prt, And, Bl.
- 10 Plants pale green to yellowish, to 5 cm tall; leaves lanceolate to ovate-lanceolate; sometimes with rhizoidal and protonematic gemmae (fig. 55, 18-20) **P. melanodon** (Brid.) A.J.Shaw
Protonematic gemmae filamentous, 50-200 μm . Rhizoidal gemmae globose or pyriform 150-200 μm . Leaf margin denticulate at apex. Capsule ovoid or shortly pyriform. Forms loose turfs on damp, exposed, clayey soils and seeping slopes and rocks, from coastal to montane areas, in the Peninsula, Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 11 1(2) Axillary bulbils **12**
- 11 2-7 Axillary bulbils **13**
- 12 Leaves erect-spreading, ovate; bulbils brownish, primordia arising from base or from middle of bulbil (fig. 55, 21-22) **P. drummondii** (Müll.Hal.) A.L.Andrews
Plants 1-5 cm tall, light or dark green, slightly glossy. Bulbils ovoid to cylindrical, 400-1000 μm . Forms dense turfs on damp, siliceous soils in high mountains, especially in snow-beds, in the north and centre of the Peninsula. Esp, And.

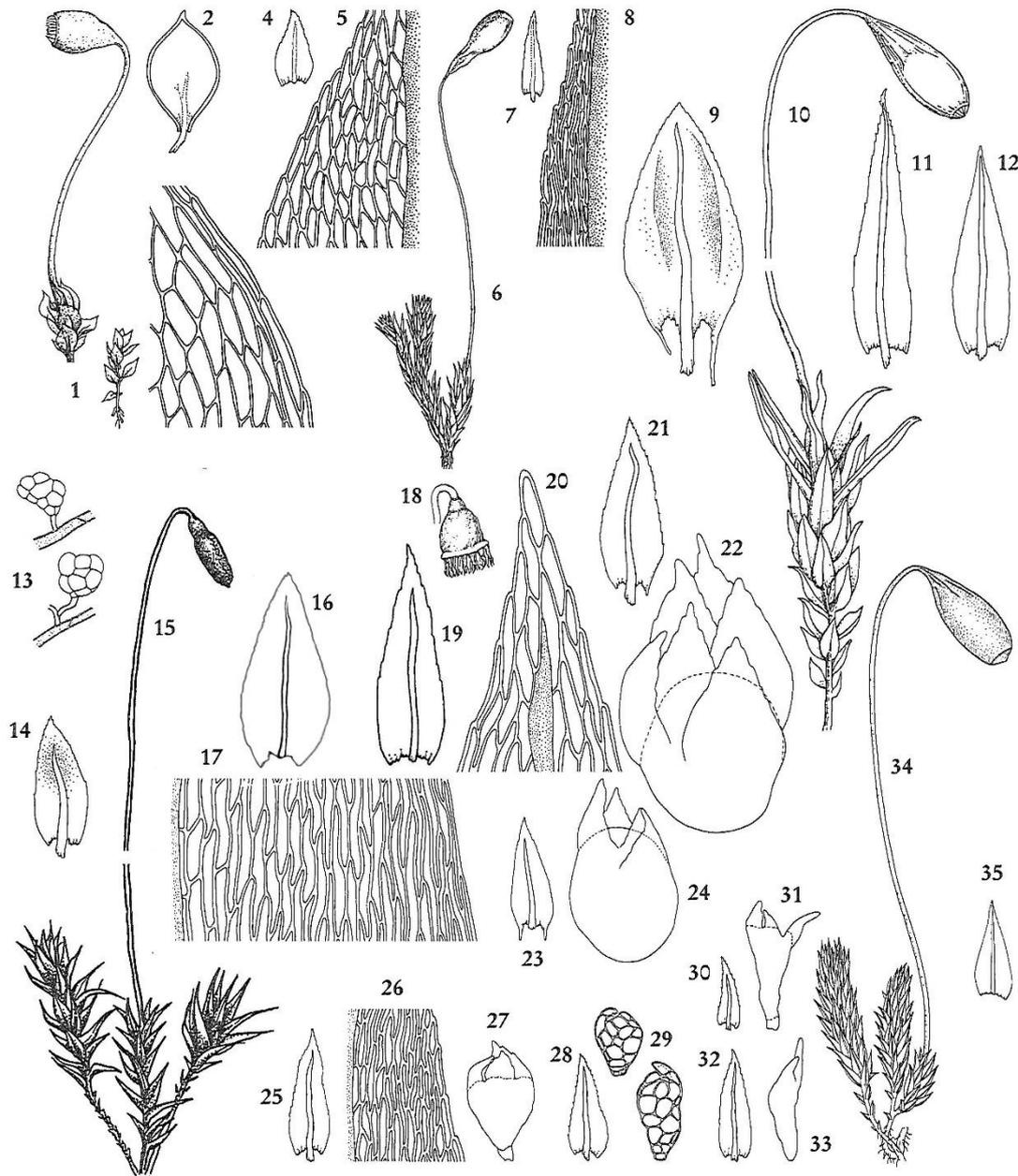


FIGURE 55. 1-3, *Epipterygium tozeri*: 1, habit, plants with and without sporophyte; 2, leaf; 3, laminal cells. 4-5, *Mielichhoferia elongata*: 4, leaf; 5, laminal cells. 6-8, *M. mielichhoferiana*: 6, habit; 7, leaf; 8, laminal cells. 9, *Pohlia ludwigii*, leaf. 10, *P. cruda*, habit. 11, *P. longicolla*, leaf. 12, *P. elongata*, leaf. 13, *P. lescuriana*, rhizoidal gemmae. 14, *P. obtusifolia*, leaf. 15, *P. nutans*, habit. 16-17, *P. wahlenbergii*: 16, leaf; 17, laminal cells. 18-20, *P. melanodon*: 18, capsule; 19, leaf; 20, leaf apex. 21-22, *P. drummondii*: 21, leaf; 22, bulbil. 23-24, *P. filum*: 23, leaf; 24, bulbil. 25-27, *P. andalusica*: 25, leaf; 26, laminal cells; 27, bulbil. 28-29, *P. camptotrachela*: 28, leaf; 29, bulbils. 30-31, *P. annotina*: 30, leaf; 31, bulbil. 32-33, *P. prolifera*: 32, leaf; 33, bulbil. 34-35, *Schizymenium pontevedrensis*: 34, habit; 35, leaf. 1, 6, 10, 15, 34 (x5); 18 (x10); 2, 4, 7, 9, 11, 12, 14, 16, 19, 21, 23, 25, 28, 30, 32, 35 (x16); 22 (x40); 24 (x50); 13, 27, 29, 31, 33 (x80); 3, 5, 8, 17, 20, 26 (x120).

12 Leaves erect, ovate-lanceolate; bulbils yellowish or brownish, primordia apical (fig. 55, 23-24)

P. filum (Schimp.) Martensson

Plants 1,5-6 cm tall. Bulbils ovoid to sub-spherical, 350-500 µm with primordia short, triangular and wide at base. Forms loose turfs on wet, sandy, acidic soils and in rock crevices by streams, in high mountains. Very rare, in the Central Pyrenees. Esp.

- 13 Bulbils obovoid, primordia apical (fig. 55, 25-27) **P. andalusica** (Höhn.) Broth.
Plants to 1 cm tall, bright green, sometimes reddish at base. Leaves ovate-lanceolate. Bulbils brownish to reddish green, 200-500 µm. Forms lax turfs or gregarious on wet soils, slopes and in exposed, acidic rock crevices in montane areas and high mountains of the Pyrenees and Sierra Nevada. Esp, Prt, And.
- 13 Bulbils obconic, vermicular or rounded, without primordia but with acute, more or less long teeth at apex **14**
- 14 Bulbils ± rounded (fig. 55, 28-29) **P. camptotrachela** (Renauld & Cardot) Broth.
Plants 0,5-1,5 cm tall. Bulbils 125-150 µm, yellowish to greenish, brownish when old, 1-4 apical teeth of 1-2 cells. Leaves ovate-lanceolate, denticulate at apex. Forms loose, dull, pale green turfs on wet, acidic soils from the lowlands to high mountains of the northern half and centre of the Peninsula and Sierra Nevada. Esp, Prt, And.
- 14 Bulbils obconic, ovoid, oblong or vermicular **15**
- 15 Bulbils vermicular, rarely obconic, apical teeth 1/3 length of bulbil, with 2-4 unicellular or pluricellular teeth (fig. 55, 30-31) **P. annotina** (Hedw.) Lindb.
Plants bright, 1-2 cm tall. Leaves lanceolate to ovate-lanceolate, acute, denticulate in the upper part. Forms lax, yellowish, light green, orange or reddish turfs on wet, shaded, acidic soils, from the lowlands to high mountains. Scattered throughout the Peninsula. Esp, Prt, And.
- 15 Bulbils vermicular or obovoid to oblong, apical teeth to 1/4 length of bulbil **16**
- 16 Bulbils vermicular, with 1-2 long apical teeth, about 1/4 length of bulbil (fig. 55, 32-33) **P. proligera** (Kindb.) Lindb. ex Broth.
Stem 0,3-2,5 cm high. Leaves narrowly lanceolate to ovate-lanceolate, denticulate in the upper part. Forms lax, glossy, light green, reddish at base turfs on wet, shaded, acidic soils. Scattered in the north and west of the Peninsula. Esp, Prt, And.
- 16 Bulbils vermicular or obovoid to oblong, without apical teeth or with teeth up to 30 µm long, 1/10 length of bulbil **P. flexuosa** Harv.

Stem 1-2 cm high. Leaves ovate-lanceolate to ovate, denticulate at apex. Forms light green to orange, dull lax turfs, on wet, acidic slopes and wet grasslands in montane areas and high mountains. Rare, in the Eastern and Central Pyrenees. Esp.

Schizymerium Harv.

Stem slender, to 1 cm high, yellowish green or glaucous, branched at base. Leaves imbricate when dry, ovate-lanceolate, acute, apex denticulate, margin recurved at base; median cells linear, 55-90 x 6-9 μm , basal cells shorter, wide; nerve percurrent. Capsule exserted, pyriform, with perceptible neck, horizontal to inclined, inclined when old; peristome single, consisting of endostome with smooth segments, exostome lacking. Synoicous (fig. 55, 34-35)

S. pontevedrensis (Luisier) Sérgio, Casas, Cros & Brugués

Forms dense turfs on wet, shaded, granitic or schistose rocks, in the lowlands and montane areas, in the west of the Peninsula. Esp, Prt.

Fam. Mniaceae

Mnium Hedw.

Stem up to 4-5 cm high, generally unbranched. Leaves lanceolate, elliptical or oblong; laminal cells elongate or \pm isodiametric, marginal cells longer, forming a border 2-3-stratose of elongate cells, with geminate teeth (except *M. stellare* which has leaves unbordered and simple teeth); nerve ending below apex, percurrent or excurrent in apiculus, often toothed at back above. Capsule oblong, inclined to pendulous; peristome double.

- 1 Plants bluish when dry; leaves unbordered; margin with simple teeth (fig. 56, 1-2) **M. stellare** Hedw.
Plants 1-4 cm tall. Laminal cells irregular, quadrate hexagonal or shortly rectangular, 23-30 μm wide. Dioicous. Forms dense or lax turfs on usually calcareous soils and rocks, in the lowlands and montane areas of the northern half of the Peninsula. Esp, Prt, And.
- 1 Plants not bluish when dry; leaves bordered; margin with geminate teeth **2**
- 2 Lower leaves densely arranged; nerve ending below apex (fig. 56, 5-8) **M. hornum** Hedw.
Plants 3,5-5 cm tall. Upper leaves elliptical, slightly decurrent; laminal cells 17-25 μm wide. Lid apiculate. Forms lax turfs on damp soils in beechwoods, oakwoods and pinewoods in the northern half and west of the Peninsula and in Algeciras Mountains. Esp, Prt, And.
- 2 Lower leaves sparsely arranged; nerve percurrent or excurrent **3**

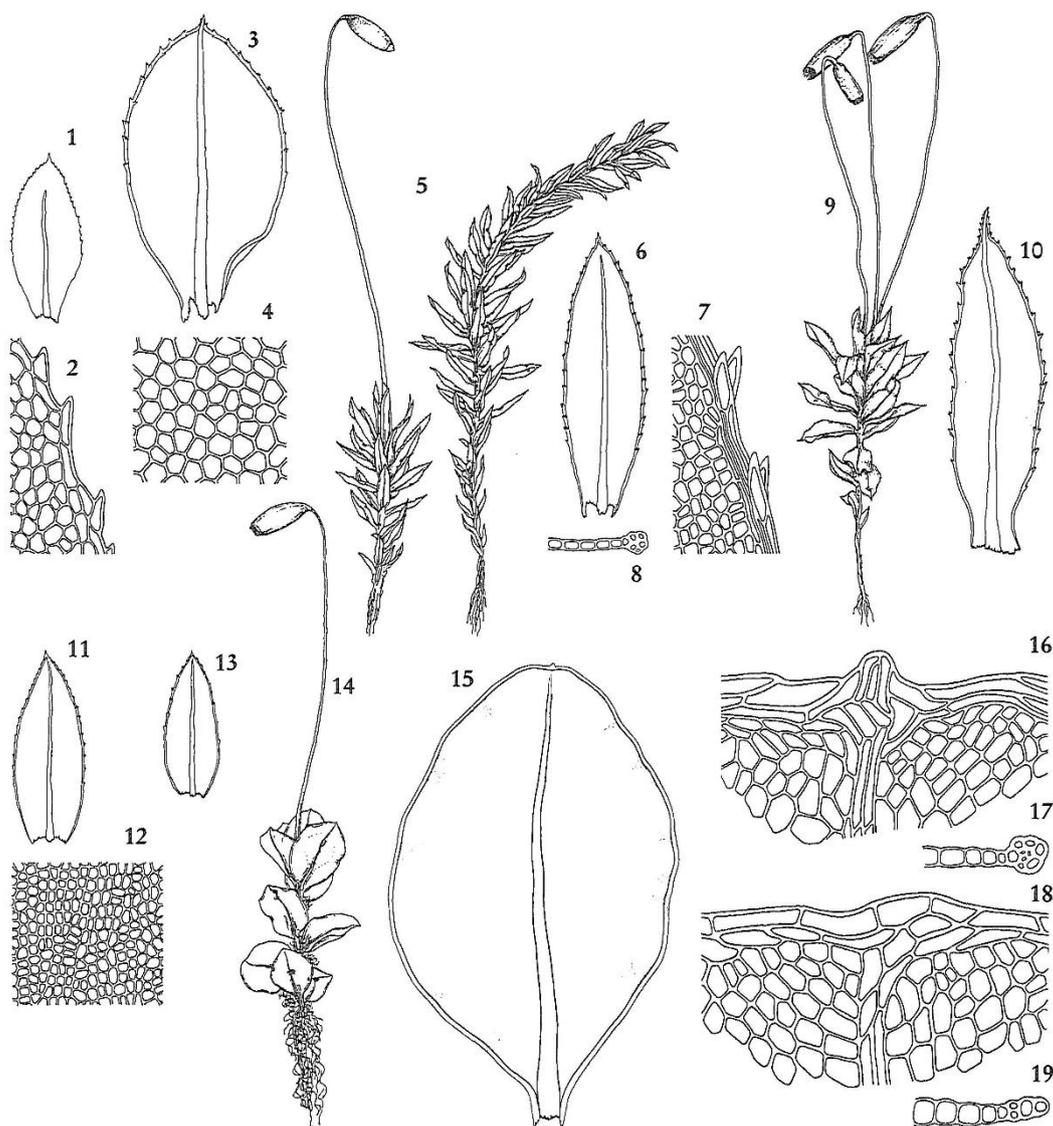


FIGURE 56. 1-2, *Mnium stellare*: 1, leaf; 2, leaf margin. 3-4, *M. spinulosum*: 3, leaf; 4, laminal cells. 5-8, *M. hornum*: 5, habit, plants with and without sporophyte; 6, leaf; 7, leaf margin; 8, leaf margin section. 9-10, *M. spinosum*: 9, habit; 10, leaf. 11-12, *M. thomsonii*: 11, leaf; 12, laminal cells. 13, *M. lycopodioides*, leaf. 14-17, *Rhizomnium punctatum*: 14, habit; 15, leaf; 16, leaf apex; 17, leaf margin section. 18-19, *R. magnifolium*: 18, leaf apex; 19, leaf margin section at base. 5, 9, 14 (x1.5); 1, 3, 6, 10, 11, 13, 15 (x8); 2, 4, 7, 8, 12, 16, 17, 18, 19 (x100).

3 Laminal cells elongated, 2:1, arranged in radiating rows (fig. 56, 9-10) **M. spinosum** (Voit.) Schwägr.
Plants 2-5 cm tall. Upper leaves elliptical, widely decurrent, nerve percurrent; laminal cells 13-20 µm wide. Lid rostrate. Forms lax turfs in fir woods, beechwoods, oakwoods and pinewoods in the north of the Peninsula. Esp, And.

3 Laminal more or less isodiametric, not arranged in radiating rows **4**

4 Nerve 135-150 µm wide in mid-leaf (fig. 56, 3-4) **M. spinulosum** Bruch & Schimp.

Plants 2-3,5 cm tall. Leaves obovate or elliptic, bright, with stout margin, nerve smooth or with a few teeth at back above; laminal cells 20-25 μm wide. Synoicous. Lid rostrate. Forms lax turfs, 2-3 cm high in montane areas. Scattered in the northeast of the Peninsula. Esp, And.

4 Nerve 50-90 μm wide in mid-leaf 5

5 Laminal cells of leaf homogeneous, 13-17 μm wide (fig. 56, 11-12) **M. thomsonii** Schimp.
Plants 1,5-3 cm tall. Leaves elliptical-lanceolate or elliptic, decurrent; nerve reddish, toothed at back above. Dioicous. Forms loose or dense turfs on calcareous soils and rocks, in montane areas and high mountains. Mainly in the north of the Peninsula. Esp, And.

5 Laminal cells of leaf heterogeneous, more than 17 μm wide 6

6 Marginal teeth blunt; nerve lacking teeth at back or with a few blunt teeth

M. marginatum (Dicks.) P.Beauv.

Plants 2-4 cm tall. Stem and leaves often dark red. Leaves elliptic; laminal cells 25-27 μm wide. Synoicous. Forms lax, dark green or reddish turfs, on wet, usually calcareous rocks and soils, in montane areas and high mountains of the north of the Peninsula, sporadic in the southeast and Mallorca. Esp, And, Bl.

6 Marginal teeth sharp; nerve with numerous, acute teeth at back (fig. 56, 13) **M. lycopodioides** Schwägr.
Plants 2,5-3 cm tall. Leaves narrowly elliptical to oblong; laminal cells 20-25 μm wide. Dioicous. Grows on wet, acidic slopes in montane areas and high mountains of the north of the Peninsula. Esp, And.

Rhizomnium (Broth.) T.J. Kop.

Plants erect, to 10 cm tall. Stem with macronemata, micronemata present or not. Leaves orbicular, elliptical or obovate, apex rounded, sometimes emarginate or apiculate, bordered by narrow, elongate cells, margin entire, nerve percurrent or not reaching apex; laminal cells 30-75 μm wide, longly hexagonal. Capsule oblong, horizontal or pendulous. Dioicous.

1 Leaf margin pluristratose from base to apex; stem with macronemata, micronemata lacking (fig. 56, 14-17) **R. punctatum** (Hedw.) T.J.Kop.

Leaves to 6 mm long, apex apiculate; nerve stout, reddish brown. Forms turfs to 6 cm high on very wet soils and rocks, by streams and on rotting stumps, from the lowlands to high mountains. Widespread in the Peninsula, rare in Mallorca. Esp, Prt, And, Bl.

- 1 Leaf margin unistratose, only pluristratose in lower part; stem with macronemata and micronemata (fig. 56, 18-19) **R. magnifolium** (Horik.) T.J.Kop.
Leaves to 10 mm long, with rounded or emarginate apex; nerve stout at base. Forms turfs to 10 cm high by streams and on damp, peaty soils in high mountains of the north of the Peninsula and in Serra da Estrela. Esp, Prt, And.

Cyrtomnium Holmen

Plants complanate, 2-3 cm tall. Stem with macronemata and micronemata. Leaves bluish green, crisped when dry, ovate or broadly elliptic, 1-2 mm, base not decurrent, apex obtuse, apiculate, margins plane, green or bluish green, unistratose, entire, nerve ending below apex; medial median laminal cells rounded-hexagonal, marginal cells linear, in 2-4 rows. Dioicous **C. hymenophylloides** (Huebener) T.J.Kop.

Forms soft, loose bluish green tufts on moist shaded calcareous soils and rocks in high mountains. Very rare in the Pyrenees. Esp.

Plagiomnium T.J.Kop.

Plants medium-sized to robust. Fertile shoots straight, with leaves arranged in 3 rows, the sterile ones creeping, with complanate leaves. Leaves plane or undulate, margin with simple teeth; marginal cells forming a unistratose border of narrow and elongated cells; nerve percurrent or excurrent in apiculus. Capsule ovoid to oblong, inclined or pendulous.

- 1 Leaves with dentate margin in upper half; leaf apex acute (fig. 57, 1) **P. cuspidatum** (Hedw.) T.J.Kop.
Leaf obovate, with acute apex; laminal cells with thickened walls at corners; nerve percurrent. Fertile shoots with one sporophyte per perichaetium. Forms lax green or yellowish green turfs, 2-4 cm high, on wet, shaded soils and rock crevices, in montane areas and high mountains, rarely in the lowlands, in the northern half of the Peninsula and in Sierra Nevada. Esp, And.

- | | | |
|---|---|----------|
| 1 | Leaves with dentate margin from base; leaf apex acute or obtuse | 2 |
| 2 | Leaves not or only slightly decurrent | 3 |
| 2 | Leaves decurrent | 4 |

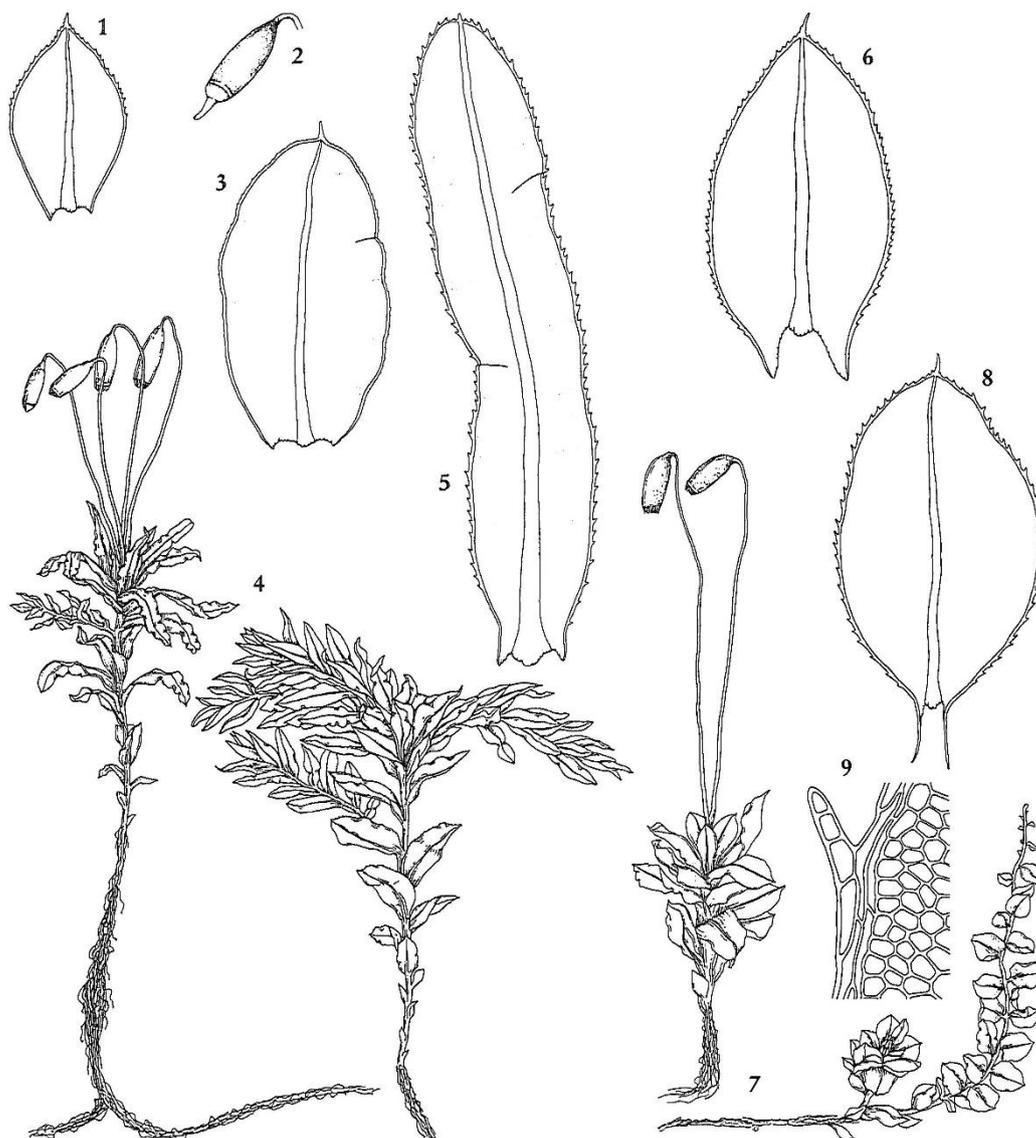


FIGURE 57. 1, *Plagiommium cuspidatum*, leaf. 2, *P. rostratum*, capsule. 3, *P. ellipticum*, leaf. 4-5, *P. undulatum*: 4, habit, plants with and without sporophyte; 5, leaf. 6, *P. elatum*, leaf. 7-9, *P. affine*: 7, habit, plants with and without sporophyte; 8, leaf; 9, leaf margin. 4, 7 (x1,5); 2 (x3); 1, 3, 5, 6, 8 (x8); 9 (x100).

3 Laminal cells hexagonal, isodiametric or slightly elongated, 22-35 μm long; stem lacking rhizoids in upper part; lid rostrate; synoicous (fig. 57, 2) ***P. rostratum*** (Schrad.) T.J.Kop.

Laminal cells with thickened walls at corners; marginal teeth unicellular. Fertile shoots 2-7 cm high, 1-5 sporophytes per perichaetium. Forms lax, green or dark green turfs on wet, shaded soils and rocks, mainly on calcareous substrata, from the lowlands to high mountains. Widespread in the northern half of the Peninsula, less frequent in the south and in Mallorca. Esp, Prt, And, Bl.

3 Laminal cells hexagonal, elongated, 50-65 μm long; stem covered with tomentum, often to top; lid convex; dioicous (fig. 57, 3) ***P. ellipticum*** (Brid.) T.J.Kop.

Leaves elliptical, apiculate, marginal teeth of 1 cell; laminal cells in divergent rows; nerve percurrent to excurrent. Fertile shoots to 10 cm high, 1-3 sporophytes per perichaetium. Forms light green turfs or patches on waterlogged soils, in montane areas and high mountains of the north of the Peninsula. Esp, And.

- 4 Leaves oblong-lingulate, transversely undulate; laminal cells 10-16 μm wide (fig. 57, 4-5)

P. undulatum (Hedw.) T.J.Kop.

Leaf margin with unicellular, sharp teeth. Fertile shoots branched, mostly with 2-5 sporophytes per perichaetium. Forms dark green turfs or patches, to 8 cm high, on damp or waterlogged soils, from the lowlands to montane areas. Widespread in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

Plants more than 8 cm tall and with large median leaf cells (25-40 μm wide) correspond to var. **madeirense** Kop. & Sérgio. Prt.

- 4 Leaves widely elliptical, not undulate; laminal cells more than 20 μm wide

5

- 5 Laminal cells isodiametric or slightly elongated; synoicous **P. medium** (Bruch & Schimp.) T.J.Kop.

Leaves shortly and widely decurrent, marginal teeth of 1-2 cells; laminal cells with thickened walls. Fertile shoots 3-9 cm high, with 2-5 sporophytes per perichaetium. Forms dark green turfs or patches on wet soils and water-splashed rocks of montane areas and high mountains in the northern half of the Peninsula. Esp, Prt, And.

- 5 Laminal cells elongated; dioicous

6

- 6 Leaves longly and widely decurrent (fig. 57, 6)

P. elatum (Bruch & Schimp.) T.J.Kop.

Marginal teeth of 1-2 cells. Forms light green turfs or patches on wet, from the lowlands to high mountains, in the northern half of the Peninsula and in Mallorca. Esp, And, Bl.

- 6 Leaves longly and narrowly decurrent (fig. 57, 7-9)

P. affine (Blandow ex Funck) T.J.Kop.

Plants to 8 cm tall. Marginal teeth of 1-4 cells. Forms loose, dark green turfs or patches on wet soils and rocks, from the lowlands to montane areas. Scattered throughout the Peninsula and Mallorca. Esp, Prt, And, Bl.

Fam. Aulacomniaceae

Aulacomnium Schwägr.

Leaves ovate-lanceolate to lanceolate, crisped when dry, margin entire, denticulate at apex or crenulate, recurved or not; laminal cells rounded-hexagonal, thick-walled, with a single, conical papilla on both surfaces;

nerve percurrent. Seta straight; capsule cylindrical, striate; peristome double. Often with gemmae in globose clusters at the end of leafless prolongations of stems.

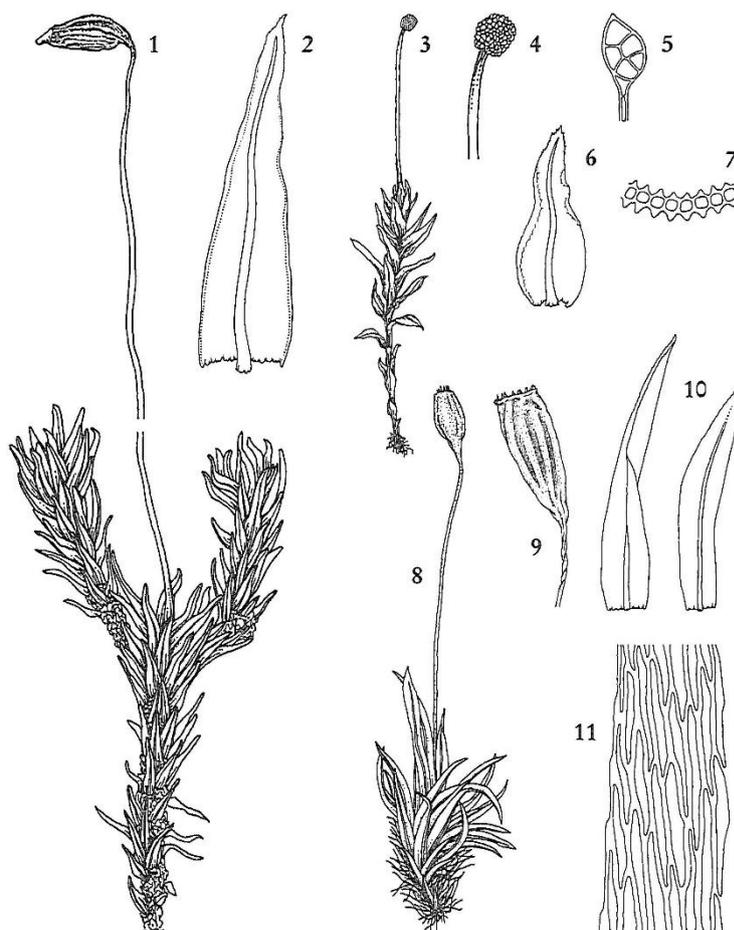


FIGURE 58. 1-2, *Aulacomnium palustre*: 1, habit; 2, leaf. 3-7, *A. androgynum*: 3, habit; 4, gemma cluster; 5, gemma; 6, leaf; 7, lamina section. 8-11, *Orthodontium pellucens*: 8, habit; 9, capsule when dry; 10, leaves; 11, median cells. 1 (x3); 3 (x4); 8 (x6); 4, 9 (x10); 2, 6, 10 (x16); 5, 7, 11 (x160).

1 Stem with dense, brown tomentum; plants to 10 cm tall; median cells of leaf with stellate lumen (fig. 58, 1-2) **A. palustre** (Hedw.) Schwägr.

Leaves lanceolate, apex entire or dentate, sometimes obtuse. Occasionally with fusiform gemmae. Forms extensive, compact, light green or yellowish turfs in peaty or wet grasslands and moorlands, in montane areas and high mountains. Widespread in the northern half of the Peninsula, rare in the south. Esp, Prt, And.

1 Stem with scarce tomentum; plants to 2,5 cm tall; median cells of leaf with rounded or oblong lumen (fig. 58, 3-7) **A. androgynum** (Hedw.) Schwägr.

Leaves ovate-lanceolate, apex acute, dentate. Usually with pluricellular ovoid to spherical gemmae in globose clusters. Forms lax, green turfs on wet, shaded, acidic slopes, bases of trees and tree stumps, in montane areas of the Peninsula. Esp, Prt, And.

Fam. Orthodontiaceae

Orthodontium Schwägr.

Stem to 0,5 cm high, densely tomentose at base. Rhizoidal gemmae brownish. Leaves linear-lanceolate, acuminate, carinate, margin plane, denticulate at apex; median cells smooth, linear 60-180 x 10-12 μm ; nerve ending below apex. Seta straight; capsule exserted, erect, oblong-pyriform, sulcate when dry, with short neck; peristome double, exostome pale yellow, with smooth, or finely papillose teeth, endostome with fragile segments, hyaline at base (fig. 58, 8-11)

O. pellucens (Hook.) Bruch & Schimp.

Grows in shaded, siliceous rock crevices and on rotten wood. Only one locality in the northwest of the Peninsula. Esp (Extinct).

O. Hookeriales

Fam. Hypopterygiaceae

Hypopterygium Brid.

Plants to 3-4 cm long. Primary stem creeping, secondary stems erect, pinnately branched, dendroid. Leaves with finely denticulate margin in the upper part, arranged in 3 rows, two rows of asymmetrical, ovate, distichous leaves with acute apex and a third row of symmetrical, orbicular, ventral leaves with acuminate apex; laminal cells quadrangular to hexagonal, 13-16 μm wide, 1-5 rows of longer marginal cells; nerve extending half way up to nearly reaching apex (fig. 59, 1-4)

H. tamarisci (Sw.) Brid. ex Müll.Hal.

Grows on wet, shaded sites. Very rare, in Serra do Bussaco. Prt.

Fam. Hookeriaceae

Hookeria Sm.

Stem decumbent, 4 cm long, sparsely branched. Leaves ovate, obtuse, asymmetrical, complanate, margin plane, entire; laminal cells hexagonal, 60-80 μm wide, smooth, usually narrower at margins; nerve lacking. Capsule ellipsoidal, horizontal, brownish; peristome double, exostome reddish, endostome yellowish (fig. 59, 5-7)

H. lucens (Hedw.) Sm.

Forms glossy, pale green patches on wet soils and seeping rocks in montane areas. Widespread in the northern half of the Peninsula, rare in the south. Esp, Prt.

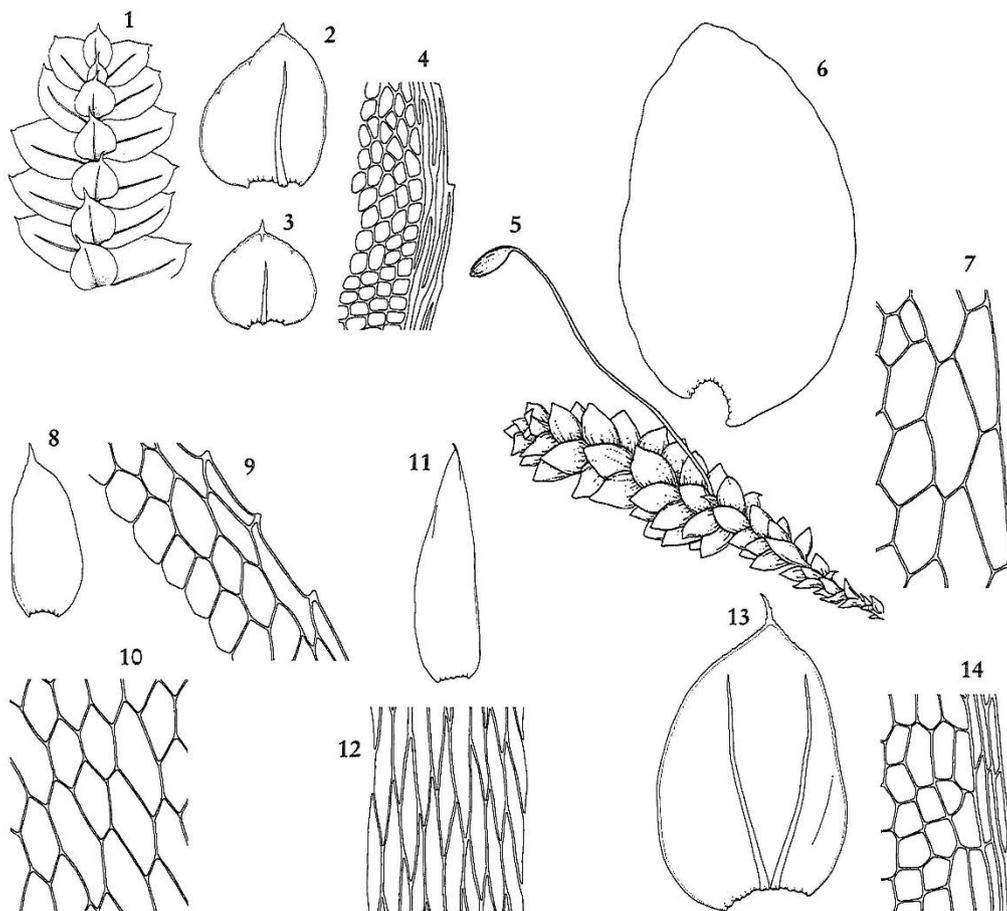


FIGURE 59. **1-4, *Hypopterygium tamarisci***: 1, habit; 2, leaf; 3, leaf on ventral side; 4, marginal cells. **5-7, *Hookeria lucens***: 5, habit; 6, leaf; 7, marginal cells. **8-10, *Tetrastichium fontanum***: 8, leaf; 9, upper marginal cells; 10, median cells. **11-12, *T. virens***: 11, leaf; 12, median cells. **13-14, *Cyclodictyon laetevirens***: 13, leaf; 14, marginal cells. **5** (x2); **1** (x10); **6** (x12); **2, 3, 8, 11, 13** (x16); **7** (x100); **4, 9, 10, 12, 14** (x160).

Fam. Leucomiaceae

Tetrastichium (Mitt.) Cardot

Plants medium-sized. Stem irregularly branched. Stem leaves complanate, oblong, lanceolate to ovate, symmetrical to strongly asymmetrical, gradually or abruptly tapered, acute, acuminate or apiculate, concave, margin entire or denticulate at apex; lamina with marginal cells narrower than median cells, alar cells not differentiated, not decurrent; nerve short, single or double, or lacking. Branch leaves similar to stem leaves or smaller.

- 1 Leaves oblong to ovate-oblong, with obtuse and apiculate apex; median cells 20-24 μm wide (fig. 59, 8-10) **T. fontanum** (Mitt.) Cardot

Plants 2-4 cm tall. Leaves usually asymmetrical, margin denticulate at apex. Grows on wet, shaded rocks. Very rare, in Algeciras Mountains. Esp.

- 1 Leaves lanceolate to ovate-lanceolate, gradually or rather suddenly narrowed to acute or acuminate apex; median cells 10-16 μm wide (fig. 59, 11-12) **T. virens** (Cardot) S.P.Churchill

Plants 2-3 cm tall. Leaves symmetrical or slightly asymmetrical, margin entire or slightly denticulate near apex. Grows on seeping, shaded rocks. Very rare, in Algeciras Mountains. Esp.

Fam. Pilotrichaceae

Cyclodictyon Mitt.

Plants slender to medium-sized. Stem decumbent, sparsely to densely tomentose. Leaves shrunken when dry, complanate, asymmetrical, concave, broadly ovate, acute or apiculate, margin denticulate near apex; laminal cells large, hexagonal, thin-walled, 15-20 μm wide, 3-4 marginal rows very narrow, forming a distinct border; nerve double, divergent, extending to 3/4 way up leaf. Capsule horizontal, ovoid (fig. 59, 13-14)

C. laetevirens (Hook. & Taylor) Mitt.

Forms soft dark green patches on seeping slopes and at base of trees by streams, in the lowlands in the northwest of the Peninsula. Esp, Prt (Extinct).

O. Hypnales

Fam. Fontinalaceae

Dichelyma Myrin

Plants large, to 10 cm, rheophilous, regularly branched. Leaves tristichous, lanceolate, carinate, acuminate, \pm falciform, secund, with denticulate apex; laminal cells uniform, very long and narrow, basal cells shorter; nerve percurrent to excurrent in short point. Capsule cylindrical, exserted (fig. 60, 1)

D. falcatum (Hedw.) Myrin

Plants dark green, flexuose. Forms loose tufts on submerged rocks in waterfalls in montane areas in the Pyrenees. Very rare. Esp.

Fontinalis Hedw.

Plants slender to robust, rheophilous, sometimes floating. Stem flexuose, irregularly branched. Leaves lanceolate to ovate-lanceolate, plane, concave or carinate, margin plane, entire or denticulate at apex; laminal cells elongate, narrow, smooth, alar cells short and wider; nerve lacking. Perichaetial leaves short, wide, usually erose. Seta short; capsule ovoid, immersed; peristome double.

1 Leaves carinate (fig. 60, 2-3)

F. antipyretica Hedw.

Plants robust, 10-40 cm long, dark green to brownish. Leaves erect; laminal cells 5-12 μm wide, alar cells rectangular or oblong, hyaline to brownish. Species very polymorphic. Forms loose tufts, floating, fixed to rocks submerged in streams, from the lowlands to high mountains. Widespread in the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

1 Leaves plane or concave, not carinate

2

2 Leaves plane, border not differentiated (fig. 60, 4-5)

F. hypnoides C.Hartm. var. duriaei (Schimp.) Kindb.

Plants medium-sized to robust, (5-)10-40 cm long. Leaves lanceolate to ovate-lanceolate, with short, wide, denticulate point; cells 10-12 μm wide, narrower towards margin, alar cells rectangular or oblong, yellow to brownish. Forms loose, floating or submerged tufts, fixed to rocks in streams, pools or ponds, from the lowlands to high mountains. Widespread in the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

2 Leaves concave, border of 1-2 rows of narrow cells (fig. 60, 6-11)

F. squamosa Hedw.

Leaves imbricate, erecto-patent, ovate-lanceolate, acuminate, border yellowish or brownish; laminal cells 12 μm wide, alar cells brownish. Forms loose, floating or submerged, dark green, olive or brownish tufts, 10-30 cm long, densely branched and fixed to rocks in streams from the lowlands to high mountains, in the northern half and west of the Peninsula and in Sierra Nevada. Esp, Prt, And.

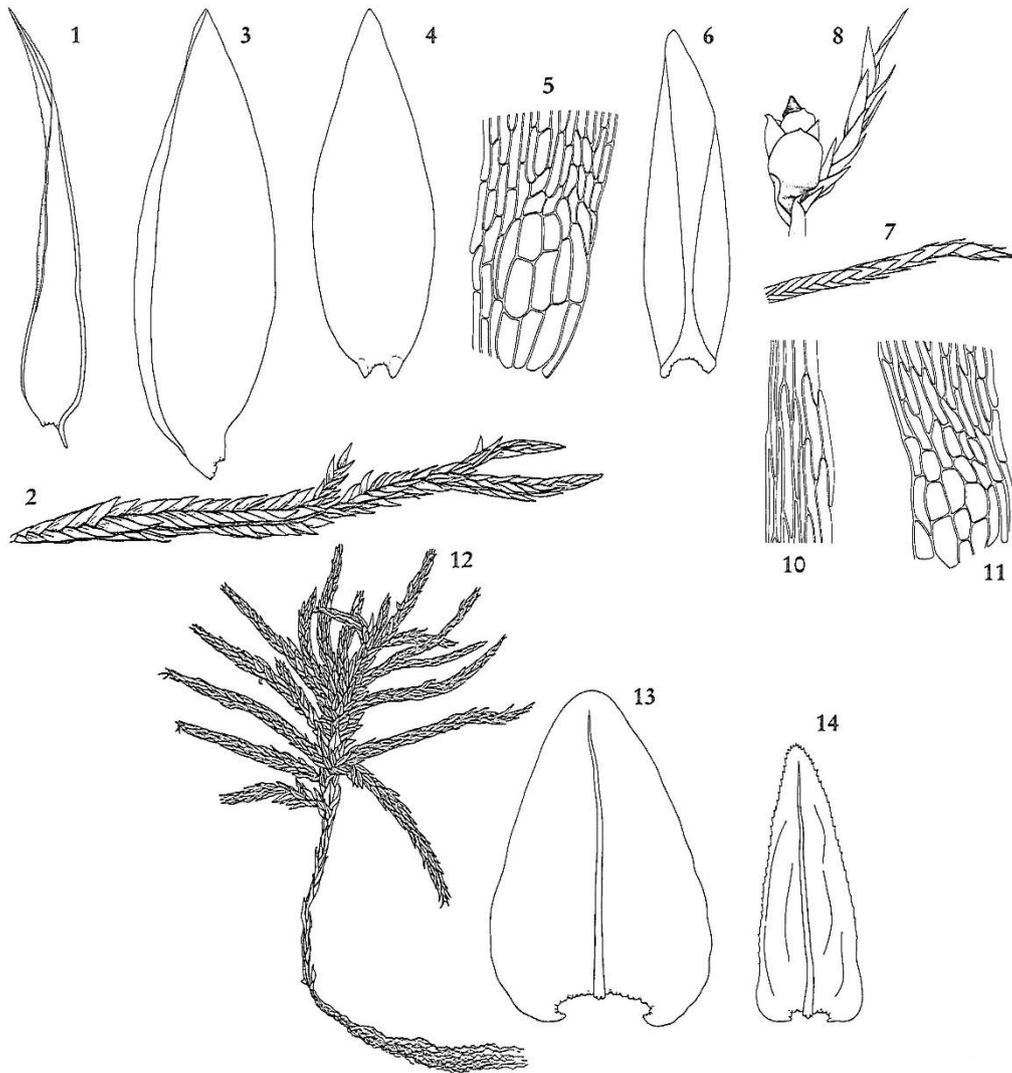


FIGURE 60. 1, *Dichelyma falcatum*, leaf. 2-3, *Fontinalis antipyretica*: 2, habit; 3, leaf. 4-5, *F. hypnoides* var. *duriaei*: 4, leaf; 5, alar cells. 6-11, *F. squamosa*: 6, leaf; 7, branch when dry; 8, capsule when dry; 10, marginal cells; 11, alar cells. 12-14, *Climacium dendroides*: 12, habit; 13, leaf of secondary stem; 14, branch leaf. 2, 12 (x1,6); 7 (x2,6); 8 (x4); 1, 3, 4, 6, 13, 14 (x12); 5, 10, 11 (x120).

Fam. Climaciaceae

Climacium F.Weber & D.Mohr

Plants dendroid. Primary stem densely tomentose, subterranean, secondary stems erect. Leaves of secondary stems appressed, ovate-cordiform, obtuse or apiculate, plicate or not. Branch leaves ovate-lanceolate, obtuse, imbricate, plicate, margin plane or slightly recurved, dentate in the upper part; laminal cells elongate, smooth, alar cells quadrate; nerve nearly reaching the apex, stout at base. Seta long; capsule cylindrical (fig. 60, 12-14)

C. dendroides (Hedw.) F.Weber & D.Mohr

Secondary stems 3-12 cm high. Forms loose, glossy light green turfs in meadows, on damp soils and by streams, in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.

Fam. Amblystegiaceae

Amblystegium Schimp.

Plants slender to medium size, usually in wet places. Stem procumbent, irregularly branched. Leaves straight or slightly curved, acuminate, margin entire or finely denticulate; laminal cells elliptical, rhomboidal or hexagonal, 2-6 times as long as wide, smooth; nerve, long or short, thin, less than 30 µm wide at base, sometimes lacking. Capsule inclined, ellipsoidal to cylindrical, curved.

- 1 Nerve extending to 3/4 way up leaf (fig. 61, 5) **A. serpens** (Hedw.) Schimp.
Stem procumbent, irregularly branched, with ascending branches or not. Leaves to 1 mm long, erecto-spreading, ovate to lanceolate, gradually tapering to long, fine acumen, margin finely denticulate. Forms small, light or dark green or yellowish patches on calcareous or siliceous soils and rocks, trunks and roots in wet, shaded sites, in the lowlands and montane areas. Widespread throughout the Peninsula. Esp, Prt, And.

- 1 Nerve short, double or lacking **2**

- 2 Nerve lacking; leaves 0,2-0,4 mm long; plants saxicolous (fig. 61, 1-2) **A. confervoides** (Brid.) Schimp.
* **Serpoleskea confervoides** (Brid.) Kartt.
Leaves erecto-patent to spreading, appressed when dry, ovate-lanceolate, straight or curved, margin entire; cells 2-4:1. Perichaetial leaves without nerve. Capsule curved to horizontal, asymmetrical. Forms rigid, dark green tufts on shaded, calcareous rocks, montane areas and high mountains. Rare, in the Pyrenees and Basque Mountains. Esp.

- 2 Nerve short, double; leaves 0,4-0,7 mm long; plants usually corticolous (fig. 61, 3-4)
A. subtile (Hedw.) Schimp.
* **Pseudoamblystegium subtile** (Hedw.) Vanderp. & Hedenäs
Plants rigid, dark green. Leaves erecto-patent to spreading, appressed when dry, ovate-lanceolate, longly acuminate, straight or curved, margin entire. Perichaetial leaves with nerve. Capsule erect or slightly inclined. Grows on rotting wood, rarely on rocks, from the lowlands to high mountains. Scattered in the Pyrenees and Cantabrian mountains. Esp.

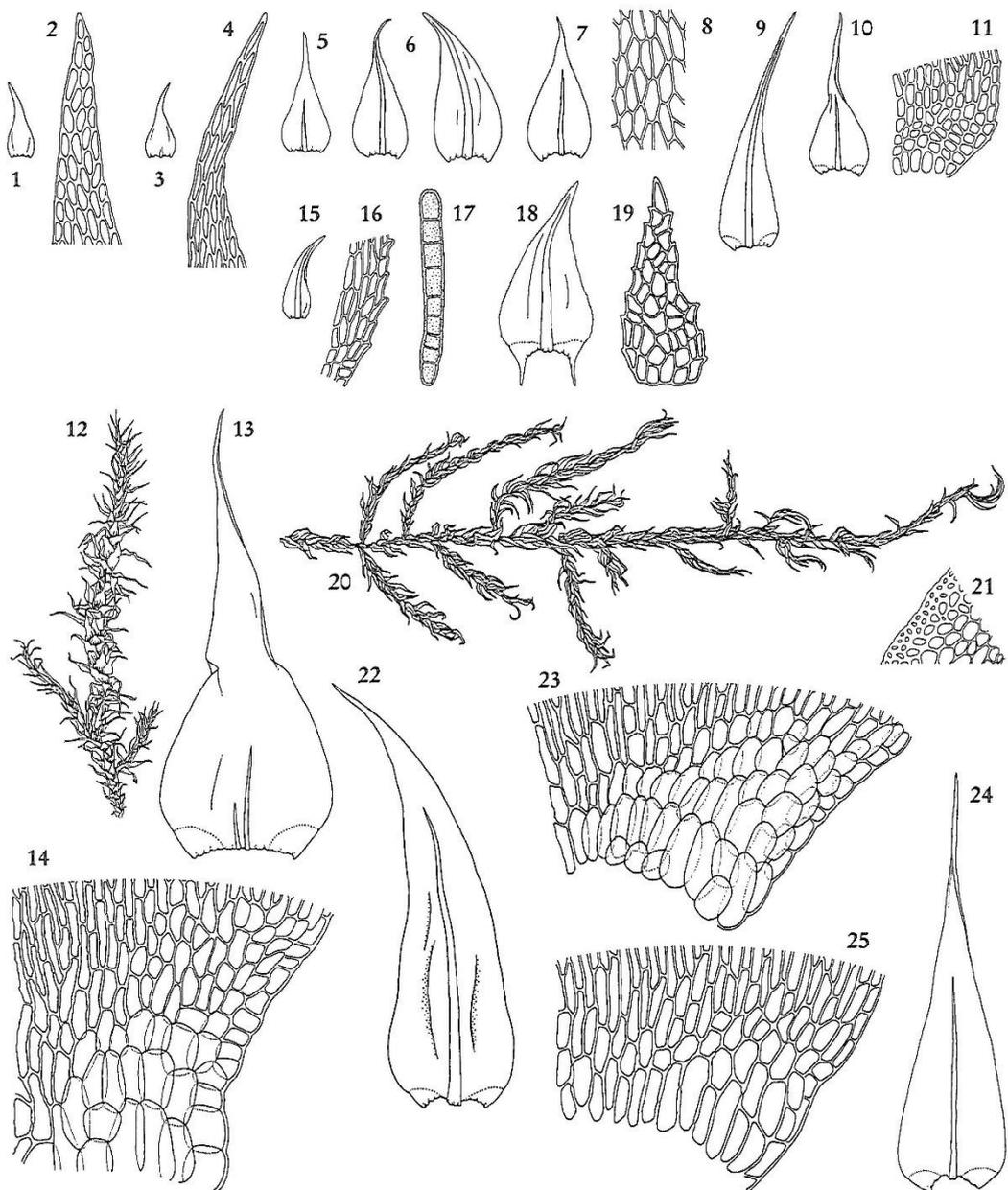


FIGURE 61. 1-2, *Amblystegium confervoides*: 1, leaf; 2, leaf apex. 3-4, *A. subtile*: 3, leaf; 4, leaf apex. 5, *A. serpens*, leaf. 6, *Hygroamblystegium varium*, leaves. 7-8, *H. humile*: 7, leaf; 8, median cells. 9, *Campyliadelphus elodes*, leaf. 10-11, *C. chrysophyllus*: 10, leaf; 11, alar cells. 12-14, *Campylium stellatum*: 12, habit; 13, leaf; 14, alar cells. 15-17, *Conardia compacta*: 15, leaf; 16, lower leaf margin; 17, gemma. 18-19, *Cratoneuron filicinum*: 18, leaf; 19, paraphyllum. 20-23, *Drepanocladus aduncus*: 20, habit; 21, stem section; 22, leaf; 23, alar cells. 24-25, *D. polygamus*: 24, leaf; 25, alar cells. 20 (x1,3); 12 (x2,3); 1, 3, 5, 6, 7, 9, 10, 13, 15, 18, 22, 24 (x20); 14 (x140); 2, 4, 8, 11, 16, 17, 19, 21, 23, 25 (x160).

Campyliadelphus (Kindb.) R.S. Chopra

Plants slender. Stem procumbent, irregularly branched, with ascending or erect branches. Stem leaves straight or falciform, triangular or ovate, narrowed in channelled acumen, margin entire or denticulate; laminal

cells linear, alar cells rectangular or quadrate, irregular, slightly inflated; nerve single, extending to 1/2 way up or more.

- 1 Nerve usually reaching the acumen; leaf margin denticulate (fig. 61, 9) **C. elodes** (Lindb.) Kanda
Leaves triangular, gradually acuminate into long, channelled acumen; alar cells rectangular. Forms tufts on lake shores, slopes by streams and wet grasslands, in montane areas. Rare, in the northern half of the Peninsula. Esp.

- 1 Nerve extending to 1/2-3/4 way up leaf; leaf margin entire or denticulate at base (fig. 61, 10-11)
C. chrysophyllus (Brid.) R.S.Chopra
Leaves with cordate or widely ovate base, abruptly narrowed into channelled acumen; alar cells quadrate or rectangular, forming a small group. Forms loose, golden or green tufts on dry or wet soils and exposed, calcareous rocks, from the lowlands to high mountains, in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

Campylium (Sull.) Mitt.

Plants medium-sized or robust, procumbent, ascending or erect, irregularly or pinnate branched. Leaves ovate-lanceolate, squarrose or reflexed, concave, with cordate base, tapering to long, channelled acumen, margin entire or finely denticulate at base; laminal cells linear, alar cells quadrate or rectangular, large, inflated, forming a distinct group; nerve short, single or double, or lacking

- 1 Plants erect; leaves 2-3 mm long (fig. 61, 12-14) **C. stellatum** (Hedw.) Lange & C.E.O.Jensen
Plants usually robust, to 7 cm long. Leaves abruptly tapered in acumen less than 1/2 length of lamina. Forms dense yellowish or golden tufts on damp, calcareous soils, wet grasslands and stream margins, from the lowlands to high mountains. Distributed in the northern half, eastern part of the Peninsula and in Sierra Nevada. Esp, Prt, And.

- 1 Plants prostrate; leaves 1-2 mm long **C. protensum** (Brid.) Kindb.
Plants medium-sized, to 5 cm long. Leaves abruptly tapered in acumen 1/2 length of leaf or more. Forms dense yellowish or golden tufts on damp, calcareous soils, wet grasslands and stream margins, from the lowlands to high mountains. Distributed in the north of the Peninsula. Esp, And.

Conardia H.Rob.

Plants very slender, prostrate, irregularly branched, papillose rhizoids on stem and sometimes on lamina. Leaves lanceolate to ovate-lanceolate, margin strongly dentate at base with reflexed teeth, finely denticulate above; laminal cells longly rhomboidal, 5-6:1, smooth; nerve percurrent. Usually with uniseriate gemmae on lamina (fig. 61, 15-17) **C. compacta** (Müll.Hal.) H.Rob.

Forms lax patches on wet, shaded, calcareous rocks in montane areas. Scattered in the Peninsula. Esp.

Cratoneuron (Sull.) Spruce

Plants medium-sized. Stem creeping or erecto-ascending, sometimes prostrate, often pinnately branched, not complanate, rarely simple; paraphyllia present or not. Leaves acuminate, plane or nearly so. Alar cells inflated, forming a decurrent group reaching nerve.

- 1 Nerve 60-100 μm wide at base; paraphyllia present; rhizoids usually forming tomentum (fig. 61, 18-19)

C. filicinum (Hedw.) Spruce

Plants rigid, very variable in habit, branches with curved tips. Paraphyllia lanceolate to ovate lanceolate. Leaves cordate-triangular to lanceolate, acuminate, plane or nearly so, straight, curved or slightly falciform, narrower at base, margin dentate; laminal cells rhomboidal or oblong-rhomboidal, mostly 2-4 times as long as wide, smooth, alar cells hyaline; nerve broad, percurrent or excurrent. Forms dense, bright green, yellow or brownish tufts on moist or wet, calcareous soils and rocks and at tree bases, by streams, from the lowlands to high mountains, in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 1 Nerve 45-60 μm wide at base; paraphyllia lacking; rhizoids sparse

C. curvicaule (Jur.) G.Roth

Plants soft, yellowish green to yellowish golden. Leaves erect, straight, ovate-lanceolate, abruptly narrowed in a slender point; margin entire, serrulate at base; laminal cells linear-rhomboidal to oblong-rhomboidal, 6:10 as long as wide, smooth, alar cells hyaline to orange-brown, nerve ending below apex. Grows in wet to moist habitats, on calcareous ground. Very rare in the Pyrenees. Esp.

Drepanocladus (Müll.Hal.) G. Roth

Plants medium-sized to robust, without red coloration. Stem without hyaloderm, complanately branched. Leaves ovate-lanceolate, longly acuminate, erect to \pm falciform, rarely secund, margin entire; median cells of lamina linear, alar cells numerous, inflated, red, yellow or brownish, forming a distinct group, non- or hardly decurrent; nerve extending 1/2-3/4 way up leaf, narrow, less than 70 μm wide.

- 1 Leaf acumen plane; alar cells well delimited, reaching nerve (fig. 61, 20-23)

D. aduncus (Hedw.) Warnst.

Stem procumbent, with ascending tips. Leaves erecto-patent to patent, straight to falciform, 2-3 mm long. Forms dense or lax wefts in wet sites, by streams or submerged, from the lowlands and coastal areas to high mountains. Widespread in the northern half and western part of the Peninsula, rarer in the south and in Mallorca. Esp, Prt, And, Bl.

In the northeast of the Peninsula, in coastal areas, there are soft, irregularly pinnate plants, with straight leaves or nearly so and short nerve not reaching the upper half of leaf.

- 1 Leaf acumen channelled; alar cells not well delimited, reaching nerve (fig. 61, 24-25)

D. polygamus (Schimp.) Hedenäs

Stem procumbent, irregularly branched. Leaves erecto-spreading or spreading, straight or curved, 1,5-2 mm long. Forms yellowish green wefts on wet or waterlogged soils, from the lowlands to high mountains, sometimes in coastal areas. Scattered in the north and west of the Peninsula. Esp, Prt.

Hygroamblystegium Loeske

Plants slender to medium-sized. Stem simple or slightly and irregularly branched. Leaves erect or erecto-patent, usually slightly curved, oblong-lanceolate to ovate-lanceolate, apex gradually acuminate, acuminate, acute or obtuse, concave, margin plane, entire to denticulate; laminal cells hexagonal or rhomboidal, 2-5:1; stout, more than 35 µm wide at base, often curved in upper part. Capsule inclined to horizontal, cylindrical, curved.

- 1 Nerve reaching apex or nearly so (fig. 61, 6)

H. varium (Hedw.) Lindb.

Amblystegium varium (Hedw.) Lindb., **A. fluviatile** (Hedw.) Schimp., **A. tenax** (Hedw.) C.E.O.Jensen

Plants morphologically very variable. Leaf apex obtuse to acuminate. Forms loose patches on soils by water and wet, shaded rocks and roots, on calcareous or acidic substrata, from the lowlands to high mountains. Widespread in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 1 Nerve extending to 3/4 way up leaf (fig. 61, 7-8) **H. humile** (P.Beauv.) Vanderp., Goffinet & Hedenäs

H. varium var. **humile** (P.Beauv.) Vanderp. & Hedenäs

Plants lax, yellowish green. Stem procumbent, with ascending branches or not. Leaves distant, ovate, abruptly tapering, apex acuminate, margin entire; nerve yellowish. Grows on wet soils in grasslands and gardens and by waterways and pools in the lowlands. Scattered in the south and eastern part of the Peninsula. Esp, Prt.

Hygrohypnum Lindb.

Plants small to robust. Stem procumbent, irregularly branched. Leaves imbricate to spreading, falciform or straight, widely ovate, oblong or orbicular, apex obtuse, sometimes ± acute, margin entire or denticulate; median cells linear, the apical ones shorter, alar cells short and wide, sometimes inflated, coloured or not; nerve short or long, single or double.

- 1 Leaves ovate, ovate-oblong or ovate-lanceolate, longer than wide, falciform or straight 2
- 1 Leaves widely ovate or orbicular, nearly as longer as wide, straight 5
- 2 Alar cells large, inflated 3
- 2 Alar cells not inflated 4
- 3 Alar cells hyaline; stem with hyaloderm (fig. 62, 1-3) **H. ochraceum** (Turner ex Wilson) Loeske
 * **Hygrohypnella ochracea** (Turner ex Wilson) Ignatov & Ignatova
 Plants green, brownish or yellowish, 4-12 cm long. Leaves erect or spreading, usually falciform, concave, gradually tapering with obtuse apex, sometimes ± acute, margin finely denticulate; nerve usually double, to 1/2 way up leaf. Forms loose tufts or wefts by streams and waterfalls, in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 3 Alar cells brownish or reddish with age; stem without hyaloderm or poorly developed
H. eugyrium (Schimp.) Broth.
 * **Pseudohygrohypnum eugyrium** (Schimp.) Kanda
 Plant 2-5 cm long. Leaves erect to spreading, usually straight or falciform, concave, gradually tapering with acute apex, margin entire or finely denticulate near apex; nerve usually double, short, slender;. Forms loose tufts or wefts on rocks by streams, in the lowlands. Very rare, in the north of the Peninsula. Esp.
- 4 Nerve single, to 2/3 way up leaf, rarely branched; alar cells differentiated (fig. 62, 4-5)
H. luridum (Hedw.) Jenn.
 Plants 4-6 cm long. Stem without hyaloderm. Leaves erect-spreading, usually straight, concave, with abruptly tapering to short, acute or obtuse point, margin entire; nerve faint or stout. Forms dense, green or yellowish patches on wet soils and rocks, in montane areas and high mountains, in the northern half of the Peninsula and in Mallorca. Esp, And, Bl.
- 4 Nerve branched, short, to 1/2 way up leaf; alar cells not differentiated **H. styriacum** (Limpr.) Broth.
 Plants 1-3 cm long. Stem without hyaloderm. Leaves erect-spreading, usually straight, concave, with abruptly tapering to acuminate or acute point, margin entire or slightly denticulate; nerve stout. Forms dense patches in snowbeds, in high mountains. Very rare, only in Sierra Nevada. Esp.
- 5 Nerve single, stout, reaching 2/3 way up leaf, rarely furcate at apex (fig. 62, 6) **H. smithii** (Sw.) Broth.
 * **Platyhypnum smithii** (Sw.) Ochyra

Stem denudate at base, 1-4 cm long. Leaves erecto-spreading or nearly spreading, concave, margin plane or slightly recurved at base; apical cells of lamina rounded or quadrate. Forms bright or dark green to blackish tufts or wefts on rocks, wet soils or submerged in fast-flowing waters, in high mountains of the Pyrenees. Esp.

5 Nerve double, short

6

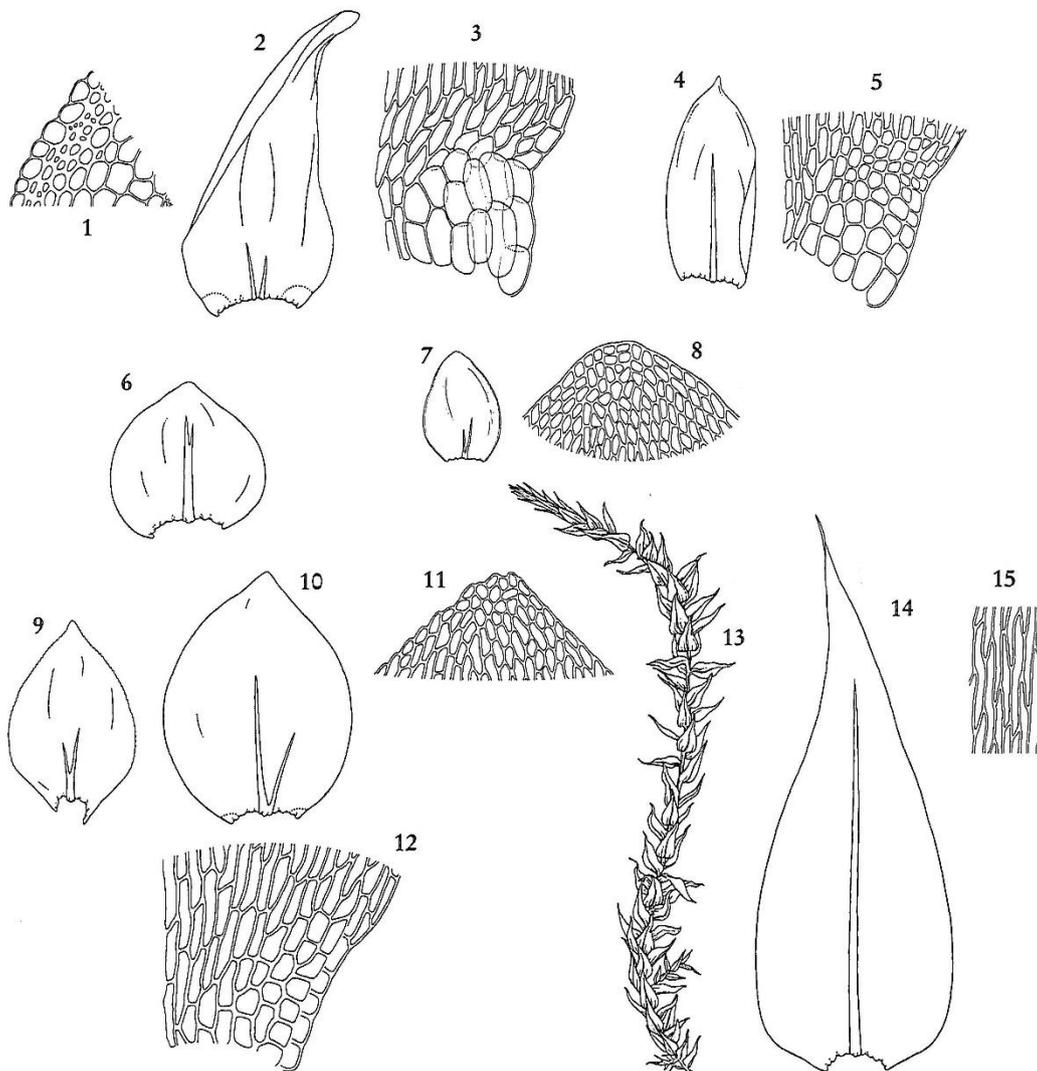


FIGURE 62. 1-3, *Hygrohypnum ochraceum*: 1, stem section; 2, leaf; 3, alar cells. 4-5, *H. luridum*: 4, leaf; 5, alar cells. 6, *H. smithii*, leaf. 7-8, *H. cochlearifolium*: 7, leaf; 8, leaf apex. 9, *H. molle*, leaf. 10-12, *H. duriusculum*: 10, leaf; 11, leaf apex; 12, alar cells. 13-15, *Leptodictyum riparium*: 13, habit; 14, leaf; 15, median cells. 13 (x1,6); 2, 4, 6, 7, 9, 10, 14 (x20); 1, 3, 5, 8, 11, 12, 15 (x160).

6 Leaves strongly concave (fig. 62, 7-8)

H. cochlearifolium (Venturi) Broth.

* ***Platyhypnum cochlearifolium*** (Venturi) Ochyra

Leaves erecto-spreading, with obtuse to broadly rounded apex, margin recurved; apical cells of lamina oblong or rhomboidal, marginal cells forming a distinct border. In the Central Pyrenees. Esp (Extinct).

6 Leaves flat to concave

7

7 Alar cells not differentiated or a few alar cells shortly rectangular or quadrate (fig. 62, 9)

H. molle (Hedw.) Loeske

* **Platyhypnum molle** (Dix. ex Hedw.) Loeske

Plants soft, 2-5 cm long. Stem not denudate base. Leaves erect or spreading, plane or concave, with rounded or obtuse apex, straight, dentate; apical cells of lamina rhomboidal, shorter towards margin. Forms loose, dark green tufts on rocks by streams, in montane areas and high mountains in the Pyrenees and Sierra Nevada. Esp.

7 Alar cells differentiated, yellowish or brownish, thick-walled (fig. 62, 10-12)

H. duriusculum (De Not.) D.W. Jamieson

* **Platyhypnum duriusculum** (De Not.) Ochyra

Plants rigid, dark green, brownish or yellowish, 3-6 cm long. Stem and branches usually denudate at base. Leaves spreading, very wide, with obtuse or rounded apex, margin entire; apical cells of lamina irregularly rhomboidal. Forms patches on rocks in waterfalls, seeping sites and by streams, in montane areas and high mountains, in the northern half of the Peninsula and in Sierra Nevada. Esp, And.

Leptodictyum (Schimp.) Warnst.

Plants very variable in colour and size, slender to moderately robust, light green to golden green, aquatic. Stem procumbent or ascending, irregularly branched. Leaves erect to spreading, \pm complanate, lanceolate or ovate-lanceolate, acuminate, with long or short point, straight or slightly curved, margin entire or nearly so; median laminal cells 7-15:1, 6-12 μm wide; nerve extending to 2/3-3/4 way up leaf. Capsule horizontal to inclined, narrowly ellipsoidal or cylindrical, curved (fig. 62, 13-15)

L. riparium (Hedw.) Warnst.

Grows submerged in pools and streams, in the lowlands and montane areas. Widespread in the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

Palustriella Ochyra

Plants pinnate or irregularly branched. Stem and branches tomentose; paraphyllia filiform, dentate. Leaves plicate, falciform or circinate, rarely straight, cordate-triangular, gradually or abruptly narrowed to acumen, margin dentate, especially at base; laminal cells elongate, alar cells large, inflated, hyaline, yellowish or brownish, forming a differentiated group which reaches the nerve and is decurrent; nerve broad and long.

1 Median laminal cells 3-6:1, papillose on dorsal side (fig. 63, 1-3)

P. decipiens (De Not.) Ochyra

Plants medium-sized, 4-10 cm long. Stem procumbent, pinnately branched, with short curved branches; paraphyllia abundant. Stem leaves widely cordate-triangular, abruptly tapering to acumen, margin denticulate; median laminal cells, at least in young leaves, prorate or papillose on dorsal side. Branch leaves narrower and smaller. Forms greenish yellow to brownish tufts on wet, basic sites, by streams and springs, in montane areas and high mountains, in the northern part of the Peninsula and in Sierra Nevada. Esp, And.

1 Median laminal cells 6-15:1, smooth

2

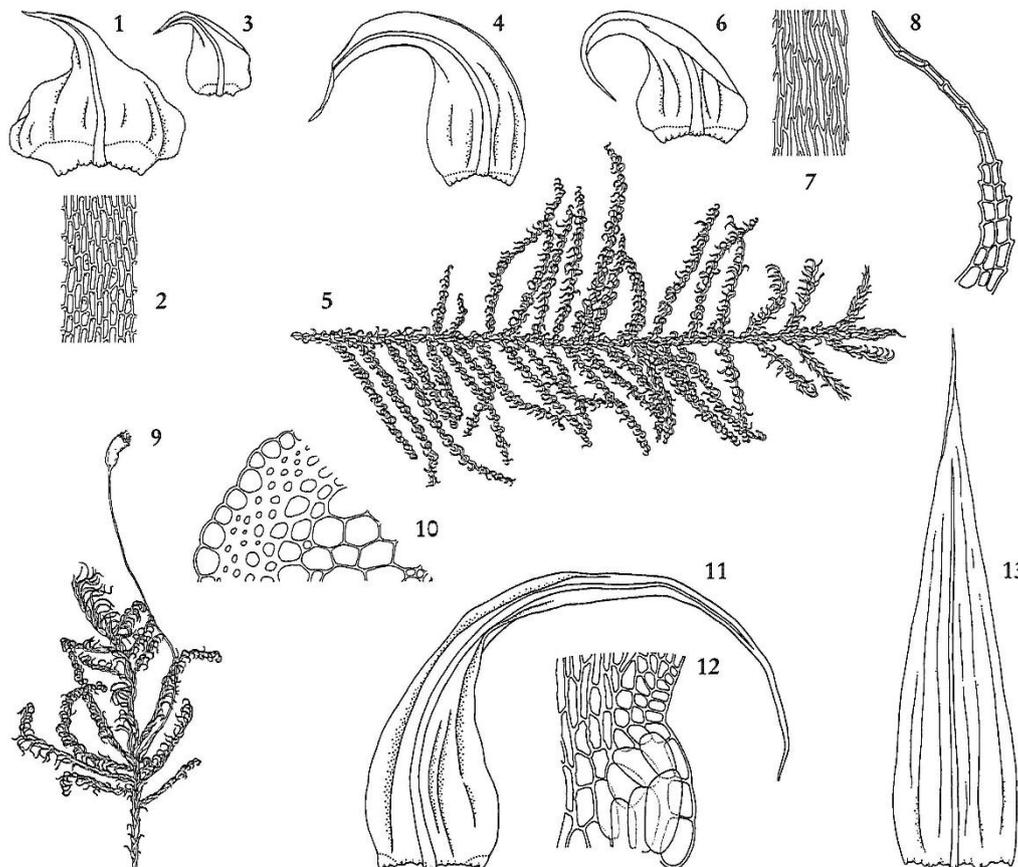


FIGURE 63. 1-3, *Palustriella decipiens*: 1, stem leaf; 2, median cells on dorsal side; 3, branch leaf. 4, *P. falcata*, leaf. 5-8, *P. commutata*: 5, habit; 6, leaf; 7, median cells; 8, paraphyllium. 9-12, *Sanionia uncinata*: 9, habit; 10, stem section; 11, leaf; 12, alar cells. 13, *Tomentypnum nitens*, leaf. 5, 9 (x1,6); 1, 3, 4, 6, 11, 13 (x20); 2, 7, 8, 10, 12 (x160).

2 Stem leaves ovate-lanceolate, gradually tapering in long acumen, falciform, margin dentate only at base; group of alar cells small (fig. 63, 4)

P. falcata (Hedw.) Hedenäs

Plants robust, to 15 cm long, irregularly branched, green, brownish or yellowish; paraphyllia and rhizoids scarce. Branch leaves similar in shape to stem leaves; alar cells strongly inflated, hyaline or brownish, forming a distinct, small group, not expanding in its marginal part. Common in spring, peat bogs, by torrents and streams, on basic substrata, from the lowlands to high mountains. Widespread in the northern part of the Peninsula, rarer in the south. Esp, Prt, And.

- 2 Stem leaves widely cordate-triangular, abruptly tapering into \pm long acumen, falciform, circinate or straight, margin slightly denticulate to dentate; group of alar cells large (fig. 63, 5-8)

P. commutata (Hedw.) Ochyra

Plants medium-size to robust, variable in habit, usually regularly pinnate. Stem procumbent, ascending or erect; paraphyllia abundant. Branch leaves narrower and smaller. Forms rigid, light or dark green wefts or tufts, often with calcium carbonate encrustations, on wet substrata, springs, by streams, calcareous torrents, from the lowlands to high mountains. Widespread in the northern part of the Peninsula, rarer in the south. Esp, And, Bl.

Sanionia Loeske

Plants medium-sized, to 12 cm long, green or yellowish green, without red coloration. Stem with hyaloderm, usually pinnate, with curved branches. Leaves plicate, ovate-lanceolate, gradually tapering to filiform acumen, falciform or circinate, secund, margin finely denticulate; median cells of lamina long and narrow, alar cells few, hyaline, inflated, forming a distinct group; nerve extending to acumen. Capsule curved (fig. 63, 9-12)

S. uncinata (Hedw.) Loeske

Grows on moist or wet soils and rocks and on tree trunks in pinewoods and fir woods, from the lowlands to high mountain, in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

Tomentypnum Loeske

Plants robust, to 10 cm long, rigid. Stem and leaf nerve at back with branched, reddish or brownish rhizoids; branches ascending, pinnate, complanate. Stem and branch leaves similar, erect, strongly plicate, lanceolate, longly acuminate, margin plane, entire; laminal cells linear, basal cells shorter, wide, porose, alar cells slightly differentiated, alar cells not or hardly differentiated; nerve thin, long. Dioicous (fig. 63, 13)

T. nitens (Hedw.) Loeske

Forms loose, golden wefts in peat bogs. Rare, in the north of the Peninsula. Esp.

Fam. Calliergonaceae

Calliergon (Sull.) Kindb.

Plants medium-sized to robust. Stem without hyaloderm. Leaves erect to spreading, ovate-cordate, concave, straight, apex obtuse or rounded; median cells elongate, alar cells rectangular, inflated, usually thin-walled, forming a distinct group; nerve stout, long, reaching the apex or nearly so.

1 Group of alar cells diffusely delimited, transition between alar cells and adjacent cells gradual; plants slightly branched (fig. 64, 1) **C. cordifolium** (Hedw.) Kindb.

Plants medium-sized to robust, green to brownish, 7-15 cm long, irregularly branched. Forms patches on very wet or peaty soils, in montane areas and high mountains. Rare, in the north of the Peninsula and the Iberian Range. Esp.

1 Group of alar cells clearly delimited, transition between alar cells and adjacent cells abrupt; plants densely branched (fig. 64, 2-3) **C. giganteum** (Schimp.) Kindb.

Plants large and robust, bright green, 10-20 cm long, radially branched, usually with cuspidate stems and branches. Grows by streams on acidic substrata. Rare, in the Pyrenees and Cantabrian Mountains. Esp.

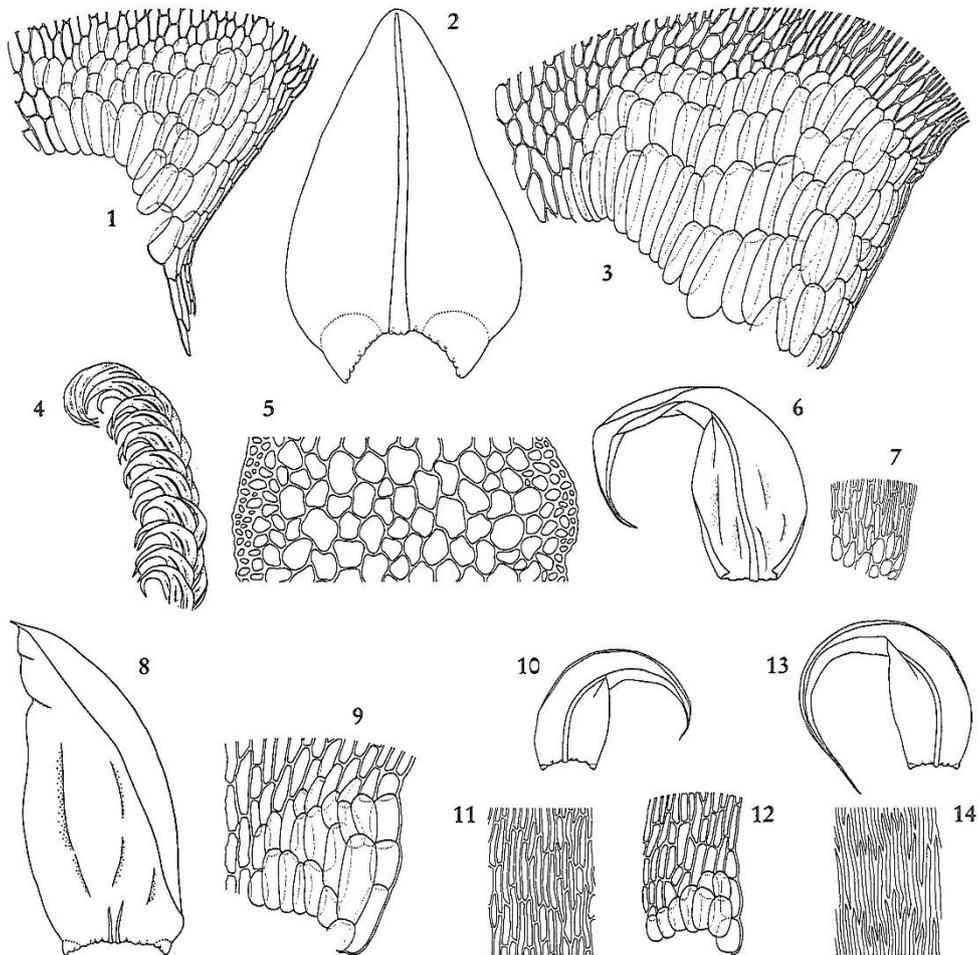


FIGURE 64. 1, *Calliergon cordifolium*, alar cells. 2-3, *C. giganteum*: 2, leaf; 3, alar cells. 4-7, *Hamatocaulis vernicosus*: 4, upper part of plant; 5, stem section; 6, leaf; 7, alar cells. 8-9, *Scorpidium scorpioides*: 8, leaf; 9, alar cells. 10-12, *S. cossonii*: 10, leaf; 11, median cells; 12, alar cells. 13-14, *S. revolvens*: 13, leaf; 14, median cells. 4 (x7); 2, 6, 8, 10, 13 (x18); 1, 3 (x90); 7, 9, 12 (x140); 5, 11, 14 (x160).

Hamatocaulis Hedenäs

Plants medium-sized to robust, procumbent to ascending, brownish or reddish, complanately branched. Stem without central strand, cortex of 1-2 layers of thick-walled cells, without hyaloderm. Leaves erect or patent, ovate-lanceolate, longitudinally plicate, concave, strongly falciform; median cells of lamina linear, alar cells not differentiated; nerve ending in upper half of leaf (fig. 64, 4-7) **H. vernicosus** (Mitt.) Hedenäs

Grows in springs and wetlands in montane areas. Scattered, in the northern half of the Peninsula. Esp.

Scorpidium (Schimp.) Limpr.

Plants medium-sized to robust. Stem with hyaloderm. Leaves erecto-patent to patent, not or weakly plicate, ovate-lanceolate or widely ovate, apex obtuse, acute or longly acuminate, falciform to nearly straight, margin finely denticulate or smooth; median cells of lamina elongate, alar cells few, inflated, hyaline, forming a transverse triangular group, non- or hardly decurrent; nerve single, extending at least 1/2 way up leaf or shorter and double, rarely lacking.

- 1 Stem leaves strongly concave, widely ovate, with acute or obtuse apex, mostly apiculate; nerve short, double, rarely single, extending 1/2 way up leaf or nerve lacking (fig. 64, 8-9)

S. scorpioides (Hedw.) Limpr.

Plants robust, turgid, dark green, reddish or brownish, often mud-encrusted. Stem with partial hyaloderm, sparsely branched, with short branches, stem and branches with curved tips. Leaves imbricate; alar cells hyaline, inflated, fragile. Submerged or floating in shallow pools, wet hollows or growing by streams, on calcareous or moderately acidic substrata. Very rare, in the north of Iberian Peninsula. Esp, And.

- 1 Stem leaves concave, ovate, gradually tapering to long, falciform or circinate acumen; nerve long, extending more than 1/2 way up leaf **2**

- 2 Median cells of stem leaves 14-95 μm long, with square or shortly tapering cells ends (fig. 64, 10-12)

S. cossonii (Schimp.) Hedenäs

Limprichtia cossonii (Schimp.) L.E.Anderson, H.A.Crum & W.R. Buck

Plants medium-sized, rarely slender. Stem irregularly branched. Leaves sometimes slightly plicate; alar cells hyaline, strongly inflated, not or hardly decurrent. Forms lax, dark green or brownish patches on waterlogged or peaty soils, in montane areas and high mountains, in the northern half of the Peninsula and in Sierra Nevada. Esp, And.

- 2 Median cells of stem leaves 64-140 μm long, with longly tapering cells ends (fig. 64, 13-14)

S. revolvens (Sw. ex anon.) Rubers

Limprichtia revolvens (Sw. ex anon.) Loeske

Plants medium-sized, erect or ascending, irregularly branched. Alar cells hyaline, inflated. Forms lax, yellowish green, brownish or reddish patches on peaty soil. Very rare, in the Pyrenees and in the western part of the Peninsula. Esp.

Straminergon Hedenäs

Plants medium sized, light green, whitish or yellowish. Stem cuspidate, slightly branched, without hyaloderm. Leaves straight, oblong or elliptical, concave, apex obtuse often with rhizoids, margin entire; median cells elongate, alar cells rectangular, inflated, well differentiated, forming an ovate group extending up leaf margin; nerve single, faint, extending to 3/4 way up leaf or more (fig. 65, 1-3)

S. stramineum (Dicks. ex Brid.) Hedenäs

Calliergon stramineum (Dicks. ex Brid.) Kindb.

Forms loose patches on waterlogged soils, stream banks and marshes, in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

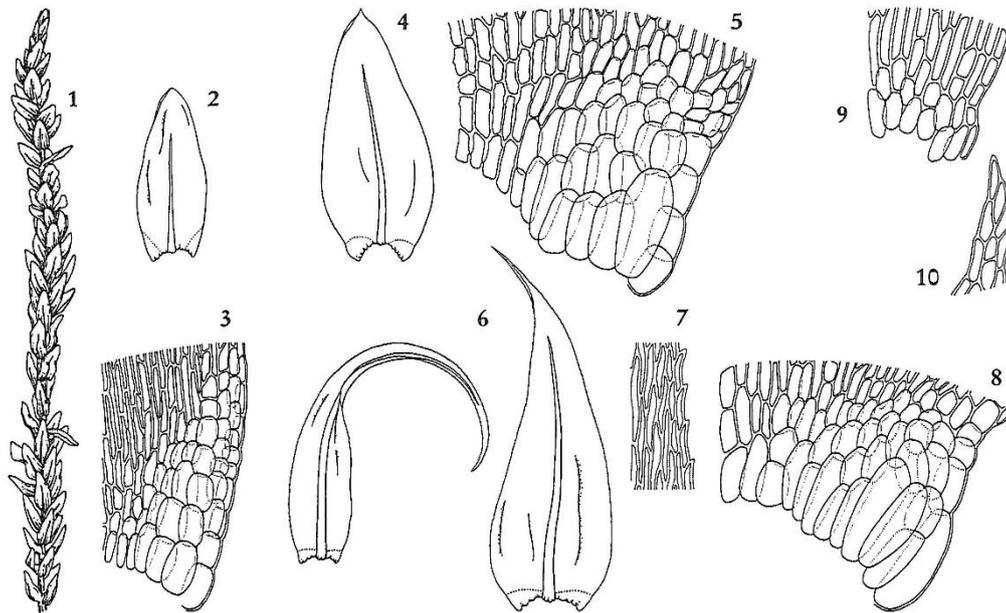


FIGURE 65. 1-3, **Straminergon stramineum**: 1, habit; 2, leaf; 3, alar cells. 4-5, **Warnstorfia sarmentosa**: 4, leaf; 5, alar cells. 6-8, **W. exannulata**: 6, leaves; 7, leaf margin; 8, alar cells. 9-10, **W. fluitans**: 9, alar cells; 10, pseudoparaphyllium. 1 (x5); 2, 4, 6 (x18); 3, 5, 8, 9, 10 (x140); 7 (x160).

Warnstorfia Loeske

Plants medium-sized to robust, radially branched. Leaves triangular to ovate, narrow, gradually tapering to long acumen or abruptly narrowed to an obtuse, usually apiculate apex, straight or falciform, margin entire,

sinuose or denticulate; median cells elongate, basal cells porose, alar cells inflated, hyaline, forming a distinct group transversely triangular or quadrate, non- or hardly decurrent; nerve single, long.

- 1 Leaves oblong or ovate, apex obtuse and apiculate, margin entire (fig. 65, 4-5)

W. sarmentosa (Wahlenb.) Hedenäs

* **Sarmentypnum sarmentosum** (Wahlenb.) Tuom. & T.J.Kop.

Plants usually reddish. Stem and upper branches cuspidate, without hyaloderm. Leaves straight, concave; group of alar cells distinctly delimited, nearly reaching the nerve; nerve extending to 3/4 way up leaf. Rarely with rhizoids of a few cells at leaf apex. Grows in wet, acidic sites, by streams and around lakes, in high mountains. Rare, in the Pyrenees and Cantabrian mountains. Esp, And.

- 1 Leaves narrowly lanceolate or ovate-lanceolate, longly acuminate, margin \pm denticulate

2

- 2 Group of alar cells large, distinctly delimited; plants with red colours; pseudoparaphyllia broad (fig. 65, 6-8)

W. exannulata (Schimp.) Loeske

* **Sarmentypnum exannulatum** (Schimp.) Hedenäs

Plants very variable, reddish or brownish. Stem with partial hyaloderm. Leaves ovate-lanceolate, slightly concave, usually falciform, margin denticulate at base and at apex; group of alar cells \pm reaching the nerve; nerve extending 60-90% leaf length, stout, 80-100 μ m wide near base. Forms patches on lake shores, by streams and in acidic peatlands, in montane areas and high mountains, in the northern half of the Peninsula and Sierra Nevada. Esp, Prt, And.

- 2 Group of alar cells small, indistinctly delimited; plants rarely with red colours; pseudoparaphyllia narrower, lanceolate (fig. 65, 9-10)

W. fluitans (Hedw.) Loeske

Plants greenish to brownish. Stem without hyaloderm. Leaves linear-lanceolate to ovate-lanceolate, falciform, sometimes straight, ovate-triangular to ovate-lanceolate, slightly denticulate, entire at base; nerve extending 50-80% leaf length. Grows on peaty soils. Rare, in the north of the Peninsula. Esp, Prt.

Fam. Leskeaceae

Lescurea Schimp.

Plants small to robust. Stem prostrate, irregularly branched, with numerous, filamentous or lanceolate, sometimes branched, paraphyllia. Leaves spreading, imbricate when dry, straight, occasionally falciform, acuminate, with 2 plicae at base, margin entire or denticulate at apex, recurved; median cells short to elongate

and narrow, smooth, papillose or with low, terminal papillae, basal cells short or long, alar cells predominantly quadrate; nerve long. Branch leaves similar to stem leaves but smaller. Capsule erect, symmetrical. Dioicous.

- 1 Laminal cells with 1 central papilla on each side (fig. 66, 8-10) **L. patens** Lindb.

Pseudoleskea patens (Lindb.) Kindb.

Stem prostrate, with branches straight, curved at apex. Leaves spreading, appressed when dry, ovate, acuminate, margin slightly dentate at apex, entirely recurved or recurved at base and also at acumen base; median cells short (1-2:1), rarely longer, apical cells mostly elongate. Forms dark green tufts, often yellowish or brownish below, on rocks, in montane areas and high mountains, in the northern half of the Peninsula and Sierra Nevada. Esp, Prt, And.

- 1 Laminal cells smooth or with distal papillae (prorate) **2**

- 2 Stem leaves more than 2 mm long, with several deep, longitudinal plicae (fig. 66, 32-35)

L. plicata (Schleich. ex F.Weber & D.Mohr) Broth.

Ptychodium plicatum (Schleich. ex F.Weber & D.Mohr) Schimp.

Plants robust. Stem prostrate, irregularly branched; paraphyllia abundant, linear-lanceolate to ovate-lanceolate, unbranched or with short branches or teeth at base. Stem leaves similar to branch leaves, erect or erecto-patent, ovate-lanceolate, gradually or abruptly acuminate, margin recurved, entire or denticulate at apex; laminal cells elongate (6-9:1), smooth, thin-walled, basal cells more thick-walled or porose, alar cells short and wide; nerve long. Capsule curved, asymmetrical. Forms loose, golden green or brownish tufts on shaded, calcareous rocks, in high mountains, in the Pyrenees and Cantabrian Mountains. Esp, And.

- 2 Stem leaves less than 2 mm long, with 1-2 short, longitudinal plicae **3**

- 3 Median cells of stem leaves less than 20 μm long (fig. 66, 11-16) **L. incurvata** (Hedw.) E.Lawton

Pseudoleskea incurvata (Hedw.) Loeske

Plants sparsely branched; stem and branches with curved tips. Stem leaves ovate or ovate-lanceolate, acute or acuminate, falciform, asymmetrical, margin recurved at base and often at acumen base, nerve usually prorate at back above; laminal cells irregular, prorate at back above, alar cells quadrate, with groups of oblate cells intercalated. Forms yellowish green or brownish tufts in rock crevices and on rocks and slopes, in montane areas and high mountains, in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 3 Median cells of stem leaves more than 20 μm long **4**

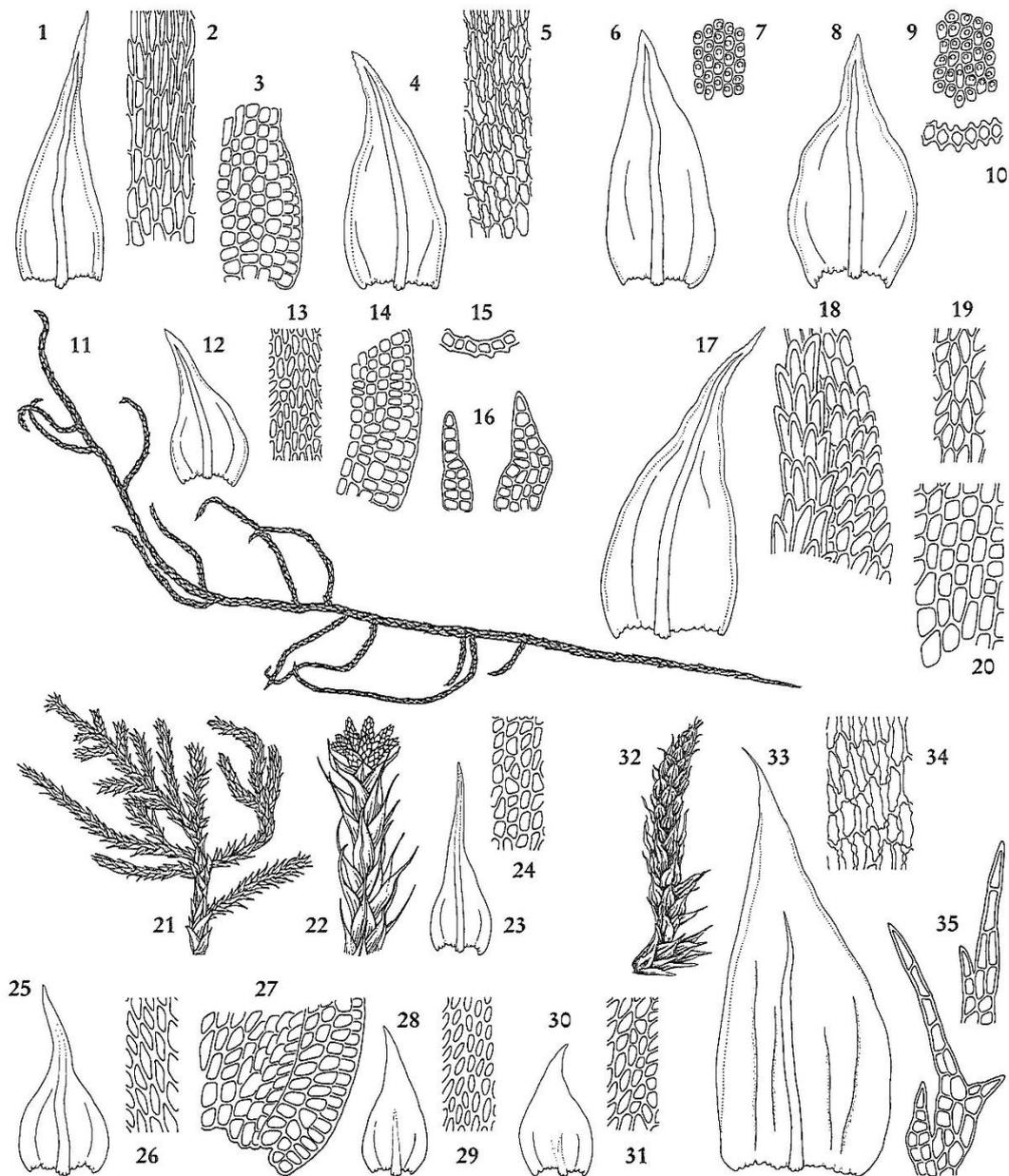


FIGURE 66. 1-3, *Lescurea mutabilis*: 1, leaf; 2, median and basal cells; 3, alar cells. 4-5, *L. saxicola*: 4, leaf; 5, median and basal cells. 6-7, *Leskea polycarpa*: 6, leaf; 7, median cells. 8-10, *Lescurea patens*: 8, leaf; 9, median cells; 10, lamina section. 11-16, *L. incurvata*: 11, habit; 12, leaf; 13, median cells; 14, alar cells; 15, lamina section; 16, paraphyllia. 17-20, *L. radicata*: 17, leaf; 18, nerve on dorsal side; 19, median cells; 20, basal cells. 21-24, *Pseudoleskeella nervosa*: 21, habit; 22, branch with propagules; 23, leaf; 24, basal cells toward nerve. 25-27, *P. rupestris*: 25, leaf; 26, basal cells toward nerve; 27, alar cells. 28-29, *P. catenulata*: 28, leaf; 29, median cells. 30-31, *P. tectorum*: 30, leaf; 31, median cells. 32-35, *Lescurea plicata*: 32, habit; 33, leaf; 34, basal cells; 35, paraphyllia. 11 (x2,5); 21, 32 (x3,5); 22 (x15); 1, 4, 6, 8, 12, 17, 23, 25, 28, 30, 33 (x35); 2, 3, 5, 7, 9, 10, 13, 14, 15, 16, 18, 19, 20, 24, 26, 27, 29, 31, 34, 35 (x200).

4 Basal cells mostly short, 1:1 or 2:1, not porose (fig. 66, 17-20)

L. radicata (Mitt.) Mönk.

Pseudoleskea radicata (Mitt.) Macoun & Kindb.

Plants with abundant branches curved at tips, with clusters of reddish brown rhizoids. Leaves ovate or ovate-lanceolate, acuminate, sometimes falciform, margin recurved from base to apex or only at leaf base and acumen base, nerve usually with prorate cells on dorsal side; median cells elongate, smooth or prorate. Forms dark green tufts,

often brownish in older parts, on acidic rocks in high mountains, in the northern half of the Iberian Peninsula and Sierra Nevada. Esp, And.

4 Basal cells mostly long, 2:1 or more, porose or not 5

5 Branch leaves with entire margin; laminal and nerve cells smooth or slightly prorate (fig. 66, 1-3)

L. mutabilis (Brid.) Lindb. ex I.Hagen

Plants silky. Tips of stem and branches straight. Leaves erect when dry, lanceolate, gradually acuminate; dorsal side of lamina and nerve smooth in the upper part, median laminal cells elongate, basal cells 2:1 or more, not porose. Forms green or yellowish green tufts on bark of trees, in montane areas and high mountains of the Pyrenees. Esp, And.

5 Branch leaves with dentate margin; laminal and nerve cells prorate above on dorsal side (fig. 66, 4-5)

L. saxicola (Schimp.) Molendo

Plants densely branched, tips of stem and branches curved. Stem leaves mostly falciform, abruptly acuminate; basal cells 2-3:1, shorter and wider than median cells, rather thick-walled and with a few pores. Branch leaves with apical and nerve cells prorate on dorsal side, sometimes also on stem leaves. Forms compact, glossy greenish yellow or brownish tufts on rocks in high mountains, in the Pyrenees, the Spanish Central Range and Cantabrian Mountains. Esp, And.

Leskea Hedw.

Stem procumbent, with central strand, irregularly branched, with small paraphyllia. Leaves erecto-spreading, mostly secund, appressed when dry, ovate to ovate-lanceolate, with broad, short acumen, plicate at base, margin entire, recurved at base; laminal cells isodiametric or nearly so, hexagonal or rhomboidal, with one central papilla on dorsal side, alar cells quadrate or oblate, smooth; nerve stout, nearly reaching the apex. Capsule erect, symmetrical; peristome teeth pale, papillose. Autoicous (fig. 66, 6-7) **L. polycarpa** Hedw.

Plants slender, forming light or brownish green tufts on trunks by streams and at base of trees, in the lowlands and montane areas, in the northern half of the Peninsula. Esp, Prt, And.

Pseudoleskeella Kindb.

Plants thin, prostrate, often irregularly branched. Stem with lanceolate pseudoparaphyllia, paraphyllia lacking. Leaves concave or with 2 plicae at base, ovate or ovate-lanceolate, acuminate; median cells isodiametric, rhomboidal or elongate, smooth, occasionally prorate; nerve short or long, single or double. Branch leaves similar to stem leaves. Capsule exserted.

- 1 Nerve extending at least half way up, usually reaching the apex; laminal cells smooth 2
- 1 Nerve not extending half way up, usually shorter; laminal cells smooth or papillose 3
- 2 Plants with propaguliferous branches at tip of ascending branches; median laminal cells 6-15 μm long (fig. 66, 21-24) **P. nervosa** (Brid.) Nyholm
Plants slender, prostrate with ascending branches, dark green to brownish. Median cells of lamina isodiametric, irregular in shape and size; nerve faint in the upper part, extending 2/3 way up leaf or percurrent. Forms tufts or mats at trees bases, on walls and rocks, from the lowlands to high mountains, in the north of the Peninsula. Esp, And.
- 2 Plants without propaguliferous branches; median laminal cells 16-30 μm long (fig. 66, 25-27) **P. rupestris** (Berggr.) Hedenäs & L.Söderstr.
Plants mostly green or brownish. Median cells of lamina longly elliptical, alar cells oblate; nerve extending 3/4 way up leaf, faint in the upper part. Grows on shaded, calcareous rocks, in the Central Pyrenees. Esp.
- 3 Laminal cells thick-walled; nerve extending 1/3 to half way up leaf, usually shorter, not clearly bifurcate; apical cells 8-15 μm long (fig. 66, 28-29) **P. catenulata** (Brid. ex Schrad.) Kindb.
Plants orange to reddish brown. Leaves elliptical to oblong, tapered into wide acumen; laminal cells mostly shortly rhomboidal. Grows on shaded, calcareous rocks, in the northern part of the Peninsula, rare in the south, and in Mallorca. Esp, And, Bl.
- 3 Laminal cells thin-walled; nerve extending to 1/3 way up leaf, short and double, occasionally single; apical cells 17-38 μm long (fig. 66, 30-31) **P. tectorum** (Funck ex Brid.) Kindb. ex Broth.
Plants brown to brownish green. Leaves very concave, ovate, abruptly tapered; laminal cells oblong to rhomboidal, smooth. Forms dense tufts on calcareous or siliceous shaded, rocks and walls, sporadically on wood, in the northeastern part of the Peninsula and in Sierra Nevada. Esp.

Fam. Thuidiaceae

Abietinella Müll.Hal.

Plants medium-sized to robust, yellowish, green or brownish. Stem ascending, pinnate; paraphyllia abundant on stem and branches, single or branched, papillose. Stem leaves erect or patent, ovate or ovate-lanceolate, acuminate, plicate, margin recurved, denticulate; laminal cells 1-2 as long as wide, apical cells

longer and thick-walled, unipapillose; nerve to 3/4 or more way up leaf. Branch leaves smaller, broadly ovate to lanceolate, obtuse to acuminate (fig. 67, 1-5)

A. abietina (Hedw.) M. Fleisch.

Thuidium abietinum (Hedw.) Schimp.

Forms wefts on dry, exposed, calcareous soils, rocks and slopes, from the lowlands to high mountains, in the northern half of the Peninsula. Esp, And.

Thuidium Schimp.

Plants medium-sized to robust. Stem creeping to ascending, regularly 2-3-pinnate; paraphyllia abundant, single or branched, papillose. Stem leaves ovate or ovate-triangular, acuminate, margin crenulate or denticulate; laminal cells 1-2 times as long as wide, rarely longer, unipapillose; nerve wide, reaching apex or nearly so. Branch leaves small, ovate, acute.

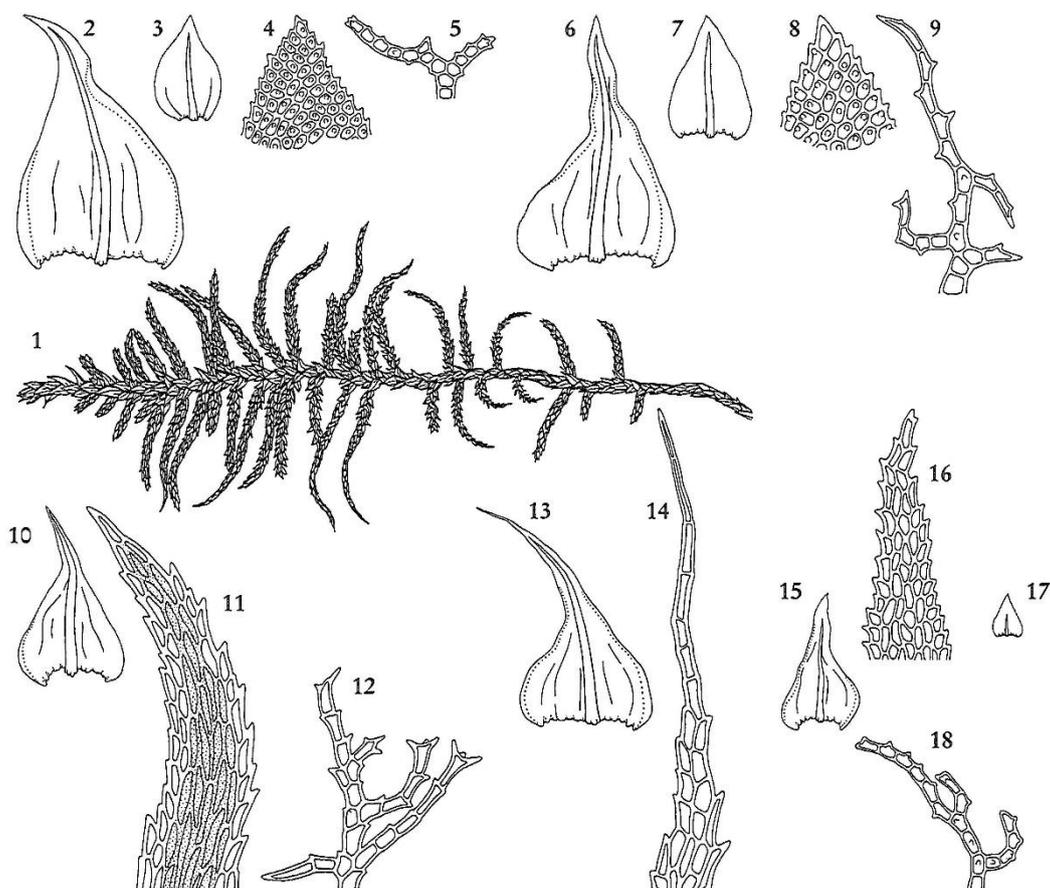


FIGURE 67. 1-5, **Abietinella abietina**: 1, habit; 2, stem leaf; 3, branch leaf; 4, branch leaf apex; 5, paraphyllium. 6-9, **Thuidium tamariscinum**: 6, stem leaf; 7, branch leaf; 8, branch leaf apex; 9, paraphyllium. 10-12, **T. recognitum**: 10, leaf; 11, leaf apex; 12, paraphyllium. 13-14, **T. assimile**: 13, leaf; 14, leaf apex. 15-18, **T. delicatulum**: 15, stem leaf; 16, stem leaf apex; 17, branch leaf; 18, paraphyllium. 1 (x2,5); 2, 3, 6, 7, 10, 13, 15, 17 (x20); 4, 5, 8, 9, 11, 12, 14, 16, 18 (x200).

- 1 Apical cell of branch leaves acute, not papillose (fig. 67, 6-9) **T. tamariscinum** (Hedw.) Schimp.
Plants robust, light green to brownish, regularly 3-pinnate, with complanate branches. Forms extensive wefts on wet, shaded rocks and soils and at tree bases, from the lowlands to high mountains, in the northern half of the Peninsula. Esp, Prt, And.
- 1 Apical cell of branch leaves truncate, with 2-3 terminal papillae **2**
- 2 Nerve of stem leaves ending at apex and nearly filling acumen; paraphyllia with terminal or sub-terminal papillae (fig. 67, 10-12) **T. recognitum** (Hedw.) Lindb.
Plants 2-pinnate. Stem leaves with reflexed or curved point; upper cells longer and narrower and more thick-walled than the rest of laminal cells. Forms ± dense, brownish green wefts on usually calcareous soils and rocks and at tree bases in forests from the lowlands to high mountains, in the northern half of the Peninsula y Sierra Nevada. Esp, And.
- 2 Nerve of stem leaves below apex; paraphyllia with central papillae **3**
- 3 Upper part of stem leaves filiform, ending in 2-9 rows of hyaline cells (fig. 67, 13-14)
T. assimile (Mitt.) A.Jaeger
T. philibertii Limpr.
Plants usually 2-pinnate. Stem leaves with reflexed or curved point. Forms yellowish green wefts on shaded, usually calcareous soils and rocks, from the lowlands to high mountains. Mainly in the northern part of the Peninsula. Esp, And.
- 3 Upper part of stem leaves acute or acuminate, not filiform, chlorophyllose (fig. 67, 15-18)
T. delicatulum (Hedw.) Schimp.
Plants 2-3-pinnate. Stem leaves appressed when dry, rarely with reflexed acumen. Perichaetial leaves ciliate. Grows on shaded rocks and soils, and at base of trees, from the lowlands to high mountains, in the northern half of the Peninsula and in Mallorca. Esp, And, Bl.

Fam. Brachytheciaceae

Brachythecium Schimp.

Plants small to robust. Stem prostrate or ascending, branches usually erect. Stem leaves lanceolate, ovate to triangular, longitudinally plicate or not, concave or flat, decurrent, acute or acuminate; laminal cells linear, smooth, rarely prorate on dorsal side, alar cells quadrate or rectangular, forming a ± distinct group, sometimes

reaching the nerve; nerve single, long, extending to 1/2 way up leaf or to the apex, sometimes ending in a projecting cell at back. Branch leaves similar to stem leaves, but usually shorter and narrower. Seta smooth or papillose; lid conical. Mostly autoicous.

1 Nerve, at least in branch leaves, extending more than 80% leaf length 2

1 Nerve extending up to 80% leaf length or less 4

2 Alar cells reaching nerve (fig. 68, 15) **B. populeum** (Hedw.) Schimp.

* **Sciuro-hypnum populeum** (Hedw.) Ignatov & Huttunen

Plants small to medium-sized. Stem leaves lanceolate, margin entire or finely denticulate in upper part; alar cells +/- opaque, quadrate or rectangular. Branch leaves strongly denticulate at apex. Seta papillose. Autoicous. Forms glossy green, yellowish or brownish wefts on wet rocks, slopes and trees by streams, in montane areas and high mountains, in the northern half of the Peninsula and in Sierra Nevada. Esp, And.

2 Alar cells not reaching nerve 3

3 Alar cells ascending up leaf margin, quadrate or quadrate-rectangular, not forming an excavate group (fig. 69, 7-8) **B. reflexum** (Starke) Schimp.

* **Sciuro-hypnum reflexum** (Starke) Ignatov & Huttunen

Plants small or medium-sized. Stem leaves appressed, with long, slightly channelled acumen, decurrent; nerve reaching leaf apex, sometimes nerve ending in a spine. Stem leaves entire or finely denticulate. Branch leaves denticulate, nerve ending in a spine. Seta papillose. Autoicous. Forms green or yellowish green wefts on soils, rocks and trees, in high mountains, in the north of the Peninsula and in Sierra Nevada. Esp, And.

3 Alar cells not ascending up leaf margin, shortly-rectangular to rectangular, forming a ± excavate group (fig. 69, 9) **B. starkei** (Brid.) Schimp.

* **Sciuro-hypnum starkei** (Brid.) Ignatov & Huttunen

Plants small or medium-sized, sometimes complanately branched. Stem leaves erecto-spreading, widely ovate-triangular, usually with the acumen twisted 180°, margin denticulate; nerve ending in a spine; laminal cells sometimes prorate in the upper part. Branch leaves strongly denticulate. Seta papillose. Autoicous. Forms green or yellowish green wefts on shaded soils and at tree bases, from the lowlands to in high mountains, in the north and of the Peninsula. Esp, Prt.

4 Alar cells not differentiated or only slightly so, forming an inconspicuous group 5

4 Alar cells differentiated, forming a conspicuous group 6

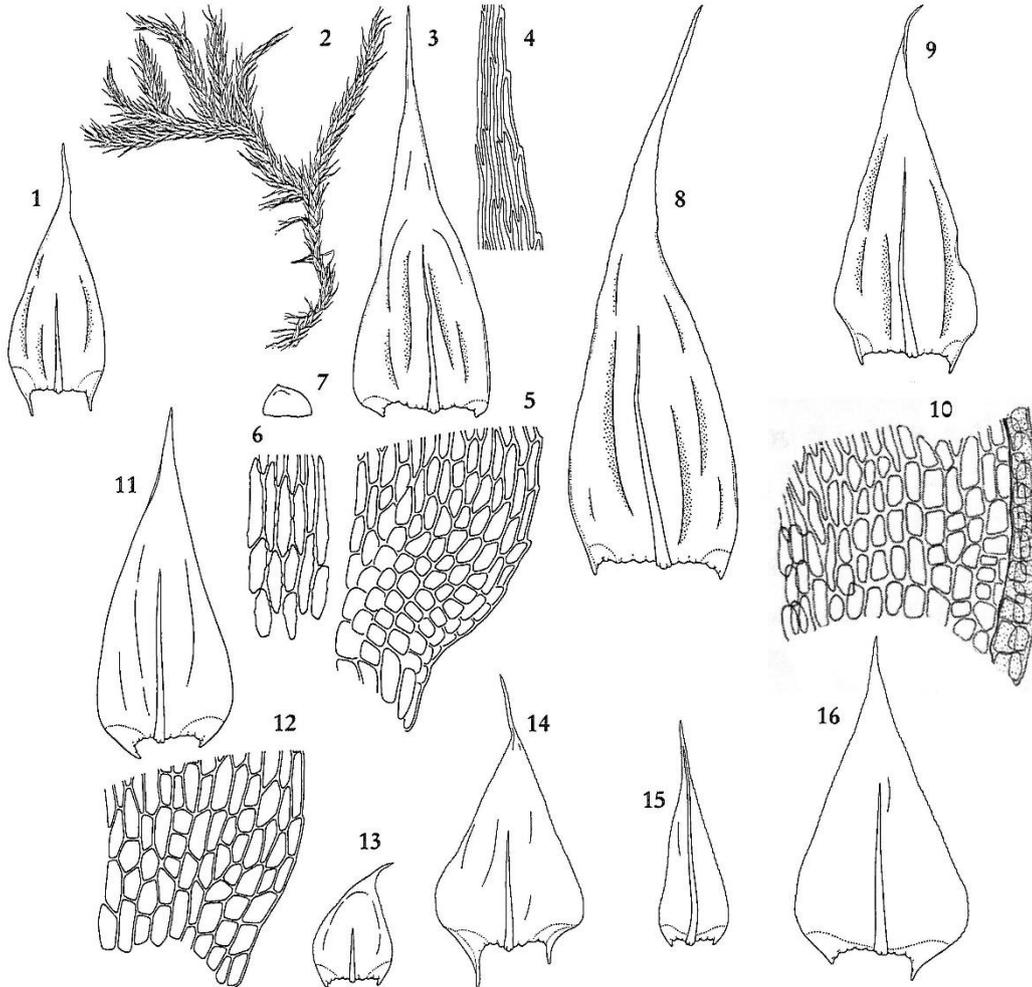


FIGURE 68. 1, *Brachythecium albicans*, leaf. 2-7, *B. turgidum*: 2, habit; 3, leaf; 4, upper marginal cells; 5, alar cells; 6, basal cells; 7, pseudoparaphyllium. 8, *B. glareosum*, leaf. 9-10, *B. salebrosum*: 9, leaf; 10, alar cells. 11-12, *B. mildeanum*: 11, stem leaf; 12, alar cells. 13, *B. collinum*, leaf. 14, *B. glaciale*, stem leaf. 15, *B. populeum*, branch leaf. 16, *B. plumosum*, leaf. 2 (x2,5); 1, 3, 7, 8, 9, 11, 13, 14, 15, 16 (x18); 4, 5, 6, 10, 12 (x160).

- 5 Stem leaves usually widely ovate or ovate-lanceolate; leaf margin denticulate to serrulate, at least towards apex (fig. 69, 13-15) **B. rutabulum** (Hedw.) Schimp.

Plants robust. Stem prostrate or ascending, with erect branches. Stem leaves with short acumen, abruptly acuminate, usually with the acumen twisted 180°, leaf base more or less decurrent; basal cells rectangular. Seta strongly papillose. Autoicous. Forms green or yellowish green wefts on rocks, slopes and at tree bases, in wet places, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl. var. **atlanticum** Hedenäs has been cited from Portugal, it is characterised by stem cortex of 2-4 layers of incrassate cells, leaves +/-plicate, broadly triangular or broadly ovate-triangular and alar cells differentiated along basal leaf margin.

- 5 Stem leaves usually triangular; leaf margin entire, rarely with a few teeth towards apex (fig. 68, 11-12)

B. mildeanum (Schimp.) Schimp.

Plants robust, yellowish. Seta smooth. Autoicous. Plants growing on wet, open soils in montane areas and high mountains Scattered in the Peninsula. Esp, Prt.

- 6 Alar cells reaching nerve (fig. 68, 16) **B. plumosum** (Hedw.) Schimp.

* **Sciuro-hypnum plumosum** (Hedw.) Ignatov & Huttunen

Plants small to medium-sized. Stem leaves ovate-lanceolate, not or slightly plicate, sometimes falciform, entire or finely denticulate near apex, nerve not ending in a spine-like projection, alar cells quadrate or rectangular; branch leaves dentate. Seta reddish, papillose above. Autoicous. Forms dark green or brownish wefts on wet, acidic rocks and by streams, from the lowlands to high mountains, in the northern and western part of the Peninsula and in Sierra Nevada. Esp, Prt, And.

- 6 Alar cells not reaching nerve **7**

- 7 Alar cells inflated (fig. 69, 10-12) **B. rivulare** Schimp.

Plants large, glossy light green to yellowish. Stem leaves widely ovate, abruptly narrowed, margin denticulate. Seta papillose. Dioicous. Grows on soils and rocks in streams, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 7 Alar cells not inflated **8**

- 8 Stem leaves usually less than 1 mm long (fig. 68, 13) **B. collinum** (Schleich. ex Müll.Hal.) Schimp.

* **Brachytheciastrum collinum** (Schleich. ex Müll.Hal.) Ignatov & Huttunen

Plants small, with julaceous branches. Leaves widely ovate, with denticulate or serrate margin; alar cells numerous, quadrate or rectangular, thin-walled. Seta smooth. Autoicous. Forms pale green or yellowish patches in rock crevices and on rocky slopes, in high mountains. Esp, And.

- 8 Stem leaves usually more than 1 mm long **9**

- 9 Stem leaves usually abruptly narrowed to acumen **10**

- 9 Stem leaves gradually narrowed to acumen **11**

- 10 Alar cells pellucid; dioicous; seta smooth (fig. 68, 1) **B. albicans** (Hedw.) Schimp.

Plants medium-sized, silky, pale green or yellowish. Stem leaves ovate-lanceolate, abruptly and longly narrowed, decurrent at base, entire or slightly dentate; alar cells quadrate, ascending up margin. Seta smooth. Dioicous. Forms wefts on open soils in woods and on slopes, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt.

- 10 Alar cells opaque; autoicous; seta papillose (fig. 68, 14) **B. glaciale** Schimp.
 * **Sciuro-hypnum glaciale** (Schimp.) Ignatov & Huttunen
 Plants medium-sized, with julaceous branches. Stem leaves ovate-triangular, with finely denticulate margin, recurved below; alar cells mostly quadrate, ± thick-walled, forming a triangular group not reaching nerve. Forms yellowish green patches on wet soils in snow-beds, in high mountains in the north of the Peninsula and Sierra Nevada. Esp, And.
- 11 Stem and branch leaves usually curved from base **B. erythrorrhizon** Schimp.
 Plants small. Stem leaves ovate-triangular to lanceolate, with finely denticulate to dentate margin, nerve ending in spine, very conspicuous in branch leaves; alar cells forming a triangular group not reaching nerve. Forms yellowish green to light green patches on humiferous soils near streams, in high mountains of Central Pyrenees. Esp.
- 11 Stem and branch leaves straight **12**
- 12 Stem leaves 0,35-0,60(0,90) mm wide **13**
- 12 Stem leaves 0,60-1,30 mm wide **16**
- 13 Seta smooth **14**
- 13 Seta papillose **15**
- 14 Laminal cells prorate on dorsal side **B. olympicum** Jur.
 * **Brachytheciastrum olympicum** (Jur.) Vanderp., Ignatov, Huttunen & Goffinet
 Plants small. Stem leaves ovate-triangular to triangular, with entire margin, nerve ending in spine; alar cells small, forming a triangular group not reaching nerve but ascending up margin. Branch leaves similar to stem leaves but with serrulate margin. Autoicous. Forms yellowish green to yellowish brown patches in rock crevices and on trees, in montane areas. Rare in the centre and west of the Peninsula. Esp, Prt.
- 14 Laminal cells not prorate on dorsal side **B. salicinum** Schimp.
 * **Brachytheciastrum salicinum** (Schimp.) Orgaz, M.J.Cano & J.Guerra, **Brachythecium velutinum** (Hedw.) Schimp. var. **salicinum** (Schimp.) Mönk.,
 Plants small. Stem leaves lanceolate, with subentire to denticulate margin, nerve ending in spine; alar cells small, forming a ovate group not reaching nerve. Branch leaves similar to stem leaves. Autoicous. Forms light green to yellowish green patches on slopes and rocks or epiphyte, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

- 15 Leaf lamina without prorate cells on dorsal side (fig. 69, 5-6) **B. velutinum** (Hedw.) Schimp.
 * **Brachytheciastrum velutinum** (Hedw.) Ignatov & Huttunen
 Plants usually small. Stem leaves lanceolate, sometimes ovate-lanceolate, with denticulate margin, nerve ending in a conspicuous spine; alar cells small, forming a ovate or triangular, pellucid group not reaching nerve. Branch leaves similar to stem leaves. Autoicous. Forms light green to yellowish green patches on slopes, soils in woods and rocks or epiphyte, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.
- 15 Leaf lamina with prorate cells on dorsal side (fig. 69, 1-4) **B. dieckei** Röll
 * **Brachytheciastrum dieckei** (Röll) Ignatov & Huttunen
 Plants small, yellowish green or yellowish. Leaves triangular to ovate-triangular, margin usually recurved at least near base, strongly dentate; alar cells thick-walled, forming a large group extending along leaf margin; nerve ending in a conspicuous spine. Autoicous. Grows on shaded soils and rocks or epiphyte. Distributed in montane areas and high mountains. Scattered in the Peninsula. Esp, Prt.
- 16 Leaf margin usually entire or sub-entire **17**
- 16 Leaf margin denticulate to serrulate, at least near apex **19**
- 17 Stem leaves 1,3-2,3 mm long; nerve ending in a projection at back of leaves **B. curtum** (Lindb.) Limpr.
 * **Sciuro-hypnum curtum** (Lindb.) Ignatov
 Plants small to medium-sized, dark green. Leaves ovate-triangular; alar cells thin-walled, forming ovate, pellucid group. Autoicous. Grows on humiferous soils and sometimes in snow-beds, in high mountains, in the north of the Peninsula. Esp.
- 17 Stem leaves more than 2,3 mm long; nerve not ending in a projection at back of leaves **18**
- 18 Plants dioicous; pseudoparaphyllia triangular; alar cells thin-walled (fig. 68, 8)
B. glareosum (Bruch ex Spruce) Schimp.
 Plants large, glossy yellowish or golden, plumose, irregularly and sparsely branched. Stem long, slightly branched, prostrate, without rhizoids. Stem leaves ovate-lanceolate, plicate, with twisted and filiform acumen and finely denticulate or entire margin, base decurrent; alar cells forming an ovate group. Seta smooth. Forms wefts on open soils, rocks and slopes, sometimes at tree base, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 18 Plants autoicous; pseudoparaphyllia orbicular, sometimes shortly apiculate; alar cells with somewhat thickened walls (fig. 68, 2-7) **B. turgidum** (C.Hartm.) Kindb.

Plants robust, rigid, golden yellow, glossy. Stem irregularly branched, with short branches. Leaves densely arranged, ovate-lanceolate, plicate, margin partially recurved, entire or nearly so; nerve extending to 1/2 way up leaf. Seta smooth. Autoicous. Grows on wet, calcareous soils in high mountains grasslands, in the central Pyrenees. Esp.

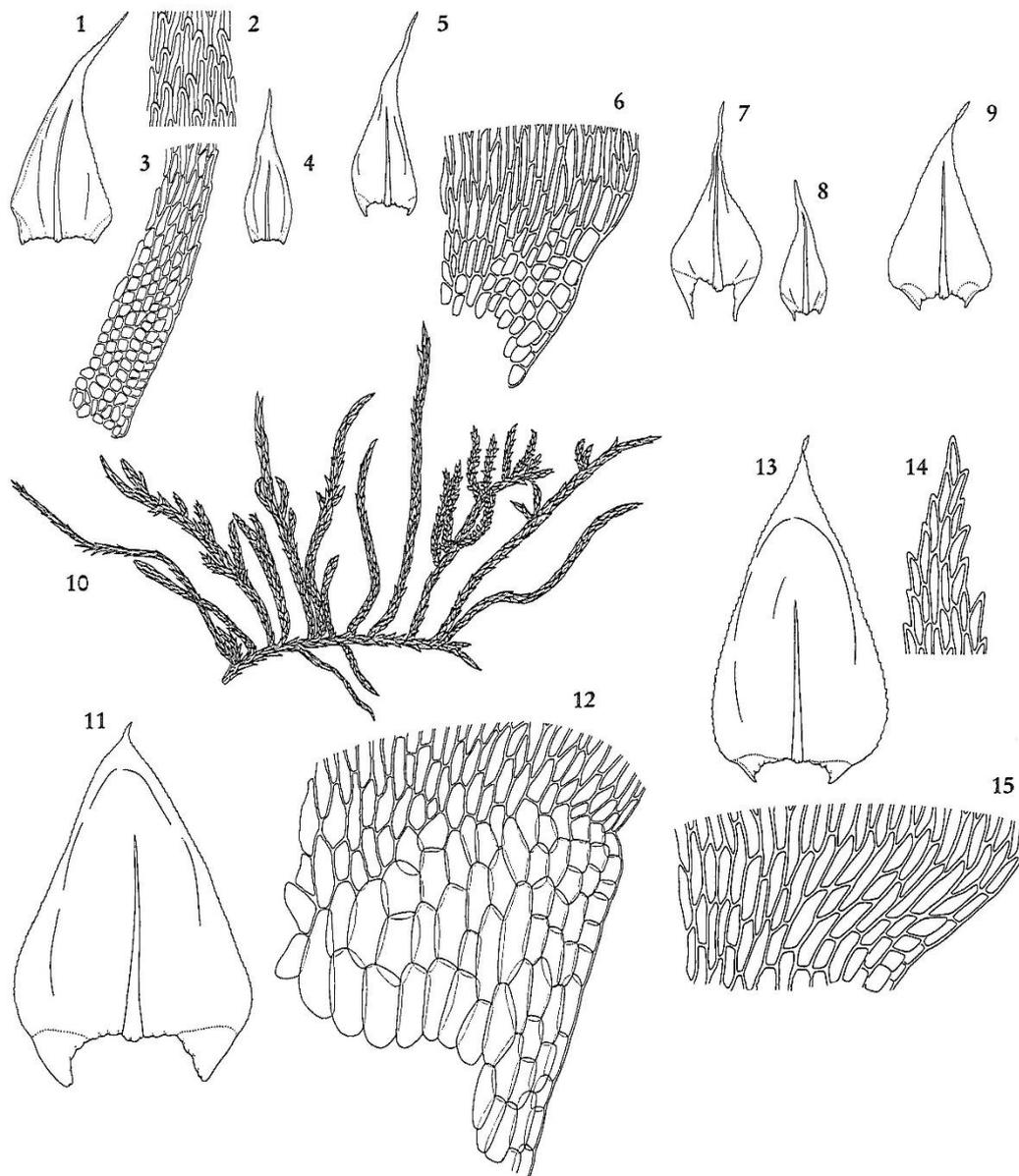


FIGURE 69. 1-4, *Brachythecium dieckii*: 1, stem leaf; 2, upper cells; 3, alar cells; 4, branch leaf. 5-6, *B. velutinum*: 5, leaf; 6, alar cells. 7-8, *B. reflexum*: 7, stem leaf; 8, branch leaf. 9, *B. starkei*, leaf. 10-12, *B. rivulare*: 10, habit; 11, leaf; 12, alar cells. 13-15, *B. rutabulum*: 13, leaf; 14, leaf apex; 15, alar cells. 10 (x1,2); 1, 4, 5, 7, 8, 9, 11, 13 (x18); 12 (x120); 3, 6, 14, 15 (x160); 2 (x200).

19 Alar cells opaque, with slightly thickened walls; dioicous, leaf apex shortly acuminate, rarely acute, 300-500 µm long **B. laetum** (Brid.) Schimp.

Plants medium-sized, light green or yellowish green. Pseudoparaphyllia ovate-triangular. Stem leaves ovate-lanceolate or triangular-lanceolate, shortly acuminate or acute, plicate, nerve ending in a conspicuous spine; alar cells

forming an triangular group, not reaching nerve. Dioicous. Seta smooth. Forms wefts on calcareous ledges, in high mountains. Very rare. Esp.

- 19 Alar cells pellucid, thin-walled; autoicous, leaf apex longly acuminate, 500-900 µm long **20**
- 20 Seta smooth; alar cells forming a small, triangular to ovate group, not ascending along leaf margins; leaf margin denticulate subentire at apex, usually recurved towards base; nerve of branch leaves sometimes ending in a spine (fig. 68, 9-10) **B. salebrosum** (Hoffm. ex F. Weber & D. Mohr) Schimp.
Plants medium-sized. Pseudoparaphyllia triangular, acuminate. Stem leaves triangular to lanceolate, plicate. Laminal cells of branch leaves smooth. Autoicous. Forms green to yellowish green wefts on shaded slopes, rocks, wet grasslands, by streams and in rock crevices, sometimes at tree bases, from the lowlands to high mountains. Widespread in the Peninsula. Esp, Prt.
- 20 Seta papillose; alar cells forming a ovate, large group, ascending along leaf margins; leaf margin denticulate to serrulate, especially at apex, usually recurved in upper half; nerve of branch leaves ending in a distinct spine **B. campestre** (Müll. Hal.) Schimp.
Plants medium-sized, green or yellowish green. Pseudoparaphyllia ovate, acute. Stem leaves ovate-lanceolate, plicate. Branch leaves usually with prorate cells on dorsal side. Autoicous. On rock ledges. Very rare, in Central Pyrenees. Esp, Prt.

Cirriphyllum Grout

Plants medium-sized to robust. Stem usually prostrate, pinnate or irregularly branched, with ascending branches. Stem leaves concave, ovate, abruptly acuminate or tapered into long, fine point, margin entire or serrulate, plane or recurved at base; laminal cells elongate, alar cells quadrate or shortly rectangular, decurrent; nerve extending 1/2-2/3 way up leaf. Branch leaves similar to stem leaves or gradually tapered. Seta papillose; capsule ovoid, curved; lid rostellate to conical. Dioicous.

- 1 Stem leaves gradually tapered in a lanceolate acumen; nerve ending in a small projection from back (fig. 70, 22) **C. crassinervium** (Taylor) Loeske & M. Fleisch.
Eurhynchium crassinervium (Taylor) Schimp.
Plants to 10-12 cm long, light green to brownish. Stem leaves widely ovate, strongly concave, similar to branch leaves; median cells of lamina narrow, acuminate, apical cells shorter, alar cells quadrate or shortly rectangular, moderately inflated, forming a distinct group ascending up margin. Capsule oblique, slightly curved. Grows on wet, shaded, mainly calcareous rocks and slopes, sometimes at base of trees, in the lowlands and montane areas. Widespread throughout the Peninsula and the Balearic Islands. Esp, Prt, And, Bl.

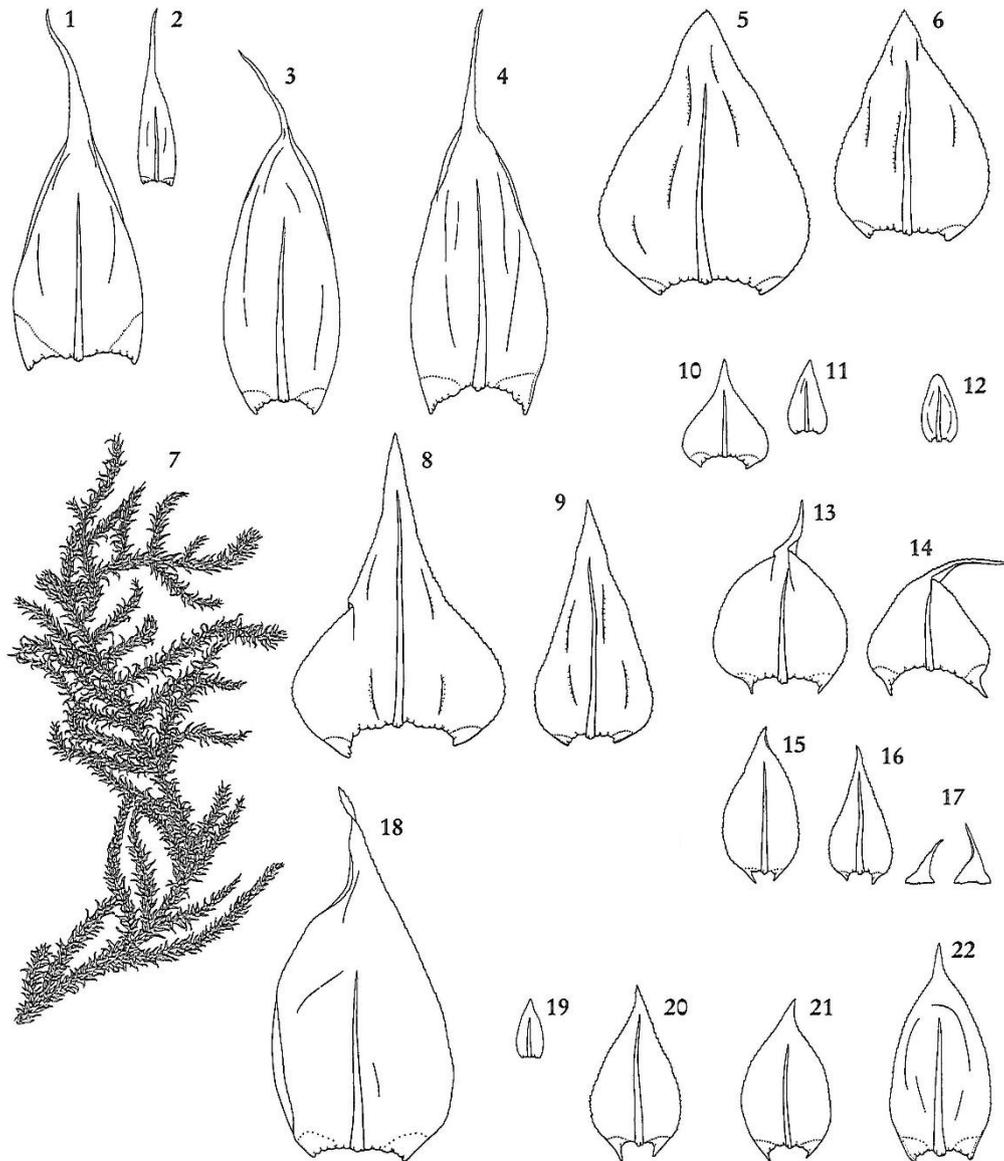


FIGURE 70. 1-2, *Cirriphyllum tommasinii*: 1, stem leaf; 2, branch leaf. 3, *C. cirrosum*, leaf. 4, *C. piliferum*, leaf. 5-6, *Eurhynchium angustirete*: 5, stem leaf; 6, branch leaf. 7-9, *E. striatum*: 7, habit; 8, stem leaf; 9, branch leaf. 10-11, *E. pulchellum* var. *pulchellum*: 10, stem leaf; 11, branch leaf. 12, *E. pulchellum* var. *diversifolium*, branch leaf. 13-17, *E. praelongum*: 13, 14, stem leaves; 15, 16, branch leaves; 17, paraphyllia. 18, *E. schleicheri*, leaf. 19, *E. pumilum*, leaf. 20, *E. speciosum*, leaf. 21, *E. hians*, leaf. 22, *Cirriphyllum crassinervium*, leaf. 7 (x1,5); 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 (x18).

2 Stem leaves \pm concave, abruptly acuminate; alar cells ascending up margin; branch leaves gradually acuminate (fig. 70, 1-2)

C. tommasinii (Sendtn. ex Boulay) Grout

* *Brachythecium tommasinii* (Sendtn. ex Boulay) Ignatov & Huttunen

Plants 3-6,5 cm long, yellowish to brownish. Leaves narrowly ovate to ovate, decurrent; laminal cells 7-11 µm wide. Forms glossy wefts on shaded, basic rocks, in montane areas and high mountains, in the north of the Peninsula. Esp, And.

- 2 Stem leaves strongly concave, abruptly tapered into long, fine point; alar cells not ascending up margin; branch leaves similar to stem leaves **3**

- 3 Stem irregularly branched; alar cells green, dull (fig. 70, 3) **C. cirrosum** (Schwägr.) Grout
* **Brachythecium cirrosum** (Schwägr.) Schimp.

Plants 4-8 cm long, glossy golden. Leaves ovate to widely ovate, decurrent, with entire or denticulate margin at apex; laminal cells 6-8 µm wide. Forms wefts on calcareous rocks and wet soils, in montane areas and high mountains, in Pyrenees. Esp, And.

- 3 Stem pinnately branched; alar cells pellucid (fig. 70, 4) **C. piliferum** (Hedw.) Grout
Plants robust, 7-13 cm long, light green. Leaves ovate to widely ovate, with finely denticulate margin; laminal cells 6-9 µm wide, alar cells little differentiated. Forms pale green wefts on wet tree bases, in montane areas and high mountains, in the north of the Peninsula. Esp, And.

Eurhynchium Schimp.

Plants small to robust. Stem prostrate or procumbent, irregularly pinnately branched, with erect or ascending branches. Stem and branch leaves similar or not, stem leaves longitudinally plicate or not, plane or slightly concave, ovate to cordate-triangular, acuminate to obtuse, margin denticulate or dentate; laminal cells smooth, median cells usually long and narrow, apical cells shorter, oblong-rhomboidal, alar cells slightly differentiated, forming a small group extending to nerve; nerve single, extending 1/2 way up leaf to near apex, in branch leaves ending in a small projection from back. Seta reddish, smooth or papillose; capsule inclined to horizontal, ovoid or cylindrical, curved or erect; lid obliquely rostrate. Autoicous, synoicous or dioicous.

- 1 Leaves longitudinally plicate; plants robust; seta smooth **2**
- 1 Leaves without or with weak longitudinal plicae; plants slender to medium-sized; seta papillose (except in *E. pulchellum*) **3**
- 2 Leaves cordate-ovate, with acute, wide acumen, making an angle of more than 45° (fig. 70, 5-6)
E. angustirete (Broth.) T.J.Kop.

Plants to 15 cm long, dark green to yellowish green. Leaves erect or patent, nerve with prorate cells in the upper part. Grows on humus-rich soils, slopes and rocks in firwoods, pinewoods and beechwoods, in montane areas and high mountains, in the Pyrenees. Esp, And.

- 2 Leaves ovate-lanceolate or cordate-lanceolate, with long, narrow acumen, making an angle of less than 40° (fig. 70, 7-9) **E. striatum** (Hedw.) Schimp.

Plants to 15 cm long, glossy green or yellowish green. Leaves erect to spreading. Forms loose patches on soils, slopes, rocks and at tree bases, in wet forests, from the lowlands to high mountains, mainly in the northern half of the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 3 Stem leaves and branch leaves differentiated; stem leaves distant, cordate-triangular to widely ovate **4**

- 3 Stem leaves and branch leaves similar; stem leaves not as above **5**

- 4 Seta smooth; plants irregularly branched; stem leaves not decurrent (fig. 70, 10-12)

E. pulchellum (Hedw.) Jenn.

* **Eurhynchiastrum pulchellum** (Hedw.) Ignatov & Huttunen

Plants small. Stem prostrate, with short, ascending branches. Stem leaves distant, triangular to narrowly oblong-ovate; apical cells of lamina short, 2:1, median cells 50-80 x 5 µm. Branch leaves 0,5-1 mm long, with acute or obtuse point, sometimes concave. Grows on tree bases and rocks, in rock crevices and on wet, calcareous soils, in pinewoods and fir woods, in montane areas and high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

var. **pulchellum** (= * *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen): Stem leaves erect-spreading; laminal cells 60-90 µm. Branch leaves with acute apex (fig. 70, 10-11).

var. **diversifolium** (Schimp.) C.O.E.Jensen (= * *Eurhynchiastrum diversifolium* (Schimp.) J.Guerra): Stem leaves densely imbricate; laminal cells 36-56 µm long. Branch leaves with rounded, obtuse apex (fig. 70, 12).

- 4 Seta papillose; plants usually regularly branched; stem leaves decurrent (fig. 70, 13-17)

E. praelongum (Hedw.) Schimp.

* **Kindbergia praelonga** (Hedw.) Ochyra, **Eurhynchium praelongum** var. **stokesii** (Turner) Dixon

Plants light green to greenish brown or brownish. Stem to 15 cm long, with complanate branches, usually with filamentous paraphyllia and triangular or lanceolate pseudoparaphyllia. Stem leaves erect to patent, widely ovate to cordate-triangular, sometimes falcate, gradually narrowed in short or long point, base widely decurrent. Branch leaves lanceolate to ovate-lanceolate. Forms wefts on wet soils and slopes in forests and at tree bases, from the lowlands to montane areas. Widespread throughout the Peninsula and in the Balearic Islands. Esp, Prt, And, Bl

- 5 Laminal cells 2-5:1; leaves to 0,8 mm long; plants very small (fig. 70, 19)

E. pumilum (Wilson) Schimp.

* **Microeurhynchium pumilum** (Wilson) Ignatov & Vanderp., **Oxyrrhynchium pumilum** (Wilson) Loeske
Plants 1-3 cm long. Nerve of stem leaves 18-31 μm wide at base. Dioicous. Forms small, dark green patches on calcareous soils and wet slopes, in forests, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

5 Laminal cells 5-15:1; leaves more than 0,8 mm long; plants medium-sized 6

6 Stem leaves more than 1,5 mm long ; laminal cells 60-90 μm long (fig. 70, 20)

E. speciosum (Brid.) Jur.

* **Oxyrrhynchium speciosum** (Brid.) Warnst.

Plants to 20 cm long, light green. Leaves ovate, acuminate; nerve nearly reaching the apex. Branch leaves not complanate. Dioicous or synoicous. Forms large wefts on wet or flushed slopes and rocks, in the lowlands and montane areas. Distributed throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

6 Stem leaves less than 1,5 mm long; laminal cells 35-70 μm long 7

7 Leaf apex twisted through 180°; laminal cells 4-6 μm wide; ; stem leaves not narrowed at base (fig. 70, 18)

E. schleicheri (R.Hedw.) Milde

* **Oxyrrhynchium schleicheri** (R.Hedw.) Röll

Plants to 6 cm long, glossy, light green. Primary stem creeping, subterranean, the secondary ones erect, regularly branched, with short branches. Leaves densely arranged, sometimes longitudinally plicate. Branch leaves not complanate,. Dioicous. Grows on wet soils, slopes and rocks, from the lowlands to high mountains. Widespread throughout the Peninsula the Peninsula. Esp, Prt, And.

7 Leaves usually flat; laminal cells 6-8 μm wide; stem leaves narrowed at base (fig. 70, 21)

E. hians (Hedw.) Sande Lac.

* **Oxyrrhynchium hians** (Hedw.) Loeske

Plants to 15 cm long, light green to golden green. Stem procumbent; stem leaves lax, widely ovate, decurrence of 1-4 cells; median cells of lamina 40-60(-80) x 5-9 μm ; nerve extending to 3/4 way up leaf. Branch leaves usually complanate, sparsely arranged, acute, plane, margin strongly dentate. Dioicous. Forms lax patches on wet, shaded soils, slopes and by streams, in the lowlands and montane areas. Widespread throughout the Peninsula and in Balearic Islands. Esp, Prt, And, Bl.

Homalothecium Schimp.

Plants medium-sized to robust. Stem prostrate, regularly or irregularly branched, with straight or curved branches. Stem leaves similar to branch leaves, plicate, triangular to triangular-lanceolate, acuminate, straight

or slightly falciform; laminal cells linear to vermicular, basal cells shorter and wider, alar cells quadrate or irregular in shape; nerve single, long, sometimes projecting as a dorsal spine. Seta smooth or papillose; capsule erect or inclined. Dioicous.

- 1 Alar cells of leaves numerous, quadrate, arranged in rows forming a group well differentiated, ascending up margin; capsule curved, inclined (fig. 71, 1-2) **H. aureum** (Spruce) H. Rob.

Plants medium-sized, to 10 cm long. Stem pinnate, with erect branches, curved when dry, 0,5-1 cm long. Stem leaves triangular to ovate-lanceolate, finely acuminate, slightly plicate, margin recurved from base to apex. Forms golden mats on dry, exposed, acidic or basic soils and rocks, mainly in montane areas. Scattered in the Peninsula and in Mallorca. Esp, Prt, Bl.

- 1 Alar cells of leaves irregular in shape, rarely arranged in rows, not ascending up margin; capsule erect or inclined **2**

- 2 Nerve extending to the apex; capsule straight; seta smooth (fig. 71, 3)

H. philippeanum (Spruce) Schimp.

Plants to 7 cm long. Stem irregularly branched, with long, erect branches. Leaves triangular, longly acuminate; nerve stout, not projecting as a spine but usually denticulate at back. Capsule erect to inclined. Forms glossy green mats, brownish below, on calcareous rocks, in montane areas and high mountains. Scattered in the Peninsula, rare in the south. Esp, And.

- 2 Nerve not reaching the apex; capsule straight or curved; seta smooth or papillose **3**

- 3 Plants irregularly branched; branches long, to 3 cm long, straight when dry; rhizoids basal; capsule inclined (fig. 71, 4) **H. lutescens** (Hedw.) H. Rob.

Plants medium-sized to robust, to 12 cm long, ascending. Leaves triangular, lanceolate or ovate-lanceolate, strongly plicate, apex acuminate, filiform, usually bent, margin entire, finely denticulate at base. Form glossy golden mats on calcareous soils and rocks and in clearings, in the lowlands and montane areas, mainly in the northern half of the Peninsula and in Mallorca, rare in the south of the Peninsula. Esp, Prt, And, Bl.

- 3 Plants usually regularly branched; branches short, to 1,5 cm long, curved when dry; rhizoids along the stem; capsule erect **4**

- 4 Seta papillose; leaf margin distinctly denticulate at base (fig. 71, 5-8) **H. sericeum** (Hedw.) Schimp.

Plants variable in size, procumbent, to 12 cm long. Stem leaves triangular or ovate-triangular, plicate, apex long and thin, margin serrulate at base, with curved teeth, slightly denticulate at apex. Branch leaves triangular-lanceolate. Forms silky, glossy golden green mats on dry, calcareous, soils, rocks, exposed walls and trunks of trees, from the

lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithusic Islands.
Esp, Prt, And, Bl.

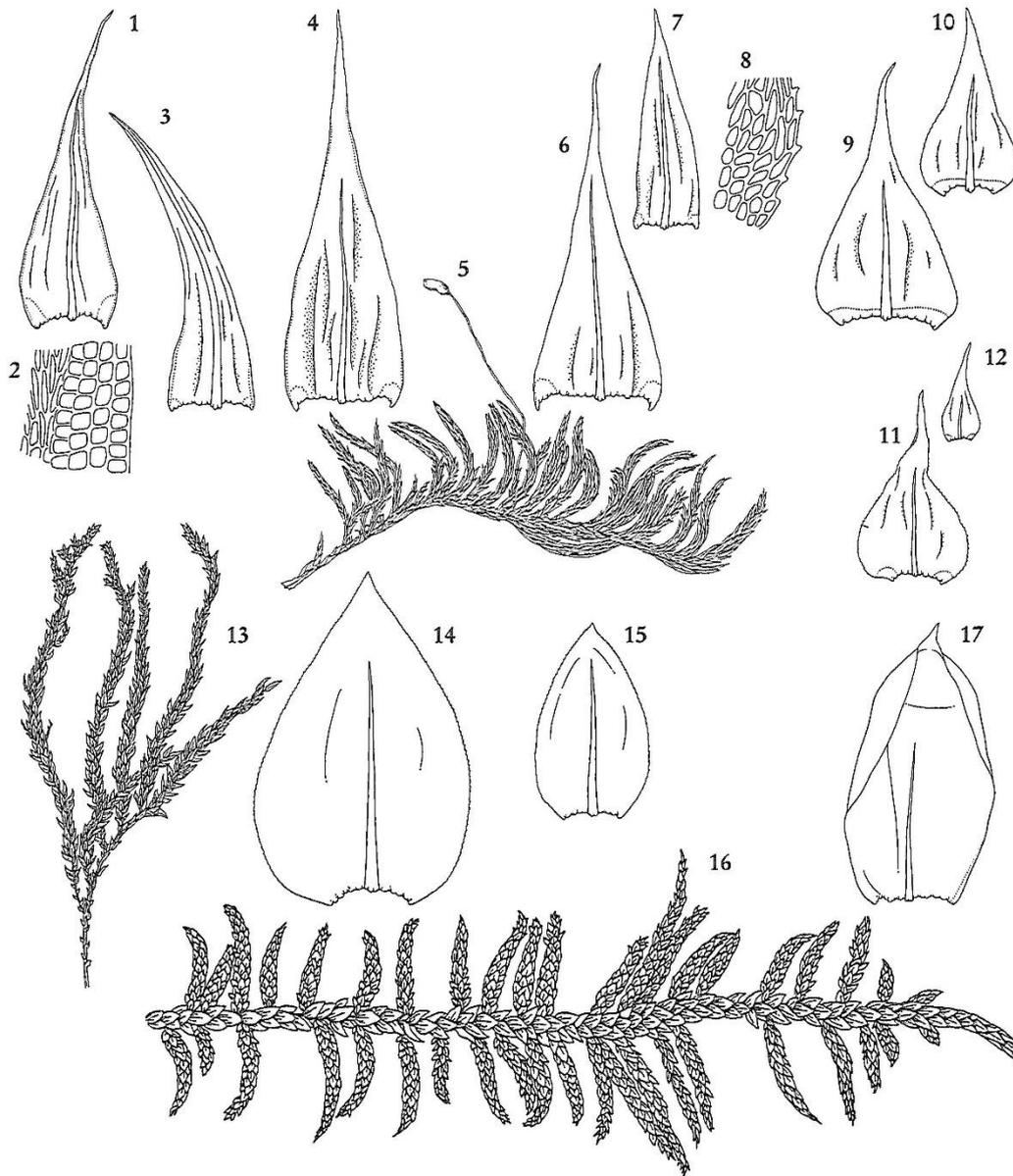


FIGURE 71. 1-2, *Homalothecium aureum*: 1, stem leaf; 2, alar cells of branch leaf. 3, *H. philippeanum*, leaf. 4, *H. lutescens*, leaf. 5-8, *H. sericeum*: 5, habit; 6, stem leaf; 7, branch leaf; 8, alar cells. 9-10, *Plasteurhynchium striatulum*: 9, stem leaf; 10, branch leaf. 11-12, *P. meridionale*: 11, stem leaf; 12, branch leaf. 13-14, *Platyhypnidium riparioides*: 13, habit; 14, leaf. 15, *P. lusitanicum*, leaf. 16-17, *Pseudoscleropodium purum*: 16, habit; 17, leaf. 5, 13, 16 (x1,5); 1, 3, 4, 6, 7, 9, 10, 11, 12, 14, 15, 17 (x18); 2, 8 (x200).

- 4 Seta smooth in the upper half; leaf margin denticulate sinuose or sinuose-denticulate at base

H. meridionale (M.Fleisch. & Warnst.) Hedenäs

Plants variable in size, procumbent, to 12 cm long. Stem leaves triangular or ovate-triangular, plicate, apex long and thin. Branch leaves triangular-lanceolate. Forms silky, glossy golden green mats on dry, calcareous, soils, rocks,

exposed walls and trunks of trees and in rock crevices, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

Plasteurhynchium M. Fleisch. ex Broth.

Plants robust. Stem prostrate, with erect or ascending branches. Stem leaves longitudinally plicate. Leaves ovate-triangular, sometimes cordate, with long, narrow acumen, margin denticulate; laminal cells smooth, rhomboidal to linear-rhomboidal, alar cells quadrate, reaching the nerve or forming a small group, basal cells porose; nerve extending to 3/4 way up leaf, in branch leaves ending in a projection from back. Seta smooth; capsule horizontal to inclined, sub-cylindrical to ellipsoidal; lid obliquely rostrate. Dioicous.

- 1 Alar cells reaching the nerve; laminal cells 3-6:1; leaves erecto-patent (fig. 71, 9-10)

P. striatulum (Spruce) M.Fleisch.

Eurhynchium striatulum (Spruce) Schimp.

Stem to 20 cm long, with usually curved ascending branches. Stem leaves ovate-triangular, acuminate. Branch leaves lanceolate to ovate-lanceolate. Forms dark green to yellow green wefts on wet, shaded, calcareous rocks in the lowlands and montane areas. Distributed in the northern half of the Peninsula, rarer in the south and in Mallorca Menorca and Pithyusic Islands. Esp, Prt, Bl.

- 1 Alar cells forming a small group, not reaching the nerve; laminal cells 8-10:1; leaves spreading (fig. 71, 11-12)

P. meridionale (Schimp.) M.Fleisch.

Eurhynchium meridionale (Schimp.) De Not.

Stem to 12 cm long, with curved, ascending branches. Stem leaves ovate-triangular to widely ovate, acuminate, spreading, margin denticulate. Branch leaves ovate-lanceolate. Forms small, glossy yellowish green mats on ledges and dry, calcareous rocks, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

Platyhypnidium M. Fleisch.

Plants robust. Stem prostrate, irregularly branched. Stem and branch leaves similar, ovate, concave or nearly flat, margin denticulate or dentate; laminal cells linear or narrowly rhomboidal, smooth, alar cells enlarged but not forming auricles; nerve extending to 3/4 way up leaf, not ending in projecting cell at back. Seta smooth; capsule with rostrate lid. Plants rheophilous.

- 1 Leaves nearly flat, erect to spreading when moist; laminal cells 95-120 μm long; nerve 65-150 μm wide at base (fig. 71, 13-14)

P. riparioides (Hedw.) Dixon

* **Rhynchostegium riparioides** (Hedw.) Cardot

Plants polymorphic, to 15 cm long, usually denudate at base, dark green to glossy blackish. Median cells of lamina 8-13:1, apical cells shorter, basal cells short, porose, pale, nerve often bifurcate in the upper part. Rheophilous, on submerged rocks and by streams, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 1 Leaves concave, imbricate when moist; laminal cells 70-90 μm long; nerve 45-80 μm wide at base (fig. 71, 15)

P. lusitanicum (Schimp.) Ochyra & Bednarek-Ochyra

* **Rhynchostegium alopecuroides** (Brid.) A.J.E.Sm.

Plants to 12 cm long, with julaceous branches when moist. Median cells of lamina 12-17:1, apical cells shorter. Rheophilous, forms glossy dark green wefts on seeping rocks, mainly in the northwestern part of the Peninsula. Esp, Prt.

Pseudoscleropodium (Limpr.) M. Fleisch.

Plants robust. Stem prostrate or ascending, regularly pinnate, branches complanate, stem and branches julaceous. Leaves imbricate, strongly concave, widely ovate or obovate, apex obtuse or rounded and apiculate, margin plane or recurved at apex, finely denticulate to entire; laminal cells linear-vermicular, basal cells shorter than wide, sometimes porose, alar cells quadrate to shortly rectangular; nerve extending to 1/2-2/3 way up leaf. Seta smooth (fig. 71, 16-17)

P. purum (Hedw.) M.Fleisch.

Scleropodium purum (Hedw.) Limpr.

Forms extensive, pale green or brownish green wefts on forest soils, in the lowlands and montane areas. Widespread throughout the Peninsula and in Mallorca and Menorca. Esp, Prt, And, Bl.

Rhynchostegiella (Schimp.) Limpr.

Plants slender, small. Stems mostly prostrate, with short branches. Leaves lanceolate to oblong-lanceolate, margin entire or denticulate, apex acute or longly acuminate; laminal cells rhomboidal to linear; nerve extending to acumen or at least to 1/2 way up leaf. Seta smooth or papillose; capsule horizontal or inclined; lid rostrate.

- 1 Rhizoids warty-papillose (fig. 72, 1-2)

R. durieui (Mont.) P. Allorge & Perss.

* **Pseudorhynchostegiella duriaei** (Mont.) Ignatov & Vanderp.

Plants with ascending stems. Leaves subulate; basal cells porose, linear above; nerve faint, 15-25 μm wide at base, short, extending 25-50% leaf length, occasionally absent in some leaves. Forms silky, glossy yellowish green mats in crevices and on ledges and acidic soils, in the lowlands and montane areas in the southwestern part of the Peninsula and Menorca. Esp, Prt, Bl.

- 1 Rhizoids smooth 3
- 2 Nerve stout, more than 45-50 μm wide at base, ending in below apex to excurrent (fig. 72, 6)
R. teneriffae (Mont.) Dirkse & Bouman
R. teesdalei (Schimp.) Limpr.
 Plants rigid. Leaves patent. Seta mamilllose. Forms olive green wefts on wet rocks, by streams and waterfalls, mainly in montane areas, rarely in the lowlands. Distributed in northern and northeastern part of the Peninsula, rare in the south of the Peninsula and in Menorca. Esp, Prt, Bl.
- 2 Nerve thin, 20-45 μm wide at base, ending well below apex 3
- 3 Leaves oblong-lanceolate, shortly acuminate (fig. 72, 5) **R. curviseta** (Brid.) Limpr.
 Leaves erecto-patent; nerve thin, 35-45 μm wide at base, 65-75% long; apical cells 4:1; median cells of lamina very long, 8-10:1. Seta papillose. Forms yellowish green to olive green compact patches on moist rocks and slopes, in the lowlands. Widespread in the northern half of the Peninsula and in Mallorca, Menorca and Pithyusic Islands, very rare in the south of the Peninsula. Esp, Prt, Bl.
- 3 Leaves de linear-lanceolate to triangular-lanceolate, longly acuminate 4
- 4 Leaves with entire margin; nerve reaching acumen; seta smooth; spores 10-16 μm (fig. 72, 3)
R. tenella (Dicks.) Limpr.
 Apical cells linear; nerve 20-30 wide at base. Forms silky, glossy golden wefts in rock crevices and on ledges and slopes, mainly on basic substrata. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.
- 4 Leaves with entire or finely denticulate margin; nerve extending to half way up leaf; seta papillose; spores 14-22 μm (fig. 72, 4) **R. litorea** (De Not.) Limpr.
 Apical cells linear; nerve 25-30 μm wide at base, 50-65%. Forms golden wefts in rock crevices and on slopes, mainly in the lowlands of the Mediterranean region and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

NOTE: *Rhynchostegiella tubulosa* Hedenäs & J.Patiño and *Rhynchostegiella pseudolitorea* Hedenäs & J.Patiño have been reported from Portugal.

Rhynchostegium Schimp.

Plants small to robust. Stem prostrate, irregularly branched. Stem and branch leaves similar, ovate-lanceolate to widely ovate, obtuse to acuminate, concave, margin entire to serrate; laminal cells narrowly

rhomboidal to linear, smooth, alar cells slightly differentiated from basal ones; nerve extending 1/2-2/3 way up leaf, not ending in projecting cell at back. Seta smooth, reddish; capsule brownish, ovoid, inclined to horizontal; lid rostrate; calyptra cucullate. Autoicous.

- 1 Stem leaves elliptical or oblong; apex obtuse and apiculate (fig. 72, 7) **R. murale** (Hedw.) Schimp.

Plants medium-sized, glossy golden green to brownish, with rhizoids along stem. Leaves concave, margin entire or slightly denticulate in the upper part; median cells of lamina 5-8 µm wide, elongate, 7-12:1, alar cells shortly rectangular; nerve extending to 1/2(-2/3) way up leaf.

var. **julaceum** Schimp.: Branch julaceous, with very concave leaves. Alar cells differentiated. Grows on rocks and rock crevices in snow-beds, in high mountains. Esp.

var. **murale**: Grows on shaded, basic rocks in montane areas, rarely in high mountains. Widespread in the northern half of the Peninsula. Esp, Prt., And

- 1 Stem leaves ovate or ovate-lanceolate; apex acute or acuminate **2**

- 2 Leaves widely ovate, with acute apex **R. confusum** Cezón, J. Muñoz, Hedenäs & Huttunen

Plants small, to 6 cm long. Leaves patent to spreading, margin denticulate in the upper part; nerve extending to 3/4 way up leaf. Forms glossy dark green to brownish mats on wet, acidic rocks near streams, rarely on trunks and at tree bases, in the lowlands and montane areas. Scattered in the centre and western part of the Peninsula. Esp, Prt.

- 2 Leaves ovate-lanceolate or ovate-elliptical, with acuminate apex **3**

- 3 Leaves shortly acuminate; apex plane; alar cells not ascending up margin (fig. 72, 8)

R. confertum (Dicks.) Schimp.

Plants small, to 8 cm long. Leaves erect to patent, margin denticulate; nerve extending to 3/4 way up leaf. Forms glossy olive green to golden mats on wet, shaded rocks, trunks and at tree bases, in the lowlands and montane areas. Widespread throughout the Peninsula and Mallorca and Menorca. Esp, Prt, Bl.

- 3 Leaves longly acuminate; apex twisted 180°; alar cells ascending up margin (fig. 72, 9-10)

R. megapolitanum (Blandow ex F.Weber & D.Mohr) Schimp.

Plants very polymorphic, to 10 cm long. Leaves erect to patent, margin denticulate; basal cells shortly rectangular to rhomboidal, extending from nerve to margin; nerve extending to 3/4 way up leaf. Forms green to glossy golden wefts on soils in *Quercus ilex* L. forests, pinewoods and brushwoods, and by roadsides, mainly in the lowlands, rarely in montane areas. Widespread throughout the Peninsula and Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

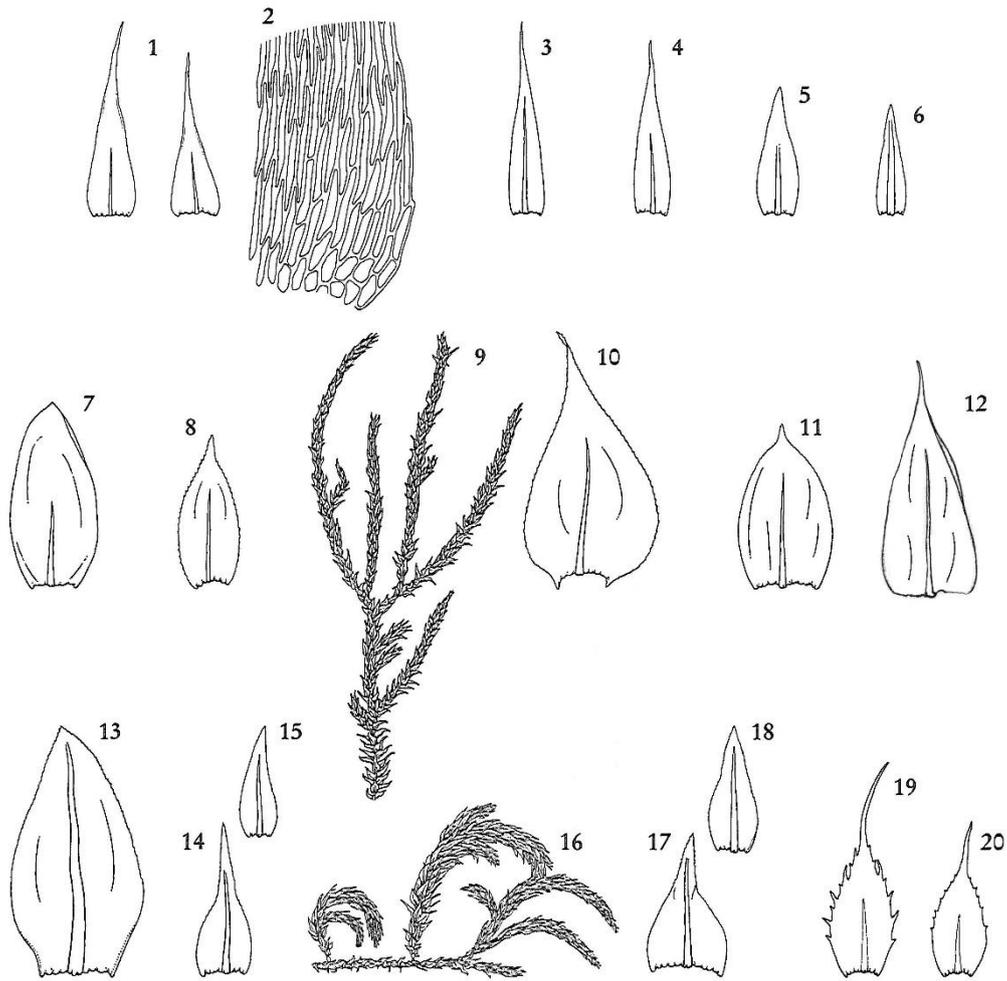


FIGURE 72. 1-2, *Rhynchostegiella duriei*: 1, leaves; 2, basal cells. 3, *R. tenella*, leaf. 4, *R. litorea*, leaf. 5, *R. curviseta*, leaf. 6, *R. teneriffae*, leaf. 7, *Rhynchostegium murale*, leaf. 8, *R. confertum*, leaf. 9-10, *R. megapolitanum*: 9, habit; 10, leaf. 11, *Scleropodium touretii*, leaf. 12, *S. cespitans*, leaf. 13, *Scorpiurium deflexifolium*, leaf. 14-15, *S. sendtneri*: 14, stem leaf; 15, branch leaf. 16-18, *S. circinatum*: 16, habit; 17, stem leaf; 18, branch leaf. 19, *Fabronia pusilla*, leaf. 20, *F. ciliaris*, leaf. 9 (x1,5); 16 (x3,5); 1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 17, 18 (x20); 19, 20 (x30); 2 (x200).

***Scleropodium* Bruch & Schimp.**

Plants medium-sized. Stem ascending, irregularly branched; branches short, curved or straight, julaceous, not complanate. Stem leaves imbricate, concave, ovate, not apiculate or fairly gradually narrowed into a short, straight or slightly curved apiculus, margin plane or slightly recurved at base; laminal cells linear, wider and slightly porose at base, alar cells rectangular or quadrate; nerve extending to 1/2-3/4 way up leaf, sometimes bifurcate and short. Branch leaves narrower than stem leaves. Seta papillose. Dioicous.

1 Plants with curved, julaceous branches, turgid; leaves shortly apiculate, strongly concave (fig. 72, 11)

***S. touretii* (Brid.) L.F.Koch**

Leaves ovate-oblong, margin irregularly denticulate in the upper part; nerve extending to 3/4 way up leaf. Forms glossy green or yellowish green patches on rocky soils and slopes, in clearings and heaths, in the lowlands, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

- 1 Plants with straight, +/- julaceous branches, not turgid; leaves longly pointed (fig. 72, 12)

S. cespitans (Wilson ex Müll.Hal.) L.F.Koch

Leaves ovate, margin dentate at apex; nerve extending 3/4 way up leaf. Forms glossy light green patches on tree bases, rocks and soils, in the lowlands and montane areas. Scattered in the northern half of the Peninsula. Esp, Prt.

Scorpiurium Schimp.

Primary stem prostrate, secondary stems ascending, curved. Stem leaves ovate to triangular, ± acuminate, margin dentate or denticulate, recurved at base; nerve ending in a spine. Branch leaves ovate to lanceolate; median cells of lamina smooth, longly rhomboidal, 4-6:1, shorter towards apex, basal cells irregularly quadrate, alar cells quadrate or hexagonal, ascending up margin; nerve ending below apex, stout, ending in a small projection from back. Dioicous.

- 1 Stem and branch leaves similar in shape, with wide, short acumen; nerve 68-110 µm wide at base (fig. 72, 13)

S. deflexifolium (Solms) M.Fleisch. & Loeske

Plants medium-sized. Leaves ovate-elliptic, margin dentate in the upper half. Forms olive-green mats, blackish below, tree stumps, temporarily submerged rocks, by streams, in montane areas. Widespread in the western part of the Peninsula, rare in the northeastern part of the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

- 1 Stem and branch leaves different in shape, stem leaves abruptly narrowed to long acumen; nerve 32-68 µm wide at base

2

- 2 Branches straight or slightly curved, about 0,3 mm wide or less; usually epiphytic (fig. 72, 14-15)

S. sendtneri (Schimp.) M.Fleisch.

Plants minute, slender. Stem leaves ovate-lanceolate, margin nearly entire; nerve to 34 µm wide at base. Branch leaves acute or acuminate, with denticulate margin in the upper half; upper laminal cells mostly prorate. Forms dark green mats on trunks of trees, in the southwestern part of the Peninsula. Esp, Prt.

- 2 Branches curved, more than 0,5 mm wide; plants growing on rocks and stony soils (fig. 72, 16-18)

S. circinatum (Bruch) M.Fleisch. & Loeske

Plants small. Stem leaves ovate-lanceolate, margin serrate; nerve 36-68 µm wide at base. Branch leaves ovate to lanceolate, acute. Forms dark green or yellowish green mats on shaded, calcareous rocks, stony soils and at base of

trees, in the lowlands and montane areas. Widespread throughout the Peninsula, especially in the Mediterranean region, rare in northwest of the Peninsula, and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, Bl.

Fam. Fabroniaceae

Fabronia Raddi

Plants small, creeping, irregularly branched. Leaves ovate-lanceolate, longly acuminate, margin dentate to ciliate; median cells elongate rhomboidal, smooth, alar cells quadrate, oblate or shortly rectangular; nerve extending to 1/2 way up leaf. Seta long; capsule small, ovoid to pyriform.

- 1 Leaf margin with long, thin, pluricellular teeth (fig. 72, 19) **F. pusilla** Raddi
Forms light green to grey green, dull or glossy wefts with short ascending branches 2-4 mm long, on trunks of trees and rocks, from the lowlands to high mountains, in the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 1 Leaf margin entire or irregularly dentate with unicellular teeth (fig. 72, 20) **F. ciliaris** (Brid.) Brid.
Forms small light green, glossy wefts with ascending branches about 5 mm long, epiphyte or on rocks. Scattered in the northeastern part of the Peninsula. Esp.

Fam. Hypnaceae

Calliergonella Loeske

Plants medium-sized to robust, erect or prostrate. Stem usually with complanate branches, reddish, with well-developed hyaloderm; pseudoparaphyllia broad. Leaves erecto-patent to imbricate, ovate-oblong, obtuse, apiculate or acuminate, margin entire or finely denticulate in the upper part; median cells elongate, alar cells numerous, inflated, hyaline or coloured, forming a distinct group; nerve short, double and faint or lacking

- 1 Stem and branches cuspidate; leaves straight, obtuse or apiculate (fig. 73, 1-3) **C. cuspidata** (Hedw.) Loeske
Stem ± pinnately branched. Leaves oblong or widely ovate. Forms dense or lax, yellowish green or brownish patches in hollows, wet grasslands, by streams and pools, on calcareous or siliceous substrata, from the lowlands to high mountains. Widespread in the northern half of the Peninsula, rarer in the south and in Mallorca. Esp, Prt, And, Bl.

1 Stem and branches not cuspidate; leaves \pm falciform, widely acuminate (fig. 73, 4-6)

C. lindbergii (Mitt.) Hedenäs

Hypnum lindbergii Mitt.

Stem irregularly branched. Leaves lanceolate to ovate-lanceolate. Forms tufts on wet, peaty soils in montane areas and high mountains. Distributed in the Pyrenees and northeast of the Peninsula, scattered in the north. Esp, And.

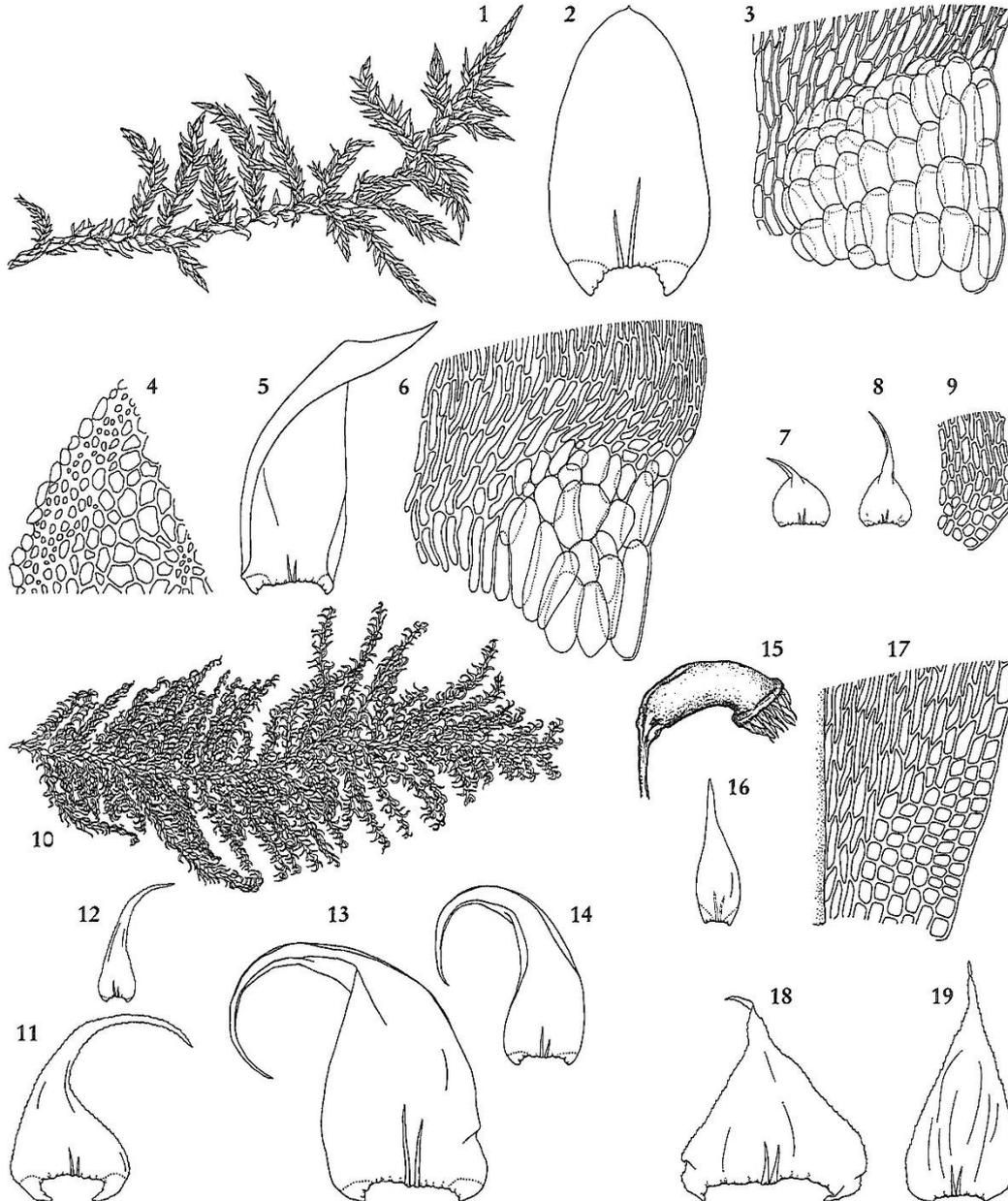


FIGURE 73. 1-3, *Calliergonella cuspidata*: 1, habit; 2, leaf; 3, alar cells. 4-6, *C. lindbergii*: 4, stem section; 5, leaf; 6, alar cells. 7, *Campylophyllum halleri*, leaf. 8-9, *C. calcareum*: 8, leaf; 9, alar cells. 10-12, *Ctenidium molluscum*: 10, habit; 11, stem leaf; 12, branch leaf. 13-14, *C. procerrimum*: 13, stem leaf; 14, branch leaf. 15-17, *Homomallium incurvatum*: 15, capsule; 16, leaf; 17, alar cells. 18-19, *Hyocomium armoricum*: 18, stem leaf; 19, branch leaf. 1, 10 (x1,6); 15 (x15); 2, 5, 7, 8, 11, 12, 13, 14, 16, 18, 19 (x20); 4 (x120); 3, 6 (x140); 9, 17 (x200).

Campylophyllum (Schimp.) M. Fleisch.

Plants small or minute, procumbent, pinnate or irregularly branched, with ascending branches. Stem leaves reflexed, squarrose or spreading, ovate or triangular, with cordate base, abruptly narrowed to channelled acumen, margin denticulate or entire; laminal cells elongate, smooth, alar cells small, quadrate or rectangular, not inflated, forming a \pm distinct group; nerve short or lacking.

- 1 Leaves squarrose, with wide, short acumen (fig. 73, 7) **C. halleri** (Hedw.) M.Fleisch.
Plants small. Leaves short, with ovate base, abruptly narrowed into a channelled acumen shorter than the rest of the lamina. Forms green or brownish wefts on calcareous soils in wet sites, in montane areas and high mountains, in the northern part of the Peninsula. Esp, And.

- 1 Leaves spreading or reflexed, with fine, long acumen (fig. 73, 8-9) **C. calcareum** (Crundw. & Nyholm) Hedenäs
* **Campylophyllopsis calcarea** (Crundw. & Nyholm) Ochyra
Plants minute. Stem leaves ovate or triangular, with cordate base, acumen channelled, longer than the rest of the lamina. Forms dense pale green or yellowish tufts on wet, calcareous soils, in forests and grasslands, in the lowlands and montane areas, in the northern half of the Peninsula. Esp, And.

Ctenidium (Schimp.) Mitt.

Plants small to robust. Primary stem prostrate, secondary stems prostrate to straight, pinnate, plumose. Paraphyllia \pm lanceolate. Stem leaves cordate, secund, decurrent, tapering into circinate acumen; laminal cells elongate, alar cells differentiated; nerve short and double or lacking. Branch leaves narrower and gradually narrowed towards apex, falcate-secund.

- 1 Stem leaves abruptly narrowed, with dentate margin; laminal cells papillose at back, prorate (fig. 73, 10-12) **C. molluscum** (Hedw.) Mitt.
Species very polymorphic. Plants small to medium-sized, bright golden green or brownish. Forms mats on soils and calcareous rocks, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca and Pithyusic Islands. Esp, Prt, And, Bl.
- 1 Stem leaves gradually narrowed, with entire or finely denticulate margin; laminal cells smooth (fig. 73, 13-14) **C. procerrimum** (Molendo) Lindb.
* **Pseudostereodon procerrimus** (Molendo) M.Fleisch., **Hypnum procerrimum** Molendo
Plants medium-sized, brownish or golden green. Stem yellowish or orange. Forms patches on calcareous rocks in montane areas and high mountains. Rare, in the Pyrenees and Basque Mountains. Esp, And.

Homomallium (Schimp.) Loeske

Plants slender. Stem prostrate, without hyaloderm and central strand; branches short, irregular, ascending; with pseudoparaphyllia. Leaves straight, erect-spreading or homomalous, concave, ovate-lanceolate, attenuated in long acumen, margin plane, entire or finely denticulate at apex; median cells of lamina rhomboidal, shorter towards margin and apex, alar cells quadrate or oblate, ascending up margins, nearly reaching nerve; nerve short and double or lacking. Seta reddish; capsule reddish, inclined to horizontal, curved, asymmetrical; peristome well developed, exostome with papillose teeth at base. Autoicous (fig. 73, 15-17)

H. incurvatum (Schrad. ex Brid.) Loeske

Forms glossy, green or yellowish wefts on wet, calcareous rocks, rarely at tree bases, in montane areas, occasionally in high mountains. Scattered in the northern half of the Peninsula and in Algeciras Mountains. Esp, Prt, And.

Hyocomium Bruch & Schimp.

Plants small to robust, erect or prostrate. Stem irregularly branched, with short branches. Stem leaves broadly cordate, abruptly tapering into acute or filiform apex, margin strongly and irregularly toothed from base to apex; laminal cells elongate; nerve short and double or lacking. Branch leaves smaller, ovate, acuminate. Seta purplish red, papillose; capsule ellipsoidal, slightly inclined (fig. 73, 18-19)

H. armoricum (Brid.) Wijk & Margad.

Forms green or brownish green patches on rocks or tree roots in moist or wet sites, by streams, torrents or waterfalls, in the north and northwestern part of the Peninsula. Esp, Prt.

Hypnum Hedw.

Plants small to robust, green, yellowish or brownish, usually glossy. Stem sparsely to densely branched, sometime pinnately so, pseudoparaphyllia simple or branched, filamentous to foliose, paraphyllia only present in *H. recurvatum*. Stem leaves ovate-lanceolate, acuminate, falciform to circinate, occasionally straight, margin plane or recurved, entire or dentate; median cells of lamina linear, alar cells forming a distinct group; nerve short and double or lacking. Branch leaves similar to stem leaves. Seta reddish; capsule straight or curved, erect to horizontal; lid mamillate to rostrate. Autoicous or dioicous.

1 Stem with hyaloderm 2

1 Stem without hyaloderm 3

- 2 Alar cells of leaf subquadrate, forming a small, scarcely differentiated group with 1-2 inflated, hyaline cells at base (fig. 74, 1-3) **H. hamulosum** Schimp.
* **Stereodon hamulosus** (Schimp.) Lindb.
Plants small. Leaves falciform to circinate, 0,64-1,45 mm long. Grows on calcareous rock ledges in high mountains, in the Central Pyrenees. Esp, And.
- 2 Alar cells forming a large, well-differentiated group of inflated, hyaline cells (fig. 74, 4-5) **H. callichroum** Brid.
* **Stereodon callichrous** (Brid.) Lindb.
Plants small to medium-sized. Leaves circinate, 1,5-2 mm long. Grows on wet soils and shaded rocks, soils, sometimes at base of trees, in montane areas and high mountains, in the Pyrenees. Esp, And.
- 3 Alar cells subquadrate to rectangular, fairly homogeneous, occasionally some cells large in the basal margin, forming a flat group; plants small to medium-sized **4**
- 3 Alar cells heterogeneous, forming a ± excavate group; plants small to robust **7**
- 4 Alar cells few, forming a small group with 4-9 cells along the margin; paraphyllia numerous, filiform or narrowly lanceolate (fig. 74, 6-8) **H. recurvatum** (Lindb. & Arnell) Kindb.
* **Drepanium fastigiatum** (Hampe) C.E.O.Jensen
Plants small to medium-sized. Leaves strongly circinate, 0,75-1 mm long; median laminal cells 30-60 x 3 µm. Autoicous. Grows on calcareous rocks and trees, in montane areas and high mountains in the Pyrenees. Esp.
- 4 Alar cells numerous, forming a larger group with 8-20 cells along the margin; paraphyllia lacking **5**
- 5 Leaves strongly dentate, especially the branch leaves; stem leaves 0,6-1 mm long; lid rostrate; plants growing mainly on trunks (fig. 74, 9-10) **H. pallescens** (Hedw.) P.Beauv.
* **Jochenia pallescens** (Hedw.) Hedenäs, Schlesak & D.Quandt
Plants small, greenish yellow to brownish. Pseudoparaphyllia scarce, lanceolate. Stem leaves ovate-lanceolate, 0,7-1,2 mm long, straight to curved. Autoicous. Forms dense tufts on trunks of trees and rotten woods, sometimes on rocky slopes, in the montane areas and high mountains of the north of the Peninsula. Esp.
- 5 Leaves ± entire to dentate; stem leaves more than 1 mm long; lid conical; plants growing mainly on rocks or soils **6**

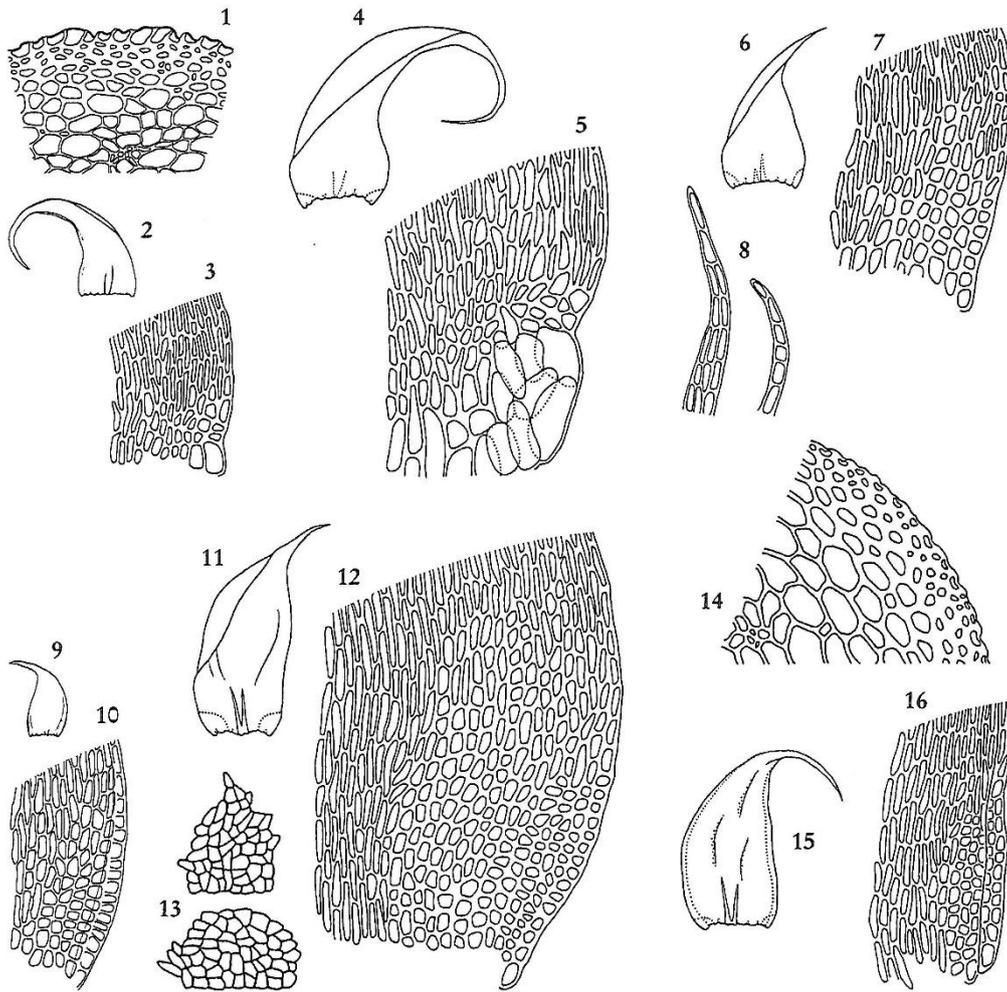


FIGURE 74. **1-3, *Hypnum hamulosum***: 1, stem section; 2, leaf; 3, alar cells. **4-5, *H. callichroum***: 4, leaf; 5, alar cells. **6-8, *H. recurvatum***: 6, leaf; 7, alar cells; 8, paraphyllia. **9-10, *H. pallescens***: 9, leaf; 10, alar cells. **11-13, *H. vaucheri***: 11, leaf; 12, alar cells; 13, pseudoparaphyllia. **14-16, *H. revolutum***: 14, stem section; 15, leaf; 16, alar cells on dorsal side. 2, 4, 6, 9, 11, 15 (x20); 13 (x100); 8 (x140); 1, 3, 5, 7, 10, 12, 14, 16 (x180).

6 Leaves strongly concave, with plane or slightly recurved margin; alar group large, with 10-16(-20) cells along the margin; pseudoparaphyllia ± rounded (fig. 74, 11-13) ***H. vaucheri*** Lesq.

* ***Buckia vaucheri*** (Lesq.) D.Rios, M.T.Gallego & J.Guerra

Plants medium-sized, green or greenish yellow. Stem irregularly branched to pinnately so, usually with julaceous branches; epidermal cells invaginated. Leaves imbricate, ovate to oblong-lanceolate, falciform; median cells short and wide, 25-50 x 4-6 µm; nerve short but somewhat conspicuous, often double. Dioicous. Grows mainly on calcareous soils and rocks, rarely epiphyte, from the lowlands to high mountains. Widespread in northern half of the Peninsula, rarer in the south and in Mallorca. Esp, And, Bl.

6 Leaves not strongly concave, with recurved margin; alar group small, with 8-15 cells along the margin; pseudoparaphyllia ovate to lanceolate (fig. 74, 14-16) ***H. revolutum*** (Mitt.) Lindb.

* ***Roaldia revoluta*** (Mitt.) P.E.A.S.Câmara & Carv.-Silva

Plants small to medium-sized, greenish yellow to brownish. Stem usually regularly pinnate; epidermal cells invaginated. Leaves ovate to lanceolate, falciform, plicate, 1-1,8 mm long. Dioicous. Grows on calcareous rocks, rarely on slopes and a tree bases, in montane areas to high mountains. Esp, And

- 7 Pseudoparaphyllia widely lanceolate or palmate, mostly incised with ciliate points (fig. 75, 1-3)

H. imponens Hedw.

* **Callicladium imponens** (Hedw.) Hedenäs, Schlesak & D.Quandt

Plants medium-sized, yellowish green to golden-brown or dark brown; stem reddish brown. Stem leaves falciform, subentire to denticulate in the upper part; alar group weakly excavate, usually tinted with orange brown, with 5-10 subquadrate to oblong cells along the margin. Grows on soils and rotten woods. Very rare, in the north and northwest of the Peninsula. Esp, Prt.

- 7 Pseudoparaphyllia subfiliform to lanceolate, not incised with ciliate points 8
- 8 Leaf margin distinctly denticulate above 9
- 8 Leaf margin weakly denticulate above, subentire or entire 12
- 9 Alar cells few, forming a strongly excavate group, with 3-8 subquadrate cells along the margin 10
- 9 Alar cells numerous, forming a non- or only slightly excavate group, with 7-18 subquadrate cells along the margin 11
- 10 Leaves loosely imbricate, ovate or oblong-lanceolate (fig. 75, 4-5)

H. jutlandicum Holmen & E.Warncke

Plants medium-sized, pale green. Stem pinnately branched, with flattened branches. Leaves ± straight to falciform, usually ending in short acumen, margin distinctly denticulate in the upper half, near the apex very strongly so; median cells of lamina 60-90 x 3-4 µm, alar cells forming a rounded group. Grows on siliceous or calcareous soils and rocks, peaty slopes and at tree bases, in the lowlands and montane areas, in the northern half and western part of the Peninsula. Esp, Prt.

- 10 Leaves ± densely imbricate, triangular or ovate-triangular, usually widest near leaf base (fig. 75, 6-7)

H. uncinulatum Jur.

Plants small to medium-sized, pale green to brownish, more or less regularly densely pinnately branched. Leaves curved to falciform, gradually narrowed to acuminate apex, margin usually distinctly denticulate; median cells 40-80 x 3-4 µm, alar cells forming a hemispherical or irregular group. Grows on tree trunks and decaying logs and on

shaded soil, from the lowlands to high mountains. Scattered in the north and western part of the Peninsula, rarer in the south. Esp, Prt.

- 11 Median cells of lamina 40-60 x 4-6 μ m; capsule straight; lid mamillate (fig. 75, 8-11)

H. andoi A.J.E.Sm.

H. mammillatum (Brid.) Loeske

Stem usually regularly pinnate-branched. Leaves seemingly imbricate in 2 rows, ovate-lanceolate, falcate-secund, margin sharply denticulate in the upper part, mainly in branch leaves; alar cells of stem leaves rather heterogeneous, the basal ones enlarged and hyaline, with 7-10(-13) subquadrate cells along the margin. Capsule oblong-cylindrical, nearly symmetrical. Grows on siliceous rocks, humiferous soils and trunks of trees from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.

- 11 Median cells of lamina 60-80 x 3-4 μ m; capsule curved; lid rostrate (fig. 75, 12-15)

H. cupressiforme Hedw. var. **cupressiforme**

It is the commonest taxon of this genus, very variable in habit and size. Plants green, greenish yellow or brownish yellow, irregularly branched to \pm pinnate. Leaves falciform, ovate to oblong-lanceolate, gradually tapering, margin denticulate in the upper part; alar group with 10-18 cells along the margin. Capsule cylindrical. Grows on soils, rocks and at tree bases, from the lowlands to high mountains. Widespread throughout the Peninsula and in Mallorca, Menorca and Pithyusic Islands. Esp, Prt, And, Bl.

- 12 Plants small-sized or slender; branch leaves 1-1,2 x 0,3-0,4 mm 13

- 12 Plants medium-sized to robust; branch leaves 1,5-2,3 x 0,4-0,6 mm 14

- 13 Leaves homomallous, usually abruptly narrowed to a slender point; leaf margin entire

H. resupinatum Taylor

H. cupressiforme Hedw. var. **resupinatum** (Taylor) Schimp.

Plants shiny. Branches short, straight. Leaves +/- straight, ovate to oblong-lanceolate; alar group with 10-17 subquadrate alar cells along the margin. Capsule erect, straight or slightly curved; lid distinctly long-beaked. Forms light green patches on trunks, rarely on rocks Widespread throughout the Peninsula. Esp, Prt.

- 13 Leaves heteromallous or secund, gradually narrowed to a slender point; leaf margin subentire to slightly denticulate (fig. 75, 16)

H. cupressiforme Hedw. var. **filiforme** Brid.

Plants light green, with slender, filiform habit. Stem sparsely and irregularly branched, branches long, sinuose. Leaves \pm straight, rarely falciform, oblong-lanceolate; alar group with 8-13(-17) subquadrate alar cells along the margin. Forms patches on trunks, vertical rocks and tree bases. Widespread throughout the Peninsula, mainly in northern half and in Mallorca. Esp, Prt, Bl.

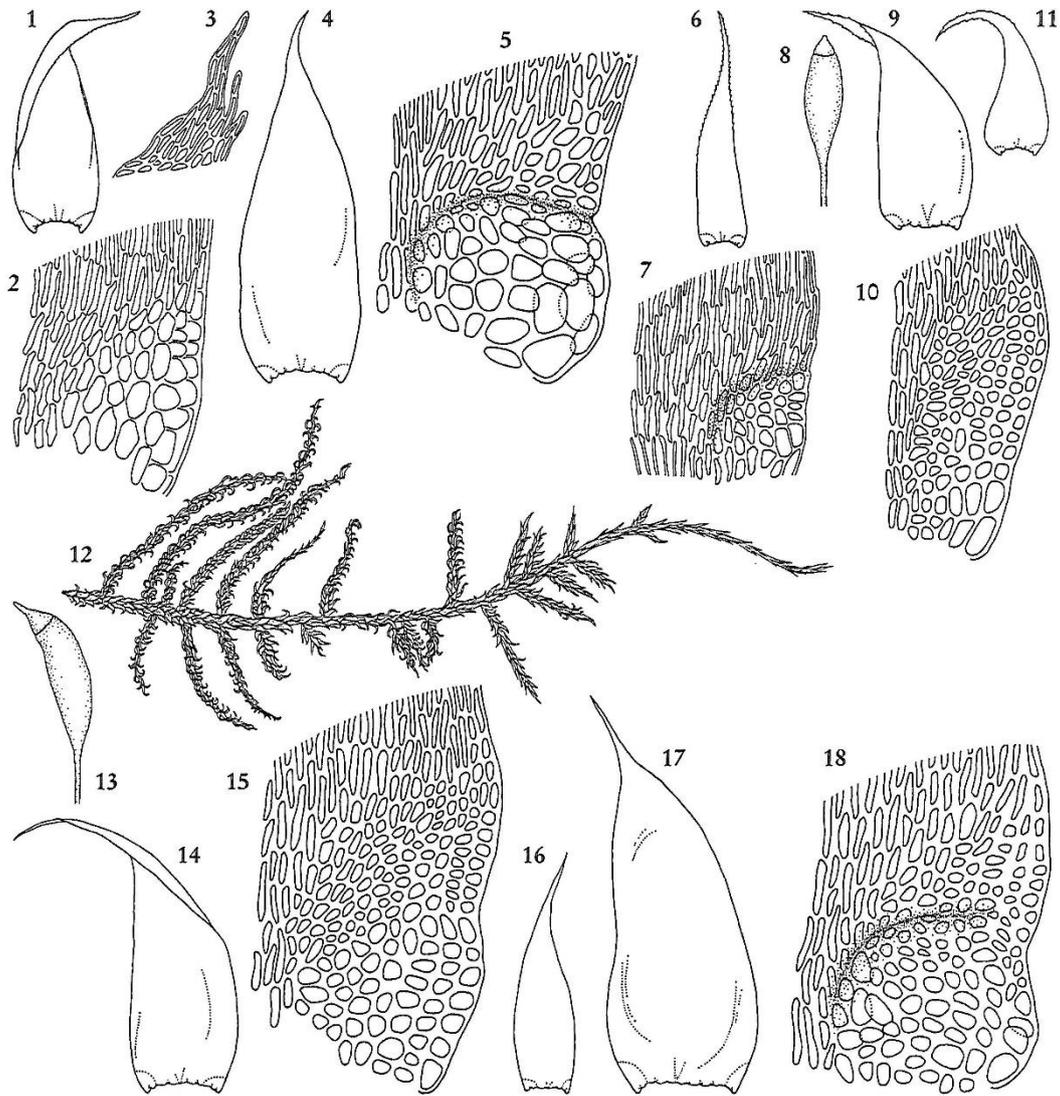


FIGURE 75. 1-3, *Hypnum imponens*: 1, leaf; 2, alar cells; 3, pseudoparaphyllium. 4-5, *H. jutlandicum*: 4, leaf; 5, alar cells. 6-7, *H. uncinulatum*: 6, leaf; 7, alar cells. 8-11, *H. andoi*: 8, capsule; 9, stem leaf; 10, alar cells; 11, branch leaf. 12-15, *H. cupressiforme* var. *cupressiforme*: 12, habit; 13, capsule; 14, leaf; 15, alar cells. 16, *H. cupressiforme* var. *filiforme*, leaf. 17, *H. cupressiforme* var. *lacunosum*, leaf. 18, *H. cupressiforme* var. *subjulaceum*, alar cells. 12 (x1,6); 8, 13 (x8); 1, 4, 6, 9, 11, 14, 16, 17 (x20); 3 (x140); 2, 5, 7, 10, 15, 18 (x180).

14 Plants robust, with swollen branches; leaves abruptly narrowed to a short point; alar group slightly excavate, not distinctly coloured, with 10-20 subquadrate alar cells along the margin (fig. 75, 17)

***H. cupressiforme* Hedw. var. *lacunosum* Brid.**

***H. lacunosum* (Brid.) Hoffm. ex Brid.**

Plants yellowish green to brownish; stem irregularly branched or ± pinnate. Leaves straight to slightly falciform, concave, margin subentire to weakly denticulate; median cells 50-70 x 3-6 µm. Grows on calcareous or siliceous soils and rocks, rarely epiphyte. Widespread throughout the Peninsula, rare in Mallorca and Menorca. Esp, Prt, And, Bl.

- 14 Plants medium-sized, branches not swollen; leaves gradually narrowed to a long, slender point; alar group strongly excavate and usually brown-coloured, with 8-14 subquadrate alar cells along the margin (fig. 75, 18)

H. cupressiforme Hedw. var. **subjulaceum** Molendo

H. subjulaceum (Molendo) Hedenäs, Schlesak & D.Quandt

Plants shiny, silky, yellowish-green to brownish; stem regularly or irregularly pinnate-branched. Leaves straight to slightly falciform, concave, margin subentire to weakly denticulate; median cells 50-70 x 3-5 µm. Grows on calcareous rocks, humus-rich soils and epiphyte, in montane areas and high mountains. Scattered in the Peninsula. Esp, Prt.

Ptilium De Not.

Stem procumbent to erect, regularly pinnate, with complanate branches; pseudoparaphyllia numerous, lanceolate to triangular. Stem leaves strongly longitudinally plicate, circinate, widely ovate at base, margin plane finely denticulate above; laminal cells linear or vermicular, smooth, basal cells shorter, porose, yellowish, alar cells quadrate to shortly rectangular, hyaline, forming a small group; nerve short and double or lacking. Branch leaves narrower (fig. 76, 1-2)

P. crista-castrensis (Hedw.) De Not.

Forms bright green wefts on humus-rich soils in silver fir forests, in high mountains in the Pyrenees. Esp, And.

Pylaisia Schimp.

Plants small, slender. Stem prostrate, with central strand, pinnate, with pseudoparaphyllia. Leaves straight, ovate-lanceolate, acuminate, margin plane, entire or denticulate at apex; laminal cells linear, vermicular, more than 10 times as long as wide, alar cells quadrate or rectangular, fairly homogeneous, basal cells rectangular, not porose, slightly thick-walled; nerve double and short. Seta reddish; capsule straight, symmetrical; exostome with smooth teeth at base. Autoicous (fig. 76, 3-5)

P. polyantha (Hedw.) Schimp.

Pylaisiella polyantha (Hedw.) Grout

Epiphytic, forming glossy, pale green or yellowish patches on trunks and branches of trees, rarely on rocks, in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt, And.

Taxiphyllum M. Fleisch.

Plants small, glossy. Stem prostrate, irregularly branched, with pseudoparaphyllia. Rhizoids smooth, yellowish. Leaves complanate, oblong-lanceolate, symmetrical, acute, sometimes apiculate, margin denticulate; laminal cells 6-10 µm wide, 5-8 times as long as wide, alar cells quadrate or rectangular, green, not decurrent; nerve short and double or lacking (fig. 76, 6-7)

T. wissgrillii (Garov.) Wijk & Margad.

Forms wefts on wet, calcareous rocks and soils, roots and at tree bases, in the lowlands and montane areas. Distributed in the north of the Peninsula and in Mallorca. Esp, Bl.

This species may be confused with *Pseudotaxiphyllum elegans*, but this is calcifuge and usually has flagelliform propagules.

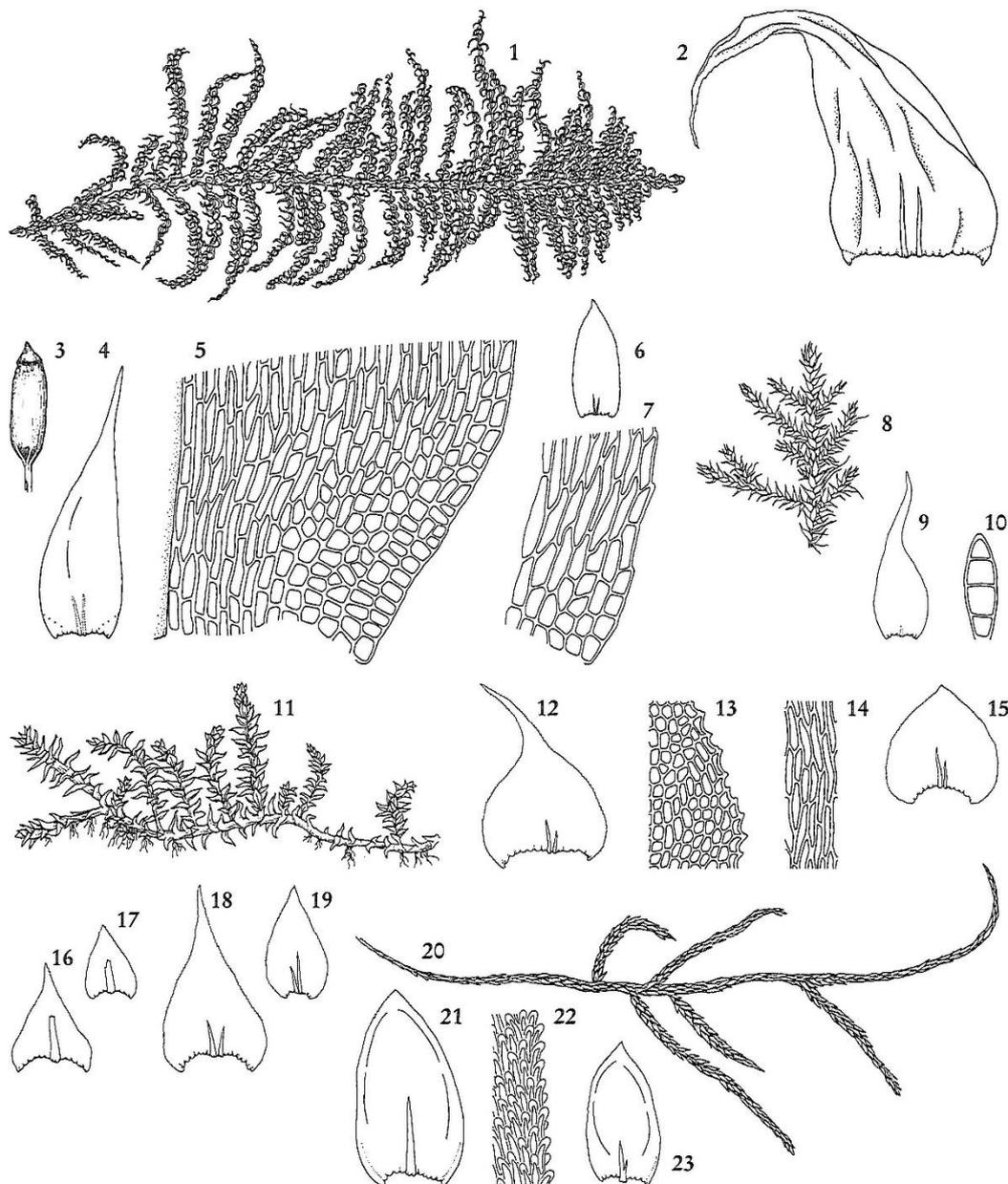


FIGURE 76. 1-2, *Ptilium crista-castrensis*: 1, habit; 2, leaf. 3-5, *Pylaisia polyantha*: 3, capsule; 4, leaf; 5, alar cells. 6-7, *Taxiphyllum wissgrillii*: 6, leaf; 7, alar cells. 8-10, *Habrodon perpusillus*: 8, habit; 9, leaf; 10, gemma. 11-15, *Heterocladium dimorphum*: 11, habit; 12, stem leaf; 13, leaf margin; 14, median cells; 15, branch leaf. 16-17, *H. wulfsbergii*: 16, stem leaf; 17, branch leaf. 18-19, *H. heteropterum*: 18, stem leaf; 19, branch leaf. 20-23, *Pterigynandrum filiforme*: 20, habit; 21, stem leaf; 22, median cells on dorsal side; 23, branch leaf. 1 (x1,6); 8, 11, 20 (x4); 3 (x8); 2, 4, 6 (x20); 9, 12, 15, 16, 17, 18, 19, 21, 23 (x35); 5 (x180); 7, 10, 13, 14, 22 (x200).

Fam. Pterigynandraceae

Habrodon Schimp.

Plants very small. Primary stem creeping, irregularly branched. Leaves erecto-patent to spreading, erect when dry, ovate-lanceolate, concave, with acuminate or filiform apex, margin plane, entire; laminal cells rhomboidal, thick-walled, short, to twice as long as wide, smooth, basal and marginal cells shorter, quadrate or oblate; nerve short or lacking. Usually with ovoid to fusiform, 1-5 celled, brown gemmae on youngest branch parts. (fig. 76, 8-10)

H. perpusillus (De Not.) Lindb.

Forms dark green wefts on tree trunks, in the lowlands and montane areas of the Mediterranean region of the Peninsula and in Mallorca. Esp, Prt, And, Bl.

Heterocladium Schimp.

Primary stem stoloniform, secondary ones pinnate or irregularly branched; paraphyllia scarce, small. Stem leaves ovate-lanceolate, with broad base gradually or suddenly narrowed to a long or short point, margin denticulate; laminal cells papillose, \pm elongate in mid-leaf, short at margins; nerve short and double or long and single or branched at tip. Branch leaves usually smaller than stem leaves and with shorter acumen.

- 1 Branch leaves different from stem leaves; stem leaves squarrose, suddenly narrowed to a filiform point; plants pinnately branched (fig. 76, 11-15)

H. dimorphum (Brid.) Schimp.

* **Heterocladiella dimorpha** (Brid.) Ignatov & Fedosov

Median laminal cells oblong-linear, thick-walled, not or slightly papillose, quadrate or oblate cells at margins, alar cells quadrate or oblate. Plants medium-sized, dull green, usually yellowish or brownish. Forms dense tufts in shaded sites, on rocks, soils and at tree bases, in montane areas and high mountains. Common in the Pyrenees, it also occurs in the northern part of the Peninsula and in Sierra Nevada. Esp, And.

- 1 Branch leaves similar to stem leaves; stem leaves patent or spreading, gradually narrowed to an acute or acuminate point; plants irregularly branched

2

- 2 Nerve extending 1/2-2/3 way up leaf, usually single or branched at the end (fig. 76, 16-17)

H. wulfsbergii I.Hagen

H. heteropterum (Brid.) Schimp. subsp. **wulfsbergii** (I.Hagen) C.E.O.Jensen & Perss.

Plants slender. Stem leaves with acute apex, nerve 30-55 μ m wide at base. Median laminal cells oblong to linear, short at margins and near apex, prorate, alar cells quadrate or oblate. Forms dark green patches on wet, shaded, acidic rock and slopes by streams, mainly in the western half of the Peninsula. Esp, Prt.

2 Nerve extending to 1/2 way up leaf, double, occasionally single or absent 3

3 Plants small to medium-sized; stem leaves 0,6-1,1 mm long; laminal cells 15-30 µm long (fig. 76, 18-19)

H. heteropterum (Brid.) Schimp.

Plants dull yellowish green to brownish. Stem leaves sometimes secund, apex acute to acuminate. Leaf nerve 20-45 µm wide at base; median laminal cells oblong to linear, short at margins and near apex, prorate, alar cells quadrate or oblate. Grows on acidic, shaded, wet rocks and slopes by streams, rarely on soil, from the lowlands to high mountains, in the northern and western part of the Peninsula, rare in the south. Esp, Prt, And.

3 Plants filiform; stem leaves 0,3-0,5 mm long; laminal cells 8-12 µm long

H. flaccidum (Schimp.) A.J.E.Sm.

Plants dark green to brownish green. Leaves with short nerve, sometimes lacking; laminal cells rounded or shortly oblong, slightly prorate, smaller toward margin. Grows in relatively wet, ± acidic places. Scattered in the Peninsula. Esp, Prt.

Pterigynandrum Hedw.

Plants slender, julaceous, prostrate, irregularly branched. Stem and branches prostrate, usually curved. Stem leaves imbricate or erecto-patent, concave, widely ovate or elliptical, acute, obtuse or obtuse and apiculate, margin denticulate in the upper part, plane or recurved at base; laminal cells linear oblong, upper cells prorate, alar cells quadrate or oblate; nerve single, bifurcate or double, extending to 1/2 way up leaf. Branch leaves smaller. Axillary gemmae frequent, fusiform, of 2-4 cells (fig. 76, 20-23) **P. filiforme** Hedw.

Forms small, dark green, yellowish or brownish mats on wet rocks or at tree bases, in montane areas. Widespread throughout the Peninsula. Esp, Prt, And.

Fam. Hylocomiaceae

Hylocomiastrum Broth.

Plants medium-sized to robust. Stem procumbent, irregularly branched or 1-2-pinnate, usually with the annual branches curved, ascending or horizontal, some dendroid; paraphyllia numerous, branched with 2-3 elongated cells, apical cells projecting as spine; pseudoparaphyllia present. Stem leaves erect, concave, strongly plicate, with irregular longitudinal plicae, oblong-ovate, wide at base, gradually or abruptly tapering into short or long, acumen, flexuose and strongly dentate; median cells of lamina linear, basal cells oblong, thick-walled,

porose, yellowish, alar cells not differentiated; nerve double or single. Branch leaves similar in form to stem leaves, with single nerve extending to 1/2-3/4 way up leaf, ending in a small projection from back. Dioicous.

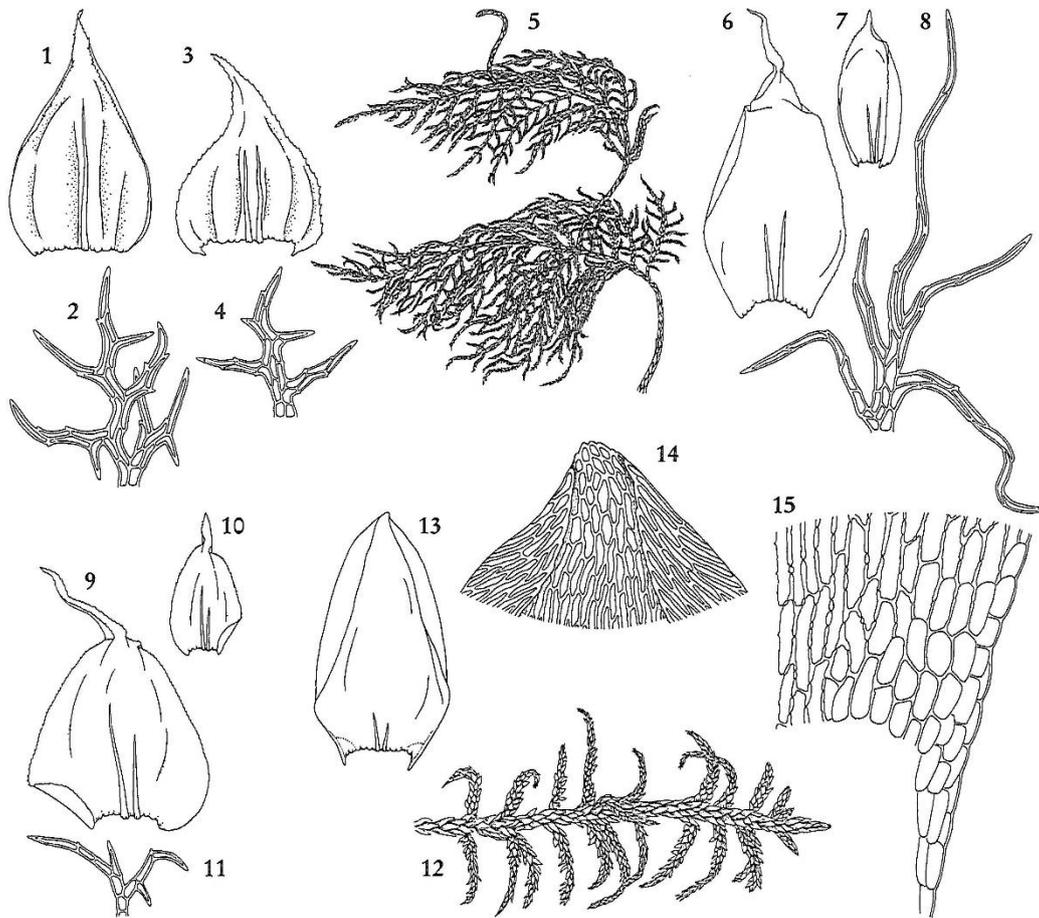


FIGURE 77. 1-2, *Hylocomiastrum pyrenaicum*: 1, leaf; 2, paraphyllium. 3-4, *H. umbratum*: 3, leaf; 4, paraphyllium. 5-8, *Hylocomium splendens*: 5, habit; 6, stem leaf; 7, branch leaf; 8, paraphyllium. 9-11, *Loeskeobryum brevirostre*: 9, stem leaf; 10, branch leaf; 11, paraphyllium. 12-15, *Pleurozium schreberi*: 12, habit; 13, leaf; 14, leaf apex; 15, alar cells. 5, 12 (x1,4); 1, 3, 6, 7, 9, 10, 13 (x14); 2, 4, 8, 11, 14, 15 (x140).

1 Stem leaves with single nerve, extending to 2/3-3/4 way up leaf (fig. 77, 1-2)

H. pyrenaicum (Spruce) M.Fleisch.

Hylocomium pyrenaicum (Spruce) Lindb.

Plants irregularly branched. Stem, reddish brown, ascending, branches cuspidate at apex. Leaves ovate, gradually or abruptly tapering into short, twisted point, margin strongly dentate, ± recurved at base; laminal cells smooth. Branch leaves smaller than stem leaves. Forms glossy green or yellowish green wefts on rocks, slopes and by streams and lakes and shaded soils, on acidic or basic substrata, in high mountains in the Pyrenees. Esp, And.

1 Stem leaves with double nerve extending to 1/3-2/3 way up leaf (fig. 77, 3-4)

H. umbratum (Hedw.) M.Fleisch.

Hylocomium umbratum (Hedw.) Schimp.

Plants irregularly branched or bipinnate. Plants Stem reddish-brown, 1-(2)-pinnate, with arcuate branches. Stem and branch leaves similar, widely ovate, gradually tapering, decurrent, margin strongly dentate, laminal cells smooth. Forms soft, dull dark green or yellowish to brownish wefts on humus-rich soils in forests, in high mountains. Scattered in the northern part of the Peninsula. Esp, And.

Hylocomium Schimp.

Plants robust, to 20 cm long. Stem procumbent reddish, regularly 2-3-pinnate, usually with the annual branches arcuate, ascending, dendroid, complanate; paraphyllia numerous, divided from base in thin, filiform branches; pseudoparaphyllia present. Stem leaves erect, concave, not or only slightly longitudinally plicate, widely ovate, wide at base, gradually or abruptly narrowed in flexuose acumen; margin dentate in the upper part; leaf cells prorate on dorsal side; median cells of lamina linear, basal cells oblong, thick-walled, porose, yellowish, alar cells not or slightly differentiate; nerve double, extending to 1/4-1/3 way up leaf. Branch leaves smaller. Dioicous (fig. 77, 5-8)

H. splendens (Hedw.) Schimp.

Forms tall, extensive, stratified golden green or olive green wefts on humus-rich soils in forests, in montane areas and high mountains, in the northern half of the Peninsula and in Mallorca. Esp, Prt, And, Bl.

Loeskeobryum Broth.

Plants medium-sized to robust. Stem procumbent, reddish, irregularly branched or 1-(2)-pinnate, usually with the annual branches arcuate or stoloniferous; paraphyllia small, numerous, thin, irregularly branched, divergent at the base, branches of a single row of elongate cells; pseudoparaphyllia present. Lower stem leaves sheathing at base, weakly longitudinally plicate, oblong-ovate, wide at base, abruptly tapering into long acumen, thin, non-decurrent, flexuose, squarrose to recurved and strongly dentate; the rest of stem leaves narrow and rugose at base of acumen, margin strongly dentate in the upper half of leaf, denticulate at base. Leaf cells smooth, median cells linear, basal cells oblong, thick-walled, porose, yellowish, alar cells not differentiated; nerve double, extending to 1/3-1/2 way up leaf. Branch leaves smaller. Dioicous. (fig. 77, 9-11)

L. brevirostre (Brid.) M.Fleisch.

Hylocomium brevirostre (Brid.) Schimp.

Forms glossy green or yellowish green to brownish wefts on rocks, humus-rich soils, at tree bases, and in wet sites on acidic substrata, in deciduous forests, in the lowlands and montane areas. Distributed in the northern part of the Peninsula. Esp, Prt.

Pleurozium Mitt.

Plants robust, to 15 cm long or more, procumbent or ascending. Stem reddish, pinnate, branches julaceous, attenuate or not, ± complanate, without paraphyllia. Stem leaves oblong, ovate or elliptical, strongly concave, with rounded to obtuse or apiculate apex, margin entire or denticulate at apex: median cells of lamina linear, smooth, apical cells shorter, basal cells wider and porose, alar cells oblong, forming a triangular group, orange to brownish; nerve short and double. Branch leaves shorter and narrower (fig. 77, 12-15)

P. schreberi (Willd. ex Brid.) Mitt.

Forms soft, glossy pale green to yellowish wefts on wet, shaded soils in beechwoods and coniferous forests, rarely in peat bogs, in montane areas and high mountains. Distributed in the northern half of the Peninsula. Esp, Prt, And.

Rhytidiadelphus (Limpr.) Warnst.

Plants robust. Stem rigid, reddish or orange, procumbent, irregularly branched, branches usually arcuate, ascending; without paraphyllia, but often with small, triangular pseudoparaphyllia, wide at base. Stem and branch leaves similar, squarrose, falciform, ovate, gradually or abruptly tapering, acuminate, longitudinally plicate or not, margin denticulate or dentate; laminal cells homogeneous, linear, basal cells short and wide, thick-walled, porose, alar cells non- or poorly differentiated; nerve double or lacking. Dioicous.

- 1 Stem leaves gradually tapering into wide acumen; laminal cells prorate at back (fig. 78, 1-3)

R. triquetrus (Hedw.) Warnst.

* **Hylocomiadelphus triquetrus** (Hedw.) Ochyra & Stebel

Plants robust, to 20 cm long, branches not complanate, horizontal to ascending, attenuated at apex. Stem leaves longitudinally plicate, with sheathing, decurrent base, margin plane, dentate at apex; nerve double, extending to 3/4 way up leaf. Branch leaves smaller. Grows on humus-rich soils in forests. Widespread in the northern half of the Peninsula, very rare in the south and in Mallorca. Esp, Prt, And, Bl.

- 1 Stem leaves abruptly tapering into narrow, squarrose or falciform acumen; laminal cells smooth at back

2

- 2 Leaves not or slightly squarrose, with irregular longitudinal plicae at base; alar cells slightly differentiated, coloured (fig. 78, 4)

R. loreus (Hedw.) Warnst.

Plants robust, to 20 cm long, branches ± complanate, arcuate, ascending. Leaves falciform, concave, ovate, longly acuminate, with channelled, denticulate acumen; nerve double, extending to 1/4 way up leaf or lacking. Branch leaves smaller than stem leaves. Forms green or yellowish green wefts on wet, acidic soils and rocks, in coniferous forests, in montane areas and high mountains. Distributed in the northern half of the Peninsula. Esp, Prt, And.

- 2 Leaves squarrose, not plicate at base; alar cells inflated, pale or hyaline (fig. 78, 5-7)

R. squarrosus (Hedw.) Warnst.

Plants to 10 cm long, branches ascending, attenuated, green or reddish green at apex. Stem leaves cordate to ovate, with long, denticulate acumen. Branch leaves narrower at base, with shorter acumen; nerve double, extending to 1/4-1/3 way up leaf. Forms soft, green, brownish or yellowish wefts in exposed, wet grasslands, peat bogs and on forest soils, on acidic substrata, in montane areas and high mountains. Distributed in the north of the Peninsula. Esp, Prt, And.

NOTE: *Rhytidiadelphus subpinnatus* (Lindb.) T.J. Kop., a species close to *S. squarrosus*, has been cited from Andorra and Portugal.

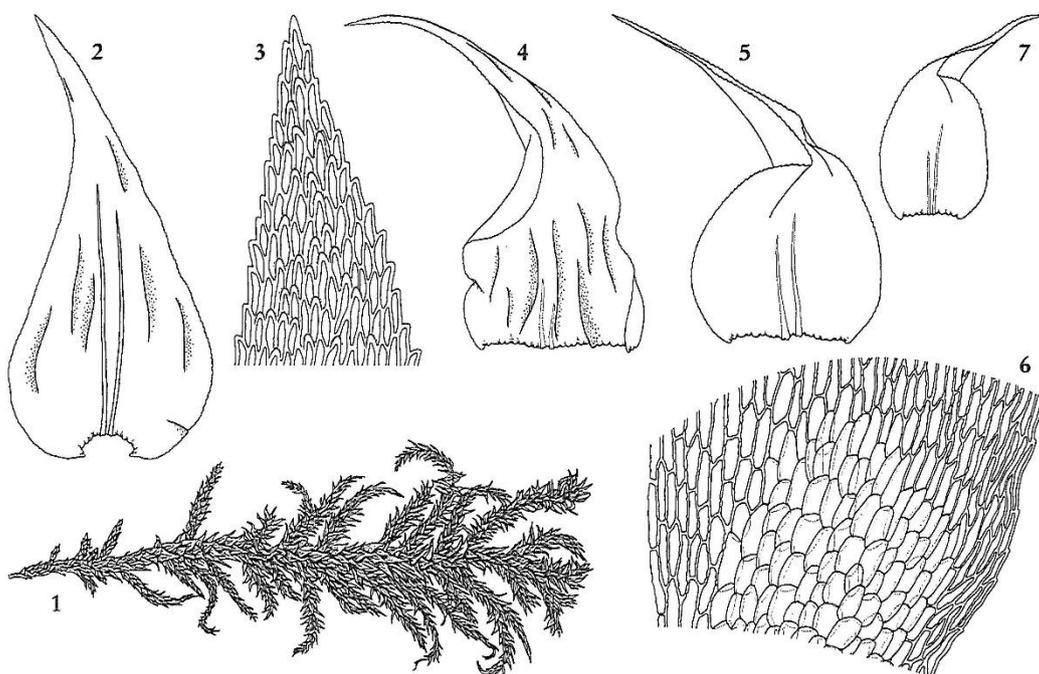


FIGURE 78. 1-3, *Rhytidiadelphus triquetrus*: 1, habit; 2, leaf; 3, leaf apex on dorsal side. 4, *R. loreus*, leaf. 5-7, *R. squarrosus*: 5, stem leaf; 6, alar cells; 7, branch leaf. 1 (x0,8); 2, 4, 5, 7 (x14); 3, 6 (x140).

Fam. Rhytidiaceae

Rhytidium (Sull.) Kindb.

Plants robust, to 10 cm long. Stem procumbent or ascending, pale, irregularly branched, branches erect; pseudoparaphyllia lanceolate, subulate. Stem leaves imbricate, ovate, gradually tapering to acuminate apex, concave, transversely undulate, rugose, falciform, secund, margin recurved from base to apex, denticulate in

the upper part; laminal cells elliptical, narrow, prorate, basal cells rhomboidal, porose, alar cells numerous, quadrate to trapezoidal, ascending up the margin; nerve single, extending to 1/2-3/4 way up leaf, usually bifurcate above. Branch leaves ovate-lanceolate, smaller (fig. 79, 1) **R. rugosum** (Hedw.) Kindb.

Forms tall, extensive, pale yellowish green to golden brown wefts on exposed soils, at forest margins, usually on calcareous substrata, in montane areas and high mountains. Distributed in the northern half of the Peninsula. Esp, And.

Fam. Plagiotheciaceae

Herzogiella Broth

Plants slender, prostrate, irregularly branched, without paraphyllia. Leaves erect to patent, lanceolate or ovate-lanceolate, acuminate, margin plane, denticulate; laminal cells long, narrow, alar cells quadrate to rectangular, hyaline; nerve short and double. Capsule curved; lid conical.

- 1 Alar cells rectangular, inflated, decurrent (fig. 79, 2-4) **H. striatella** (Brid.) Z.Iwats.
Plants slender, with ascending branches. Leaves ovate to ovate-lanceolate; laminal cells to 50 long. Forms glossy light green wefts on rotting stumps of silver firs and humus-rich soils, in high mountains. Rare, in the Pyrenees. Esp, And.

- 1 Alar cells rectangular, not inflated or decurrent (fig. 79, 5-7) **H. seligeri** (Brid.) Z.Iwats.
Leaves lanceolate to ovate-lanceolate, flexuose when dry; laminal cells to 70 long. Forms glossy light green wefts on rotting stumps of silver firs, in montane areas and high mountains, in the northern part of the Peninsula. Esp, And.

Isopterygiopsis Z.Iwats.

Plants slender, procumbent. Stem irregularly branched. Leaves ± complanate, ovate-lanceolate, abruptly or gradually narrowed, symmetrical, margin entire or nearly so; laminal cells vermicular, 4-6 µm wide, alar cells scarce, poorly differentiated; nerve short and double or lacking; pyriform to cylindrical axillary gemmae sometimes present.

- 1 Stem leaves with hyaloderm; leaves complanate, non-secund, with entire margin (fig. 79, 8-10)
I. muelleriana (Schimp.) Z.Iwats.
Isopterygium muellerianum (Schimp.) A.Jaeger

Axillary gemmae frequent, 60-100 µm long. Forms glossy pale green wefts on wet slopes, in rock crevices and at bases of shaded, acidic rocks and trees, in montane areas, in the northern part of the Peninsula. Esp, And.

- 1 Stem leaves without hyaloderm; leaves not or little complanate, sometimes secund, with nearly entire margin (fig. 79, 11-13)

I. pulchella (Hedw.) Z.Iwats.

Isopterygium pulchellum (Hedw.) A.Jaeger

Axillary gemmae rare, to 60 µm long. Forms small wefts in rock crevices and on rotting stumps in shaded sites, in montane areas and high mountains, in the north of the Peninsula, in Serra do Bussaco and in Mallorca. Esp, Prt, And, Bl.

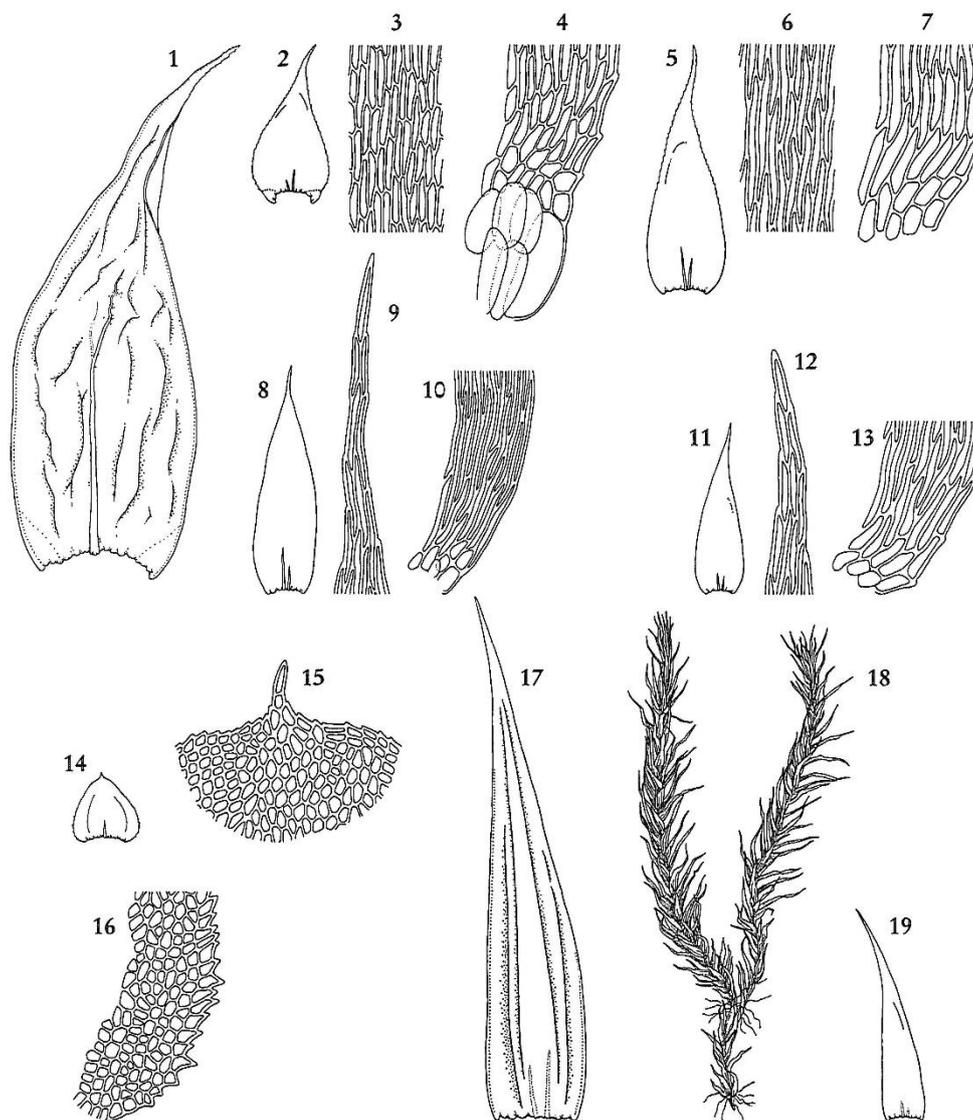


FIGURE 79. 1, *Rhytidium rugosum*, leaf. 2-4, *Herzogiella striatella*: 2, leaf; 3, median cells; 4, alar cells. 5-7, *H. seligeri*: 5, leaf; 6, median cells; 7, alar cells. 8-10, *Isopterygiopsis muelleriana*: 8, leaf; 9, leaf apex; 10, alar cells. 11-13, *I. pulchella*: 11, leaf; 12, leaf apex; 13, alar cells. 14-16, *Myurella julacea* var. *julacea*: 14, leaf; 15, leaf apex; 16, leaf margin at base. 17, *Orthothecium rufescens*, leaf. 18-19, *O. intricatum*: 18, habit; 19, leaf. 18 (x6); 1 (x18); 2, 5, 8, 11, 14, 17, 19 (x20); 3, 4, 6, 7, 9, 10, 12, 13, 15, 16 (x200).

Myurella Schimp.

Plants slender, to 3 cm long, julaceous. Leaves densely imbricate, very concave, widely ovate, acuminate, obtuse or apiculate, margin irregularly dentate or spinulose, especially at base; laminal cells short, rhomboidal or elliptical-rhomboidal, papillose on the dorsal surface; nerve short or lacking (fig. 79, 14-16)

M. julacea (Schwägr.) Schimp.

Plants glaucous, yellowish or brownish when old. Isolated or forming small tufts on wet, calcareous soils and ledges and in calcareous rock crevices, in montane areas and high mountains, in the Pyrenees, Cantabrian Mountains and Sierra Nevada. Esp, And.

var. **julacea**: Leaves obtuse or apiculate, margin irregularly dentate (fig. 79, 14-16).

var. **scabrifolia** Limpr.: Leaves acuminate in long apiculus, margin spinulose.

Orthothecium Schimp.

Plants small and slender or robust. Stem prostrate with ascending branches and axillary rhizoids. Leaves concave, longitudinally plicate or not; laminal cells homogeneous, long, narrow, ± porose, basal cells shorter; nerve lacking or very short and double.

- 1 Plants robust, to 10 cm long; leaves strongly longitudinally plicate (fig. 79, 17)

O. rufescens (Dicks. ex Brid.) Schimp.

Leaves 3-4 mm long, linear-lanceolate, acuminate, rigid, straight when dry, margin recurved. Forms glossy golden green to reddish wefts in springs, by streams, on humus-rich slopes and wet, shaded walls, mainly on basic substrata, in montane areas and high mountains, in the north of the Peninsula. Esp.

- 1 Plants small and slender, to 4 cm long; leaves not longitudinally plicate

2

- 2 Leaf margin plane; leaves usually secund when dry (fig. 79, 18-19) **O. intricatum** (Hartm.) Schimp.

Leaves 0,5-2 mm long, linear-lanceolate, longly and finely acuminate, erecto-patent when dry. Forms small, bright pale green patches in sheltered, wet, calcareous rock crevices, in the entrance of caves and karstic chasms, in montane areas and high mountains, in the north and northeastern part of the Peninsula, very rare in the south and in Mallorca. Esp, Bl.

- 2 Leaf margin recurved; leaves straight when dry

O. strictum Lorentz

Leaves 1-1,5 mm long, ovate-lanceolate or oblong-lanceolate, acuminate, erect when dry. Forms small, bright yellowish green patches on calcareous rock, in high mountains. Very rare, in the east of the Peninsula. Esp

Plagiothecium Schimp.

Plants glossy, light to dark green, growing on wet, shaded, acidic substrata. Stem prostrate, simple or irregularly branched. Leaves complanate, rarely imbricate, ovate or ovate-lanceolate, abruptly or gradually tapering, obtuse and apiculate or piliferous, symmetrical or asymmetrical, flat or concave, margin plane or recurved, entire or dentate at apex; laminal cells smooth, median cells linear, linear-rhomboidal or hexagonal, apical cells shorter, alar cells decurrent, hyaline, rectangular, rounded or quadrate, basal cells wider and shorter; nerve short and double or lacking. Capsule cylindrical, straight or curved, erect or inclined.

- 1 Leaves abruptly tapering to long, fine point (fig. 80, 1) **P. piliferum** (Sw.) Schimp.
Plants small, light green. Leaves symmetrical. Decurrent alar cells rectangular, arranged in 2-3 vertical rows. Capsule erect. Capsule erect or slightly inclined. Forms wefts on slopes and wet, acidic rocks, in montane areas. Rare, in the north of the Peninsula. Esp, Prt, And.
- 1 Leaves not abruptly tapering to long, fine point **2**
- 2 Leaves about 4 mm long, transversely undulate (fig. 80, 2-3) **P. undulatum** (Hedw.) Schimp.
Plants robust, light green, sparsely branched. Decurrent alar cells rectangular, arranged in 1-2 vertical rows. Capsule curved, inclined. Forms wefts on shaded, wet rocks and acidic slopes, from the lowlands to high mountains. Widespread in the north of the Peninsula. Esp, Prt.
- 2 Leaves less than 4 mm long, not transversely undulate **3**
- 3 Median cells of leaf linear, less than 10 μm wide **4**
- 3 Median cells of leaf elliptical, rhomboidal or hexagonal, 10 μm wide or more **5**
- 4 Median cells of leaf 5-7 μm wide; capsule erect or slightly inclined (fig. 80, 4-5) **P. laetum** Schimp.
Plants slender. Stem leaves complanate, erect or erecto-patent, asymmetrical, oblong-lanceolate, acumen not curved. Decurrent alar cells arranged in 1-3 vertical rows. Capsule erect or slightly inclined. Forms glossy wefts on rotten stumps, slopes and acidic rocks, in montane areas, in the northern part of the Peninsula. Esp, Prt, And.
- 4 Median cells of leaf 6-9 μm wide; capsule curved, inclined (fig. 80, 6-7) **P. curvifolium** Schliepf. ex Limpr.
Plants slender. Stem leaves complanate, erecto-patent, asymmetrical, oblong-lanceolate, acumen curved. Decurrent alar cells arranged in 3-4 vertical rows. Capsule inclined to horizontal. Forms glossy green wefts on wet, acidic soils and slopes, in montane areas, in the northern part of the Peninsula. Esp, Prt.

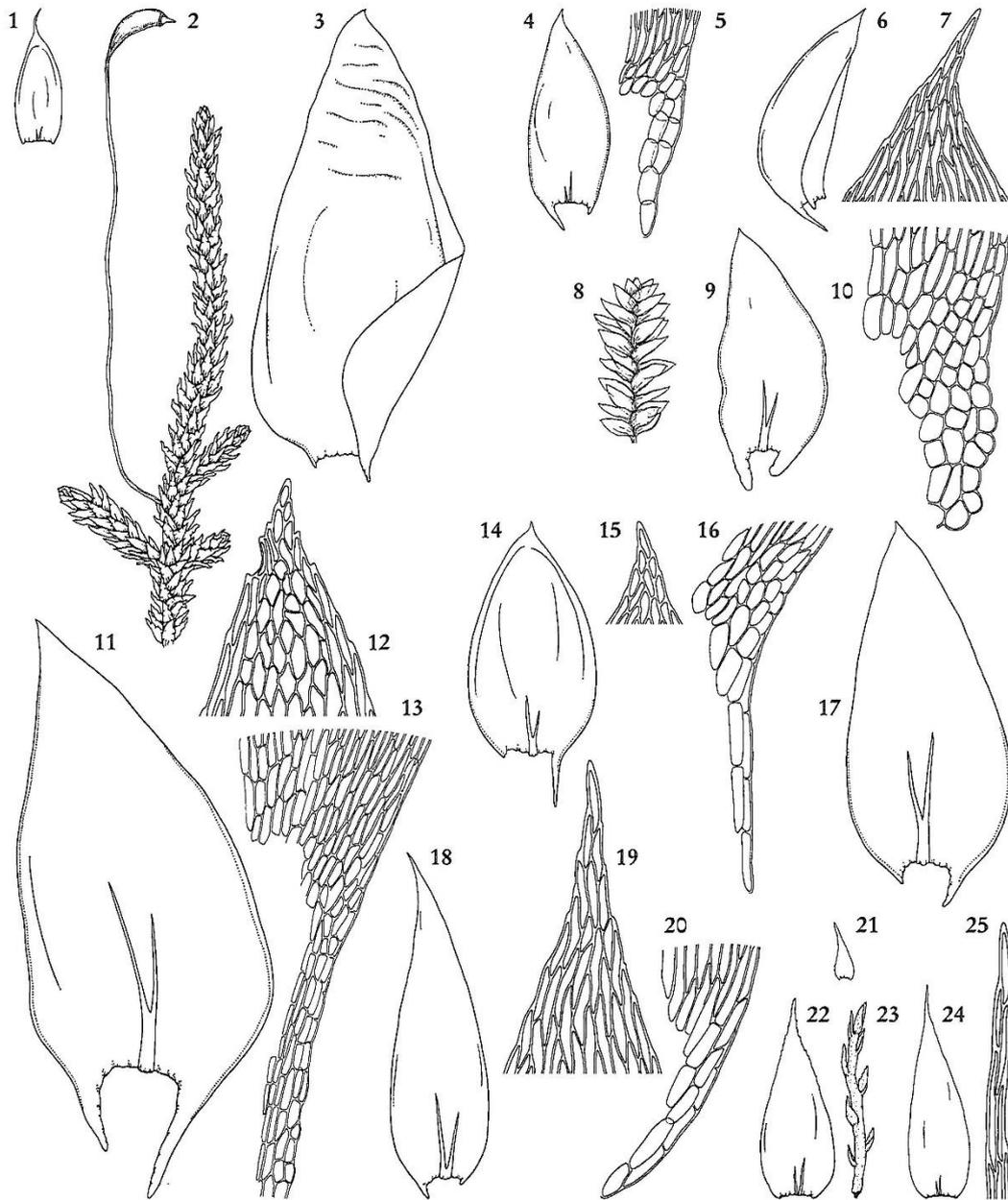


FIGURE 80. 1, *Plagiothecium piliferum*, leaf. 2-3, *P. undulatum*: 2, habit; 3, leaf. 4-5, *P. laetum*: 4, leaf; 5, decurrent cells. 6-7, *P. curvifolium*: 6, leaf; 7, leaf apex. 8-10, *P. denticulatum* var. *denticulatum*: 8, habit; 9, leaf; 10, decurrent cells. 11-13, *P. platyphyllum*: 11, leaf; 12, leaf apex; 13, decurrent cells. 14-16, *P. cavifolium*: 14, leaf; 15, leaf apex; 16, decurrent cells. 17, *P. nemorale*, leaf. 18-20, *P. succulentum*: 18, leaf; 19, leaf apex; 20, decurrent cells. 21, *Platydictya jungermannioides*, leaf. 22-23, *Pseudotaxiphyllum elegans*: 22, leaf; 23, propagule. 24-25, *P. laetevirens*: 24, leaf; 25, leaf apex. 2 (x1,6); 8 (x2,6); 1, 3, 4, 6, 9, 11, 14, 17, 18, 21, 22, 24 (x20); 23 (x40); 13 (x60); 5, 10, 16, 20 (x100); 7, 12, 15, 19 (x160); 25 (x200).

5 Decurrent cells of leaf quadrate, shortly rectangular or rounded, inflated, prominent in the margin (fig. 80, 8-10)

***P. denticulatum* (Hedw.) Schimp.**

Plants small to medium-sized. Leaves clearly asymmetrical, with plane, denticulate apex. Decurrent alar cells arranged in 3-6 vertical rows. Seta reddish brown; capsule curved, horizontal. Forms glossy, dark green to yellowish

green wefts on soils, slopes, wet rocks, stumps and at tree bases, in coastal areas, montane areas and high mountains, in the northern half of the Peninsula and in Sierra Nevada. Esp, Prt, And.

var. **denticulatum**: Plants not julaceous. Leaves not undulate (fig. 80, 8-10).

var. **obtusifolium** (Turner) Moore: Plants with julaceous branches. Leaves rounded, concave. Rare, in the Pyrenees.

var. **undulatum** R.Ruthe ex Geh.: Leaves \pm transversely undulate.

- 5 Decurrent cells of leaf longly rectangular, sometimes with some quadrate in the margin 6
- 6 Upper cells of leaf shorter than median cells, some hyaline; decurrent cells of leaf rectangular, some quadrate (fig. 80, 11-13) **P. platyphyllum** Mönk.
Plants medium-sized. Leaves asymmetrical. Decurrent alar cells arranged in 2-4 vertical rows. Capsule inclined. Forms glossy wefts at tree bases, by streams, waterfalls and on wet acidic soils and rocks, in montane areas and high mountains of the northern half of the Peninsula. Esp, Prt, And.
- 6 Upper cells of leaf similar to median cells; decurrent cells of leaf all rectangular 7
- 7 Leaves distinctly concave, acute or obtuse and apiculate; plants with julaceous branches (fig. 80, 14-16) **P. cavifolium** (Brid.) Z.Iwats.
Plants slender to medium-sized. Leaves symmetrical. Decurrent alar cells arranged in 1-3 vertical rows. Capsule straight. Forms glossy wefts on acidic slopes and in wet rock crevices, in montane areas and high mountains, in the northern half of the Peninsula. Esp, Prt.
- 7 Leaves plane, acute or acuminate; plants with complanate branches 8
- 8 Leaves acute; median cells of lamina 4-6:1; plants usually dull, dark green (fig. 80, 17) **P. nemorale** (Mitt.) A.Jaeger
Plants medium-sized, to 5 cm long. Leaves complanate, symmetrical, ovate. Decurrent alar cells arranged in 1-3 vertical rows. Seta reddish; capsule inclined. Forms dull, olive green to dark green wefts on wet, acidic slopes rocks, at tree bases and by streams, from the lowlands to high mountains. Widespread throughout the Peninsula. Esp, Prt, And.
- 8 Leaves acuminate; median cells of lamina 6-10:1; plants usually glossy, yellowish or yellowish green (fig. 80, 18-20) **P. succulentum** (Wilson) Lindb.
Plants medium-sized, to 2,5 cm long. Leaves complanate, symmetrical, with a point longer than in *P. nemorale*; nerve bifurcate, stout at base. Decurrent alar cells arranged in 1-3 vertical rows. Capsule inclined. Forms dense, glossy, silky, yellowish wefts on acidic soils and wet rocks, from the lowlands to high mountains. Distributed in the northern half of the Peninsula, sporadically in the southeastern part. Esp, Prt, And.

Platydictya Berk.

Plants very small and slender, irregularly branched. Stem with red, papillose rhizoids. Leaves sparsely arranged, less than 0,5 mm long, straight to sub-secund, lanceolate, acuminate, margin denticulate, especially near base; laminal cells shortly oblong-rhomboidal, 3-5:1, smooth, alar cells quadrate or shortly rectangular, scarcely differentiated; nerve lacking (fig. 80, 21)

P. jungermannioides (Brid.) H.A.Crum

Forms loose green or dull yellowish green patches on soils, rocks, walls of caves, in rock crevices and at tree bases near streams, on calcareous substrata, in montane areas and high mountains, in the northern part of the Peninsula. Esp, And.

Pseudotaxiphyllum Z.Iwats.

Plants slender. Stem irregularly branched; epidermal cells 7-12 μm wide, thick-walled, yellowish. Rhizoids reddish brown, finely papillose. Leaves complanate, ovate-lanceolate, acuminate, margin plane, denticulate near apex or entire; laminal cells fusiform, basal cells shorter and wider, alar cells poorly differentiated; nerve short and double. Axillary propagules flagelliform, caducous, 0,7-1,5 mm long, with small primordial leaves.

- 1 Leaves complanate and curved downwards; apical cells of leaf 10-30 μm long; median cells of leaf 50-100 μm long (fig. 80, 22-23)

P. elegans (Brid.) Z.Iwats.

Isopterygium elegans (Brid.) Lindb.

Forms small, glossy wefts at tree bases and on wet, shaded siliceous rocks, from the lowlands to high mountains, in the north and west of the Peninsula. Esp, Prt, And.

- 1 Leaves complanate and pointing in all directions; apical cells of leaf 35-60 μm long; median cells of leaf 90-160 μm long (fig. 80, 24-25)

P. laetevirens (Dixon & Luisier ex F. Koppe & Düll) Hedenäs

Forms small, yellowish wefts in exposed or shaded crevices, by streams and on wet soils and rocks. In the northern part of the Peninsula, very rare in Algeciras Mountains. Esp, Prt.

Fam. Entodontaceae

Entodon Müll.Hal.

Plants robust, prostrate or ascending. Stem pinnate, with short, ± complanate branches. Leaves concave, with rounded, obtuse or apiculate apex, margin plane or recurved at base; alar cells quadrate to shortly rectangular, green or hyaline, median cells linear; nerve short and double or lacking.

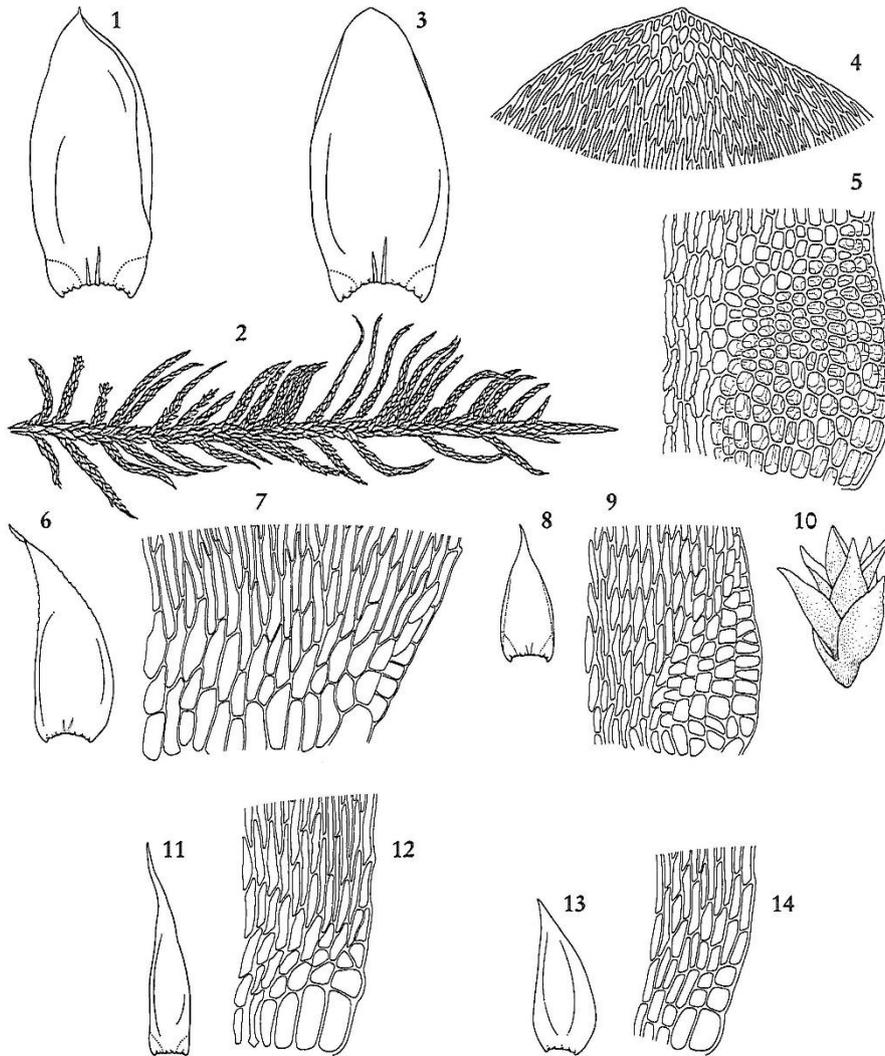


FIGURE 81. 1, *Entodon cladorrhizans*, leaf. 2-5, *E. concinnus*: 2, habit; 3, leaf; 4, leaf apex; 5, alar cells. 6-7, *Isopterygium tenerum*: 6, leaf; 7, alar cells. 8-10, *Platygyrium repens*: 8, leaf; 9, alar cells; 10, propaguliferous branchlet. 11-12, *Sematophyllum substrumosum*: 11, leaf; 12, alar cells. 13-14, *S. demissum*: 13, leaf; 14, alar cells. 2 (x1,6); 1, 3, 6, 8, 11, 13 (x20); 10 (x50); 4, 5, 7, 9, 12, 14 (x180).

1 Leaves apiculate; group of alar cells unistratose (fig. 81, 1)

E. cladorrhizans (Hedw.) Müll.Hal.

Plants light green to yellowish. Leaves imbricate when dry, elliptical, apical margin entire or denticulate. Forms glossy golden green to reddish wefts on wet soils in beech forests and alder forests. Scattered in the Pyrenees and northeastern part of the Peninsula. Esp.

- 1 Leaves obtuse, non-apiculate; group of alar cells 2-3-stratose (fig. 81, 2-5) **E. concinnus** (De Not.) Paris
Stem golden brown to pinkish. Leaves appressed when dry, concave, elliptical, slightly decurrent, with obtuse apex, usually cucullate, margin entire. Forms glossy yellowish or pale brown wefts on humus-rich soils and calcareous rocks, in montane areas. Scattered in the northern part of the Peninsula. Esp, And.

This species may be confused with *Pleurozium schreberi*, but this has red stems and alar cells oblong and orange brown.

Fam. Pylaisiadelphaceae

Isopterygium Mitt.

Plants medium-sized, shiny, yellow green to golden brown. Stem irregularly branched; pseudoparaphyllia filiform or narrowly lanceolate. Leaves spreading to erect-spreading, complanate, sometimes asymmetrical, ovate-lanceolate, gradually tapering into more or less long acumen, which is often twisted and flexuose, margin denticulate in the upper half; laminal cells linear, alar cells few, quadrate or shortly rectangular, yellowish; nerve short and double. Seta brown to reddish; capsule horizontal, curved and asymmetrical, constricted below mouth when dry (fig. 81, 6-7)

I. tenerum (Sw.) Mitt.

Forms glossy, golden wefts on wet slopes. Very rare, localized in Algeciras Mountains. Esp.

Platygyrium Schimp.

Plants small to medium-sized. Stem prostrate, with pseudoparaphyllia, with ascending, curved or straight branches. Stem leaves erect, lanceolate to ovate-lanceolate, acuminate, margin entire, partially narrowly recurved; laminal cells elongate, elliptical, basal cells narrowly rhomboidal, porose or not, alar cells distinctly differentiated, quadrate-trapezoidal or shortly rectangular, ascending up margin; nerve absent or short and double. Small, deciduous, axillary, propaguliferous branchlets present on erect branches. Seta brownish red; capsule straight, symmetrical. Dioicous (fig. 81, 8-10)

P. repens (Brid.) Schimp.

Corticolous, in the lowlands. Very rare, in the north of the Peninsula. Esp.

Fam. Sematophyllaceae

Sematophyllum Mitt.

Plants slender. Stem prostrate, 2-3 cm long, irregularly branched, without paraphyllia. Leaves erect to patent, stem and branch leaves similar, minute, lanceolate to oblong-ovate, with short or long acumen, margin entire; median cells of lamina linear-rhomboidal, alar cells inflated; nerve lacking or very short and double. Capsule inclined to horizontal, constricted below mouth after dehiscence; lid conical to rostrate; peristome double.

- 1 Leaves narrowly lanceolate, with long, filiform apex; alar group large, with 4-6 inflated cells (fig. 81, 11-12) **S. substrumulosum** (Hampe) E.Britton
Alar cells brownish or hyaline. Forms compact, silky, glossy golden green mats on rotten trunks and bark of trees, rarely on soils. Distributed in the western part of the Peninsula, rare in the south, north and in Mallorca and Menorca. Esp, Prt, Bl.
- 1 Leaves oblong-ovate, with acute to shortly acuminate apex; alar group small, with 2-4 inflated cells (fig. 81, 13-14) **S. demissum** (Wilson) Mitt.
Alar cells hyaline, basal cells sinuose. Forms glossy yellowish green mats on wet, rocky slopes in the lowlands. Scattered localities in the north of the Peninsula. Esp.

Fam. Cryphaeaceae

Cryphaea D.Mohr

Plants small to medium-sized, densely or sparsely branched. Primary stem creeping, secondary stems erect. Leaves imbricate, ovate, obtuse, acute or acuminate, concave, margin entire, plane or recurved at base; median cells of lamina rounded or elliptical, 1,5:1, smooth, thick-walled, basal cells towards nerve longer; nerve extending to 3/4 way up leaf. Capsule ellipsoidal, immersed, borne unilaterally along the secondary stems.

- 1 Branch leaves acute to acuminate; margin recurved at base (fig. 82, 1-2) **C. heteromalla** (Hedw.) D.Mohr

Plants 3-5 cm long. Stem creeping, ± densely branched, branches erect. Forms dark green wefts on trunks of trees and bushes, more rarely on rocks, in the lowlands and montane areas. Widespread throughout the Peninsula but commoner in the north and west. Esp, Prt.

1 Branch leaves obtuse; margin plane (fig. 82, 3-4)

C. lamyana (Mont.) Müll.Hal.

* **Dendrocryphaea lamyana** (Mont.) P.Rao

Plants 5-8 cm long. Stem creeping, simple or sparsely branched, branches erect or curved when dry. Grows on rocks and at tree bases, submerged in streams, in the west and southwest of the Peninsula. Esp, Prt.

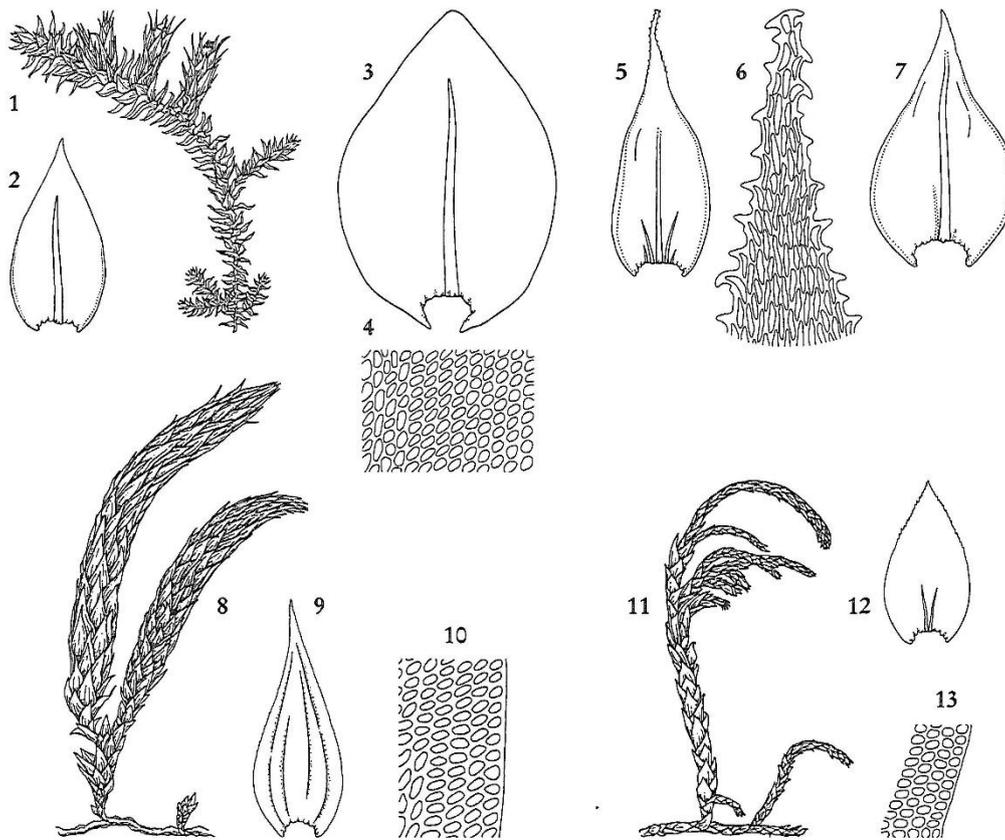


FIGURE 82. 1-2, *Cryphaea heteromalla*: 1, habit; 2, leaf. 3-4, *C. lamyana*: 3, leaf; 4, median cells. 5-6, *Antitrichia curtispindula*: 5, leaf; 6, leaf apex. 7, *A. californica*, leaf. 8-10, *Leucodon sciuroides* var. *sciuroides*: 8, habit; 9, leaf; 10, lower marginal cells. 11-13, *Nogopterium gracile*: 11, habit; 12, leaf; 13, lower marginal cells. 8, 11 (x3,5); 1 (x4); 2, 3, 5, 7, 9, 12 (x20); 6 (x140); 4, 10, 13 (x200).

Fam. Leucodontaceae

Antitrichia Brid.

Plants glossy dark green. Leaves ovate to ovate-lanceolate, ± longitudinally plicate, apex acute or acuminate, with reflexed teeth, especially in branch leaves, margin narrowly recurved; laminal cells smooth,

2-3 times as long as wide, thick-walled, basal cells shorter, rounded; nerve long, extending to 3/4 way up leaf or more. Capsule ellipsoidal, inclined; peristome double.

- 1 Leaves ovate-lanceolate, acuminate, with large, irregular teeth at apex, with 1-2 lateral nerves at base distinct and short (fig. 82, 5-6) **A. curtispindula** (Hedw.) Brid.

Plants robust, irregularly branched. Leaves strongly plicate. Forms wefts at tree bases and on siliceous rocks, in montane areas. Scattered in the Peninsula, more frequent in the northern half and in Mallorca. Esp, Prt, And, Bl.

- 1 Leaves ovate, acute, with fine teeth at apex, lateral nerves absent or indistinct (fig. 82, 7)

A. californica Sull.

Plants slender to medium-sized, ± regularly branched. Leaves not or slightly plicate. Forms wefts on trunks and rocks in montane areas, in the centre and south of the Mediterranean region of the Peninsula and in Mallorca, rare in the north. Esp, Prt, Bl.

Leucodon Schwägr.

Plants robust, dark green. Primary stem creeping, secondary stems simple or sparsely branched, pendulous, curved or straight. Leaves spreading, imbricate when dry, ovate-lanceolate, longitudinally plicate, acuminate, margin plane, entire or denticulate at apex; laminal cells long, narrow, smooth, marginal cells short, oblong at base; nerve lacking. Capsule ovoid to ellipsoidal or cylindrical (fig. 82, 8-10)

L. sciuroides (Hedw.) Schwägr.

Sometimes with groups of propaguliferous shootlets at branch apex. Forms extensive tufts on trees and rocks in montane areas. Widespread in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

var. **sciuroides**: Secondary stems to 4 cm long. Leaves lanceolate or ovate-lanceolate, plicate, 1,9-2,3 mm long. (fig. 82, 8-10).

var. **morensis** (Schwägr.) De Not.: Secondary stems to 8 cm long. Leaves ovate-lanceolate, strongly plicate, 2,6-3,3 mm long.

Nogopterium Crosby & W.R. Buck

Plants medium-sized. Primary stem creeping, secondary stems erect, curved, secund, often with flagelliform branches. Branch leaves spreading, imbricate when dry, ovate, concave, acute, margin plane, dentate at apex; laminal cells rhomboidal, papillose on dorsal side, basal cells towards nerve elongate, marginal cells rounded, quadrate or oblate, forming several rows; nerve short, forked or double. Capsule ovoid-cylindrical (fig. 82, 11-13)

Nogopterium gracile (Hedw.) Crosby & W.R. Buck

Pterogonium. gracile (Hedw.) Sm.

Forms loose, dark green patches on rocks and trunks of trees, in montane areas. Widespread throughout the Peninsula and in Mallorca. Esp, Prt, Bl.

Fam. Neckeraceae

Homalia Brid.

Stem prostrate, usually stoloniferous, secondary stems irregularly branched, sometimes with flagelliform branches. Leaves complanate, oblong to spatulate, with rounded, +/- dentate apex, margin plane; laminal cells rhomboidal in the upper part, gradually narrower and longer towards leaf base; nerve single or double, short or long.

1 Nerve short and double

H. webbiana (Mont.) Mitt.

* **Pseudomalina webbiana** (Mont.) Enroth

Plants small. Stem with pseudoparaphyllia. Leaf margin denticulate at apex. Grows on moist sandstones. Very rare, in the south of the Peninsula. Esp.

1 Nerve extending more than 1/2 way up leaf, single

2

2 Leaf apex strongly dentate; stem with pseudoparaphyllia (fig. 83, 1-4)

H. lusitanica Schimp.

Plants medium-sized. Forms golden green mats on wet, shaded rocks and slopes, by streams and on walls of caves, in the lowlands near coastal areas and in montane areas, in the east, west and south of the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

2 Leaf apex denticulate; stem without pseudoparaphyllia (fig. 83, 5-6)

H. trichomanoides (Hedw.) Brid.

Plants medium-sized. Forms loose wefts at tree bases and on wet, calcareous soils and rocks, in the lowlands and montane areas in the north of the Peninsula. Esp, Prt.

Neckera Hedw.

Plants mostly large. Secondary stems pinnate, bipinnate or irregularly branched, often with propaguliferous flagelliform branches. Leaves complanate, oblong, asymmetrical, plane or transversely undulate, apex rounded to acuminate, margin entire or denticulate at apex; nerve thin, single or double, or absent; laminal cells elongate, gradually shorter towards apex and leaf base. Capsule ovoid or ellipsoidal, emergent or exerted; peristome double.

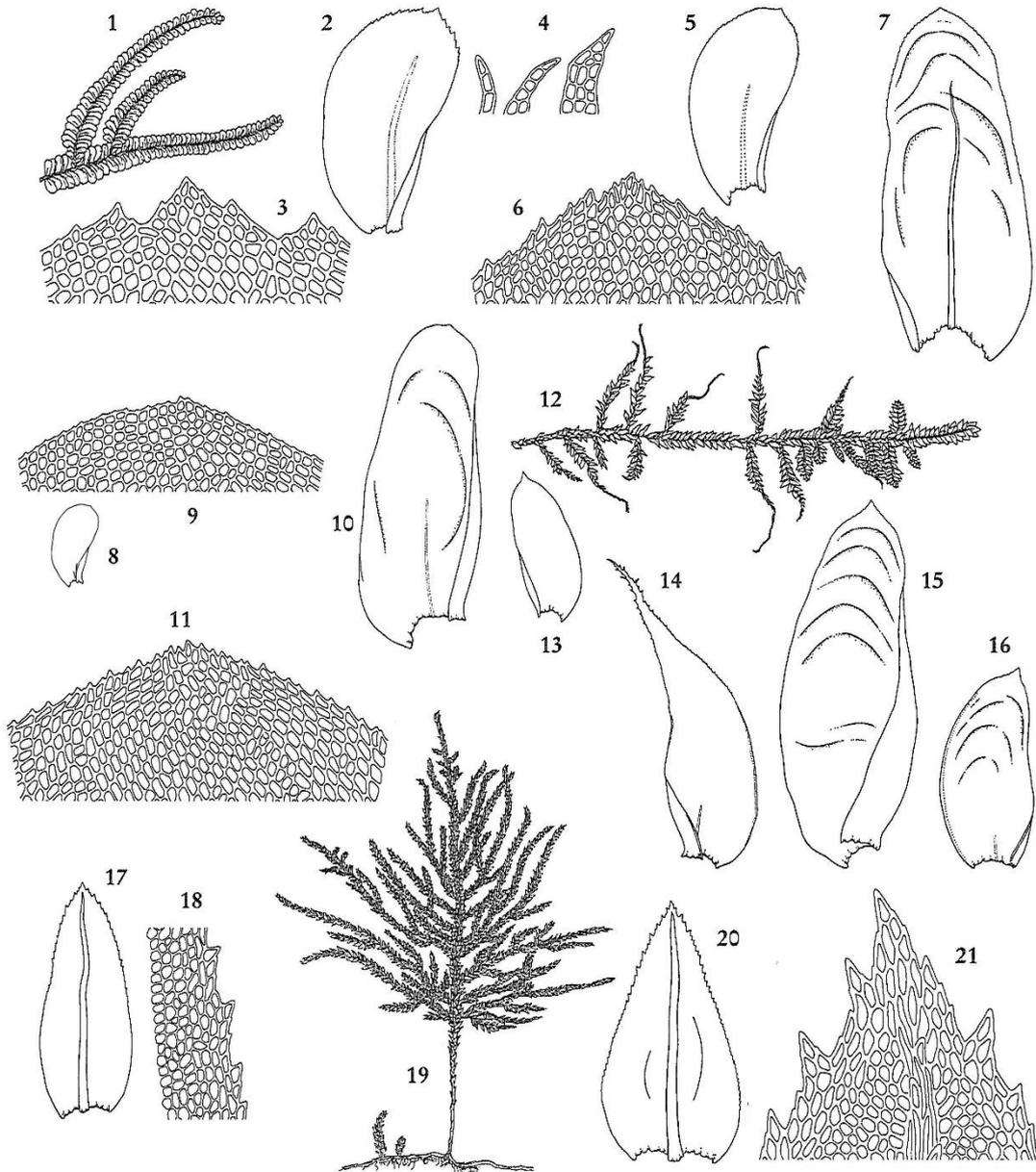


FIGURE 83. 1-4, *Homalia lusitanica*: 1, habit; 2, leaf; 3, leaf apex; 4, pseudoparaphyllia. 5-6, *H. trichomanoides*: 5, leaf; 6, leaf apex. 7, *Neckera menziesii*, leaf. 8-9, *N. besseri*: 8, leaf; 9, leaf apex. 10-11, *N. baetica*: 10, leaf; 11, leaf apex. 12-13, *N. complanata*: 12, habit; 13, leaf. 14, *N. cephalonica*, leaf. 15, *N. crispa*, leaf. 16, *N. pumila*, leaf. 17-18, *Thamnobryum maderense*: 17, leaf; 18, margin in the middle of leaf. 19-21, *T. alopecurum*: 19, habit; 20, leaf; 21, leaf apex. 19 (x0,8); 1, 12 (x1,4); 2, 5, 7, 8, 10, 13, 14, 15, 16, 17, 20 (x18); 3, 4, 6, 9, 11, 18, 21 (x160).

- | | | |
|---|---|-----------------------------------|
| 1 | Nerve single, extending to 3/4 way up leaf (fig. 83, 7) | <i>N. menziesii</i> Drumm. |
| | Plants about 15 cm long, golden green, darker below. Stem irregularly branched, with paraphyllia, often with flagelliform branches. Leaves oblong, transversely undulate, obscurely complanate, apex obtuse. Forms pendulous, loose patches in wet, deep, calcareous rock crevices, in montane areas. Scattered in the Peninsula. Esp, Prt. | |
| 1 | Nerve single, extending to 1/3 up leaf, short and double or lacking | 2 |

- 2 Leaves 0,3-0,6 mm long (fig. 83, 8-9) **N. besseri** (Lobarz.) Jur.
 * **Alleniella besseri** (Lobarz.) S.Olsson, Enroth & D.Quandt
 Plants small. Stem regularly pinnate, mostly with flagelliform branches. Nerve short and double or lacking. Forms bright green patches on trunks and branches, mainly on *Buxus sempervirens* L., in montane areas in the northeast of the Peninsula and in Mallorca. Esp, And, Bl.
- 2 Leaves 1-3,8 mm long **3**
- 3 Leaves plane when dry or wet (fig. 83, 12-13) **N. complanata** (Hedw.) Huebener
 * **Alleniella complanata** (Hedw.) S.Olsson, Enroth & D.Quandt
 Stem regularly branched, with numerous flagelliform branches. Leaves apiculate; margin finely denticulate at apex. Seta long. Forms glossy light green patches on trunks of trees and on rocks, in montane areas, in the northern and western half of the Peninsula and in Mallorca. Esp, Prt, And, Bl.
- 3 Leaves transversely undulate on dry, sometimes on wet **4**
- 4 Leaves acuminate; margin irregularly dentate or ciliate at apex (fig. 83, 14)
N. cephalonica Jur. & Unger
 Stem irregularly branched, without flagelliform branches. Seta short. Grows on rocks and bark of trees. Very rare, in Algeciras Mountains. Esp.
- 4 Leaves apiculate; margin denticulate or entire **5**
- 5 Leaf margin recurved on both sides; plants small, 2(4)-8 cm long (fig. 83, 16) **N. pumila** Hedw.
 Leaves to 1,5 mm long, with obtuse apex or attenuated in acute point Seta short; capsule emergent. Forms dark green to pale green wefts on trunks of branches, rarely on rocks, in the lowlands and montane areas, in the north and west of the Peninsula. Esp, Prt.
- 5 Leaf margin flat; plants large, 20-30 cm long **6**
- 6 Leaf apex rounded and apiculate or obtuse (fig. 83, 15) **N. crispa** Hedw.
 * **Exsertotheca crispa** (Hedw.) S.Olsson, Enroth & D.Quandt
 Plants robust, 5-20 cm long, glossy golden brown, with flagelliform branches. Leaves undulate on dry and moist, 3-5 mm long. Stem regularly or slightly branched. Seta long. Forms loose, pendulous patches on calcareous rocks, trunks of trees and branches of *Buxus sempervirens* L., in montane areas in the Peninsula and in Mallorca. Esp, Prt, And, Bl.

- 6 Leaf apex obtuse or rounded (fig. 83, 10-11) **N. baetica** J.Guerra, J.F.Jiménez & J.A.Jiménez
* **Exsertotheca baetica** González-Mancebo, O.Werner, J.Patiño & Ros
Plants yellowish green, without flagelliform branches. Leaves undulate on dry, plane or moist, ovate-oblong, narrowed in the upper part. Epiphytic. Very rare, in Algeciras Mountains. Esp.

Thamnobryum Nieuwl.

Plants robust. Primary stem creeping, the secondary ones erect and dendroid. Branch leaves of the first or second order erecto-patent, imbricate when dry, margin plane, strongly dentate in the upper half; laminal cells short, smooth or slightly papillose, marginal cells longer; nerve long, nearly reaching the apex.

- 1 Branches complanate; stem leaves ovate; median cells of lamina isodiametric or a little longer than wide, 8-23 x 6-13 μm (fig. 83, 17-18) **T. maderense** (Kindb.) Hedenäs
Grows on wet, shaded acidic soils. Very rare, in the west of the Peninsula. Prt.
- 1 Branches not complanate; stem leaves ovate-triangular; median cells of lamina longer than wide, 9-40 x 6-9 μm (fig. 83, 19-21) **T. alopecurum** (Hedw.) Gangulee
Forms lax, dark green patches on shaded, usually water-splashed rocks by streams or in chasms, in the lowlands and montane areas of the Peninsula and in Mallorca and Menorca. Esp, Prt, Bl.

Fam. Leptodontaceae

Leptodon D.Mohr

- Plants medium-sized. Primary stem prostrate, adhering to substratum, secondary stems ascending or decumbent, with pinnate branches, circinate when dry. Leaves ovate, rounded at apex, spreading, appressed when dry, margin recurved on one side, entire, dentate or denticulate at apex; laminal cells ovate, short, smooth, thick-walled; nerve single, hardly extending beyond 1/2 way up leaf. Seta short; capsule ellipsoidal (fig. 84, 1-3)
- L. smithii** (Hedw.) F.Weber & D.Mohr
Usually with straight propaguliferous branches. Forms lax, dark green to black patches on trunks of trees and rocks. Common in the Peninsula and in Mallorca, Menorca and Pithyusic Island. Esp, Prt, And, Bl.

Fam. Lemnophyllaceae

Isothecium Brid.

Plants small to robust. Primary stem prostrate, secondary stems decumbent to erect, irregularly branched, often dendroid. Stem leaves imbricate, concave, ovate to ovate-triangular, acuminate, acute or obtuse and apiculate, margin denticulate, at least in the upper part or entire; laminal cells linear-rhomboidal, shorter towards margin and apex, basal cells shorter or rectangular, alar cells small, opaque, yellowish to brownish, thick-walled; nerve single, extending beyond 1/2 way up leaf, usually bifurcate in the upper part, occasionally short and double. Branch leaves ovate to lanceolate. Seta reddish, smooth; capsule inclined. Dioicous.

1 Leaf margin denticulate in upper part; apical cells to 3:1 2

1 Leaf margin denticulate throughout; apical cells more than 4:1 3

2 Alar cells not ascending up margins; stem leaves acute or apiculate (fig. 84, 4-5)

I. alopecuroides (Lam. ex Dubois) Isov.

I. myurum Brid.

Plants very variable in size but usually robust. Secondary stems procumbent, irregularly branched, with straight or curved branches. Stem leaves ovate-oblong, margin incurved in the middle of leaf; nerve faint, extending to 1/2 way up leaf. Capsule erect. Forms dark green wefts on rocks and at bases of trees, from the lowlands to high mountains, in northern half of the Peninsula and in Mallorca, very rare in the south of the Peninsula. Esp, Prt, And, Bl.

2 Alar cells ascending up margin; stem leaves acuminate (fig. 84, 6-7)

I. algarvicum W.E. Nicholson & Dixon

Plants small to medium-sized. Stem and branches curved when dry, branches often attenuated, flagelliform branches common. Stem leaves ovate, margin plane, group of alar cells gradually narrowing upwards along margin, extending 1/3-1/4 way up leaf. Branch leaves with scattered upper cells prorate dorsally. Forms green, yellow-green or brownish wefts on sheltered, acidic rocks and at tree bases, in montane areas. Rare, in the south and western part of the Peninsula. Esp, Prt.

3 Leaves ovate-lanceolate to triangular

I. myosuroides Brid.

Secondary stems sub-dendroid or irregularly branched, with straight or curved branches, attenuated at tips. Alar cells shortly rectangular or rhomboidal; nerve long or short, bifurcate in the upper part. Capsule inclined. Forms yellowish green to brownish wefts on rocks and at tree bases in wet, shaded sites, from the lowlands to high mountains.

var. **myosuroides**: Plants medium-sized, sub-dendroid. Stem leaves erecto patent when moist. Widespread in the northern half of the Peninsula, rare in the south. Esp, Prt (fig. 84, 8-9).

var. **brachytheციoides** (Dixon) Braithw. (= * **I. interludens** Stirt.): Plants robust, irregularly branched. Stem leaves imbricate when moist. Very rare, in montane areas in the northwest of the Peninsula. Esp.

3 Leaves widely ovate or ovate-triangular (fig. 84, 10-11)

I. holtii Kindb.

Plants medium-sized to robust, dendroid, with ascending, julaceous secondary branches, longer than in *I. myosuroides*. Stem leaves ovate to cordate-triangular; alar cells shortly rectangular; nerve broad, stout, extending to 1/2 way up leaf. Capsule inclined. Forms flat, light or dark green to orange wefts on periodically flushed rocks and by mountains streams, in the northern half of the Peninsula, very rare in the south. Esp, Prt.

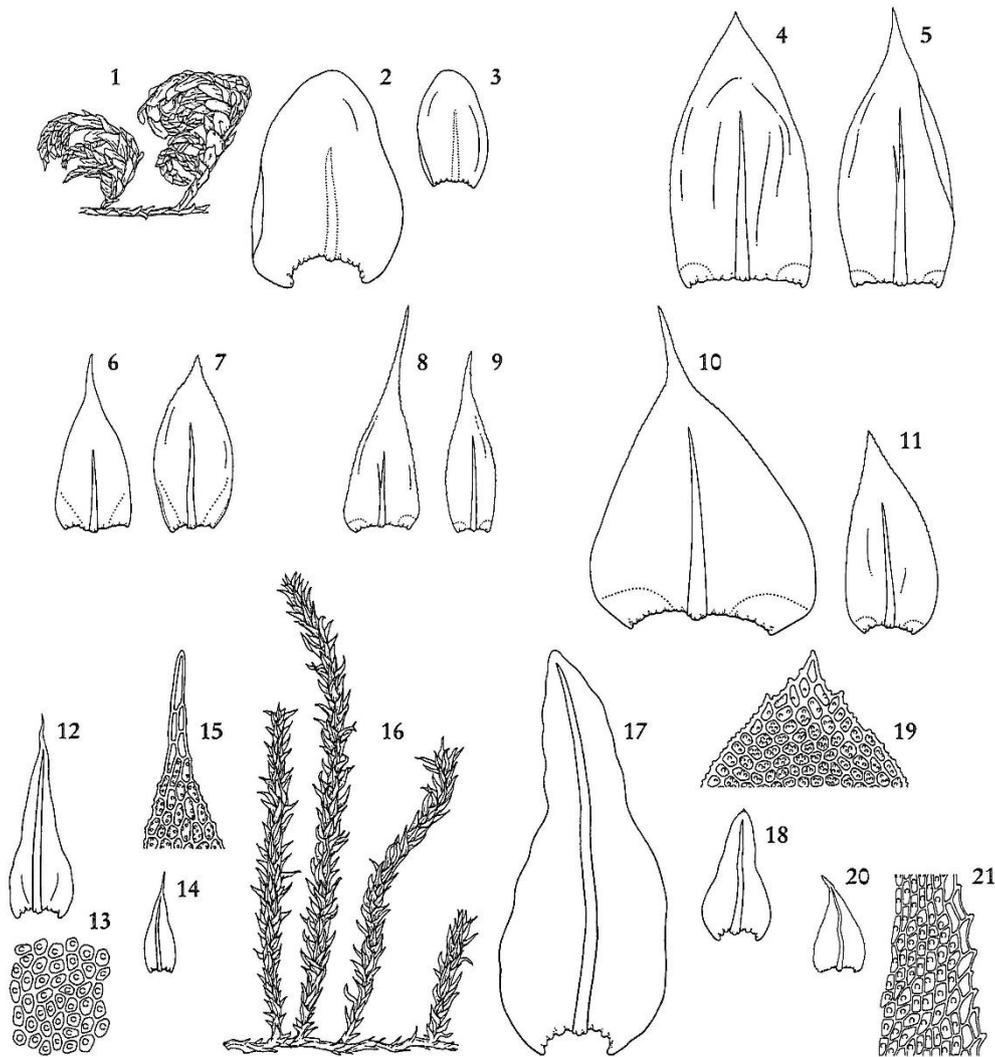


FIGURE 84. 1-3, **Leptodon smithii**: 1, habit when dry; 2, stem leaf; 3, branch leaf. 4-5, **Isothecium alopecuroides**: 4, stem leaf; 5, branch leaf. 6-7, **I. algarvicum**: 6, stem leaf; 7, branch leaf. 8-9, **I. myosuroides** var. **mysuroides**: 8, stem leaf; 9, branch leaf. 10-11, **I. holtii**: 10, stem leaf; 11, branch leaf. 12-13, **Anomodon longifolius**: 12, leaf; 13, laminal cells. 14-15, **A. rostratus**: 14, leaf; 15, leaf apex. 16-17, **A. viticulosus**: 16, habit; 17, leaf. 18-19, **A. attenuatus**: 18, leaf; 19, leaf apex. 20-21, **Claopodium whippleanum**: 20, leaf; 21, margin in the middle of leaf. 16 (x2); 1 (x4); 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 17, 18, 20 (x20); 13, 15, 19, 21 (x240).

Fam. Anomodontaceae

Anomodon Hook. & Taylor

Plants slender to robust. Primary stem stoloniferous, secondary stems simple or irregularly branched, ± erect or pendent. Leaves of secondary stems and branches similar, ovate, lanceolate or lingulate, acuminate to obtuse, margin entire, crenulate or sparsely dentate; laminal cells short, papillose; nerve nearly reaching the apex.

- 1 Laminal cells with one conical, low, rounded papilla (fig. 84, 12-13)

A. longifolius (Schleich. ex Brid.) Hartm.

Anomodontella longifolia (Schleich. ex Brid.) Ignatov & Fedosov

Plants slender. Stem with foliose pseudoparaphyllia, branches fasciculate or irregularly pinnate, often attenuated or flagelliform. Leaves ovate-lanceolate, longly acuminate. Forms yellowish green tufts on acidic or calcareous rocks and at base of trees, in beechwoods and oakwoods in the north of the Peninsula. Rare. Esp.

- 1 Laminal cells with 2-3, often branched papillae

2

- 2 Leaf apex acuminate, elongate in hyaline point (fig. 84, 14-15)

A. rostratus (Hedw.) Schimp.

* **Claopodium rostratum** (Hedw.) Ignatov

Stem profusely and irregularly branched, branches julaceous, erect. Leaves ovate-lanceolate, acuminate, less than 1,2 mm long. Forms dense, glaucous or yellowish green tufts on calcareous walls or vertical rocks and at base of trees in deciduous forests in montane areas, in northeastern part of the Peninsula. Esp.

- 2 Leaf apex obtuse, acute or apiculate, not elongate in hyaline point

3

- 3 Plants robust; secondary stems more than 2,5 mm wide when moist ; leaves more than 2 mm long (fig. 84, 16-17)

A. viticulosus (Hedw.) Hook. & Taylor

Secondary stems 6-8 cm long. Leaves with obtuse apex, rarely acuminate; laminal cells papillose. Forms erect to pendulous tufts on calcareous rocks and as an epiphyte in deciduous forests in montane areas, in the north and east of the Peninsula, very rare in the west, and in Mallorca. Esp, Prt, And, Bl.

- 3 Plants slender to medium-size; secondary stems up to 2 mm wide when moist; leaves less than 2 mm long (fig. 84, 18-19)

A. attenuatus (Hedw.) Huebener

* **Pseudanomodon attenuatus** (Hedw.) Ignatov & Fedosov

Secondary stems to 3 cm long, verticillate-like, often flagelliform. Leaves with obtuse apex, apiculate or not, margin often sparsely dentate near apex; apical cell smooth, long, translucent. Forms dense, dull yellowish green tufts on

basic soils or calcareous rocks and as an epiphyte in deciduous forests in montane areas, in the northeastern part of the Peninsula. Esp, And.

Claopodium (Lesq. & James) Renauld & Cardot

Plants small, creeping, slightly radiculose, irregularly branched. Stem leaves ovate-lanceolate, gradually longly acuminate, margin strongly dentate; laminal cells rhomboidal, 6-7 μm wide, usually 2:1, with a central papilla, marginal cells elongate, usually without chlorophyll; nerve nearly reaching apex. Branch leaves smaller and more shortly acuminate than stem leaves (fig. 84, 20-21) **C. whippleanum** (Sull.) Renauld & Cardot

Forms yellowish to dark green mats on shaded, acidic soil, slopes, banks, rocks and at tree bases. Scattered in the Peninsula. Esp, Prt.

GLOSSARY

- acrocarpous** Erect mosses producing perichaetia and later the sporophyte at the tip of the stem [fig. 29, 6].
- acumen** Long and tapering point forming an angle less than 45°.
- acuminate** Ending in an acumen [fig. A, 3].
- acute** Tapering to a point forming an angle 45°-90°, [fig. A, 3].
- alar cells** Cells at basal angles of leaf, which usually differ from other leaf cells in their shape or colour [fig. B, 4].
- androecium** Antheridia and surrounding bracts.
- annual** Moss that completes its life cycle in less than one year.
- annulus** One or more rings of differentiated cells between the urn and lid, which assist in the dehiscence, then peels off or remains attached to the capsule mouth.
- antheridium / antheridia (pl.)** Male reproductive organ containing the antherozoids.
- apical** At apex or tip; referring to the apex.
- apiculate** Ending in an apiculus [fig. A, 3].
- apiculus / apiculi (pl.)** Short abrupt point.
- apophysis / apophyses (pl.)** Swollen upper part of seta, beside the base of the capsule [fig. C, 3].
- appendiculate** Having short, thin, transverse projections, as on the cilia of the inner peristome in some species of *Bryum* [fig. 52, 16].
- applied** Close to the organ where it is inserted.
- appressed** Closely applied, as the leaves against the stem [fig. A, 1].
- archegonium / archegonia (pl.)** Female reproductive organ containing an ovum.
- arista / aristae (pl.)** Long, thin, rigid point.
- articulate** Having thickened transverse joints.
- articulation** The point of connection between two parts or rigid segments, usually thickened.
- ascending** Growing upwards from an older part applied to substrate.
- attenuate** Tapering gradually.
- auricle** Small, ear-like lobe at the basal margin of a leaf.
- autoicous** Monoicous plant, having archegonia and antheridia in separate inflorescences on the same plant [fig. C, 2].
- axil** The angle between a stem and the upper surface of a leaf or any other structure which is growing out of that stem.
- axillary** 1. Referring to the axil. 2. Located in an axil.
- axillary hair.** Uniseriate hair found in the leaf axils, generally inconspicuous and well concealed by the leaf bases [fig. 34, 11; 36,4].

basal At the base of a structure; referring to the base.

basal cells Cells at the base of leaf, located between the margin and the nerve [fig. B, 4].

basal membrane Cylindrical membrane at the base of the endostome of some mosses [fig. 44, 12].

bifurcate Forked into \pm equal halves.

bipinnate Twice-pinnately branched.

border Cells along a leaf margin that differ from other leaf cells in their shape, size, colour or wall thickening.

bordered Having a border [fig. B, 2].

bulbiform Resembling a bulb, as mosses with a very short stem and leaves concave and closely attached [fig. 33, 3].

bulbil Axillary propagule resembling a small bulb [fig. 55, 22].

caducous Falling off early.

calyptra A membranous covering of haploid tissue over the developing sporophyte [fig. C, 5].

campanulate Bell-shaped [fig. C, 5].

capitate Forming a head.

capitulum / capitula (pl.) Group of crowded, short branches on the tip of the stem of *Sphagnum* species [fig. 4, 9].

capsule Terminal part of the sporophyte, usually differentiated into *lid*, *urn* and *neck*.

carinate Longitudinally folded forming a keel [fig. C, 1].

central strand Longitudinal cylinder of small, thin-walled cells at the centre of the stem [fig. 73, 4].

channelled Groove-shaped, U-shaped in cross section [fig. C, 1].

chlorophyllose With chloroplasts.

ciliate Having cilia.

cilium / cilia (pl.) Fine hairs, usually unicellular and unbranched, at the margin of a structure or alternating with the segments of the endostome.

circinate Curved in a circle [fig. A, 2].

cladautoicous Monoicous plant, having archegonia and antheridia in separate branches.

clavate Club-shaped.

cleistocarpous Indehiscent capsule, that has no lid.

columella Central column of sterile tissue of the urn.

comal tufts A tuft of leaves at tip of a stem or branch [fig. 52, 14].

commisure In *Sphagnum*, the junction between hyaline cells and green cells [fig. 2, 7].

complanate Apparently, flattened into one plane, referring to leaf arrangement [fig. A, 1].

conduplicate Longitudinally folded along the middle, as *Fissidens* leaves [fig. 23, 9].

confluent Merging together.

conical Cone-shaped.

constricted Abruptly narrowed.

contorted Irregularly bent or twisted.

convolute Longitudinally rolled [fig. 34, 7].

cordate Heart-shaped [fig. B, 1].

cordiform Heart-shaped.

cortex Outermost layer or layers of cells of a stem or branch.

cortical Referring to the cortex.

corticolous Growing on bark.

crenulate With minute, rounded teeth along the margin [fig. B, 2].

cribrose Finely perforated [fig. 19, 14].

crisped Strongly curled and twisted.

cucullate Hood-shaped; in calyptra split along one side only; in leaves with the apex strongly concave and curved inwards [fig. C, 5].

cushion Life form with more or less erect, tightly clustered and radiating stems.

cuspidate Ending in a stout point; in stems and branches this point is formed by imbricate leaves [fig. A, 1; B, 3].

cyathiform Cup-shaped.

cygneous Strongly curved like the neck of a swan [fig. 20, 4].

cylindrical Cylinder-shaped, e.g. capsule in many species [fig. C, 3].

deciduous Falling off.

decumbent Prostrate but with ascending tips.

decurrent Anything which extends below its point of origin on a structure. Leaves with basal margins extending below the stem past the leaf insertion [fig. B, 1]; the hyaline point of a leaf extending down its margin.

dehiscent Capsule that opens regularly by means of a lid or valves.

dendroid Branched like a tree [fig. 60, 12].

dentate With teeth [fig. B, 2].

denticulate Finely dentate [fig. B, 2].

dentiform Shaped like a tooth.

denudate Stem with leaves worn away or lost.

depauperate Poorly developed.

dioicous Producing archegonia and antheridia on separate plants [fig. C, 2].

distal Away from the base or point of attachment (opposite of *proximal*).

distichous Leaves arranged in two opposite rows [fig. A, 1].

dorsal Said of the back or lower surface of a leaf (opposite of *ventral*).

ellipsoidal Solid with an elliptical outline [fig. C, 3].

elliptical Ellipse-shaped [fig. A, 2].

emarginate Broadly notched at apex.

emergent Referring to the capsule, only partly projecting beyond the tips of perichaetial leaves [fig. 48, 16].

endostome The inner peristome when the peristome is double [fig. 52, 16].

entire Smooth on the margin; lacking teeth.

ephemeral Short-lived.

epiphragm Membrane positioned horizontally over the capsule mouth and below the lid, disintegrating at maturity.

epiphyte A plant growing on another plant, usually a tree or a shrub.

epiphytic Growing on another plant.

erect Vertical [fig. A, 1].

erecto-patent Posture between erect and patent, leaves making an angle with the stem of 45° or less.

erose Margin irregularly notched or ragged, as if gnawed.

evanescent Vanishing or disappearing.

excavate Abruptly concave or hollowed out.

excurrent Nerve that extends beyond the leaf apex [fig. B, 3].

exostome The outer peristome when the peristome is double [fig. 52, 16].

exothecium The capsule epidermis or the outermost layer of cells in the capsule [fig. 18, 1].

exserted When the capsule is raised high above the perichaetial leaves [fig. 50, 8].

falcate Curved like a sickle.

falcate-secund Strongly curved and turned to one side.

falciform Sickle-shaped [fig. A, 2].

fascicle Cluster of branches originating at the same point on a stem [fig. 5, 12].

fasciculate Bunched together, in bundles or fascicles.

fibrillose With fibrils.

fibrils Fine, fibre-like wall thickenings of the *Sphagnum* hyaline cells [fig. 2, 3].

fimbriate Fringed, generally with radiating cell walls of partly eroded marginal cells [fig. 3, 9].

flexuose Slightly wavy, irregularly bent.

furrow Groove.

fusiform Spindle-shaped [fig. 49, 15].

gametophyte The haploid, gamete-producing generation; in bryophytes, the dominant generation.

geminate Arranged in pairs [fig. 56, 7].

gemma / gemmae (pl.) Propagulum globose, ellipsoidal, cylindrical or filamentous, uni- or pluricellular [fig. 34, 12; 24, 26; 41, 28].

gibbous Swollen or bulging on one side [fig. C, 3].

glabrous Not hairy, smooth.

glaucous Having a somewhat glaucous appearance or nature; becoming glaucous.

glaucous With a whitish, greyish, or bluish bloom.

globose Spherical [fig. C, 3].

gregarious Growing close together but not densely.

guide cells Cells with large lumen, thin-walled and longitudinally arranged, found in a median layer across the nerve of many mosses [fig. C, 1].

habit General appearance of a plant.

hair-point 1. Filiform appendix. **2.** Long, fine point often formed by the excurrent nerve.

hairy Covered by hairs, having abundant hairs.

high mountains Referring to land above c. 1800 m.

homomallous Pointing the same way.

humus Soil substratum forming by decomposing organic material.

hyaline cells Large, empty, water-storage cell as in leaves of *Sphagnum* and *Leucobryum* [fig. 2, 7].

hyaline Colourless and transparent or translucent.

hyaloderm Uni- or pluristratose cortex of comparatively large, thin-walled, colourless cells [fig. 2, 2; 2, 4].

hydrophilous Growing in or by water.

hygrophilous Growing in moist places.

imbricate Closely appressed and overlapping, like shingles on a roof [fig. A, 1].

immersed 1. Referring to a capsule exceeded by the perichaetial leaves [fig. 33, 25]. **2.** Referring to the stomata below the epidermis of capsule [fig. 48, 10].

imperforate Not pierced through.

inclined Capsules that are between the erect and horizontal positions [fig. C, 3].

incrassate Thick-walled.

incurved 1. Curved inward and upward; e.g., peristome teeth curved over the capsule mouth; **2.** Applied to a leaf margin curved towards the ventral side (opposed to *recurved*) [fig. C, 1].

indehiscent Lacking distinct opening mechanism; said of the capsule that, at maturity, opens by irregular rupture or wall breakdown [fig. 41, 3].

inflexed Bent upward (ventrally) and weakly inward; e.g., leaf margins or leaves on a stem bent or turned abruptly inward, or towards the stem, as some leaf apex.

innovation In some mosses, a branch formed below perianth.

insertion The point of attachment of a structure; applied to leaves and branches on a stem.

julaceous Stem or branch with cylindrical appearance, because of the strongly imbricate, concave leaves [fig. A, 1].

keeled Sharply folded along the middle, like the keel of a boat; V-shaped in cross section.

lamella / lamellae (pl.) 1. Small lamina. **2.** Ridges or plates along a leaf blade or nerve [fig. 8, 14]. **3.** In the genus *Bryum*, exostome enlargement joining the transverse articulations.

lamina / laminae (pl.) The flat blade of a leaf not including the nerve.

lanceolate Lance-shaped [fig. A, 2].

lax Loose, parts distant from each other.

leaf A photosynthetic, laminal outgrowth from the stem.

lenticular Shaped like a double-convex lens.

lid The cover of a moss capsule, which opens during the dehiscence [fig. C, 4].

linear Long, narrow and with parallel sides, applied to leaves and cells [fig. A, 2; B, 4].

lingulate Tongue-shaped [fig. A, 2].

lobate Divided into lobes.

lowlands Referring to land up to c. 800 m.

lumen / lumina (pl.) The cell cavity inside the cell walls.

macronema / macronemata (pl.) Large, branched, rhizoids produced around branch insertions and leaf axils.

mamilla / mamillae Protuberance from cell surface into which cell lumen projects.

mamillate Convex to hemispherical with a blunt central projection.

mamillose With mamillae [fig. B, 4].

margin The edge of a laminal structure.

marginal At the margin, especially as applied to a leaf.

mats A densely interwoven, horizontal growth form; e.g., *Brachythecium*, *Hypnum*.

median cells Cells located between the upper and lower parts of a leaf [fig. B, 4].

median Middle or central.

Mediterranean Region [fig. 1].

micronema / micronemata (pl.) Thin, sparsely branched rhizoids produced on stem between leaves.

mitriform Regularly lobed at base, referring to calyptra [fig. C, 5].

monoicous With antheridia and archegonia on the same plant [fig. C, 2], including *autoicous*, *paroicous* and *synoicous*.

montane areas Referring to land c. 800-1800 m.

mouth Opening of the capsule.

mucro A short, abrupt point.

mucronate Ending in mucro [fig. B, 3].

muticous Without arista, hair or hyaline point.

neck The sterile basal portion of a capsule [fig. C, 3].

nerve Longitudinal midrib of a leaf, always more than one cell thick.

nodulose Cell wall with short knob-like thickenings in the inner side.

oblate Wider than long, applied to cells [fig. 66, 27].

oblong Rectangular with rounded corners or ends, applied to cells and leaves [fig. A, 2 and B, 4].

obovate Egg-shaped with apex broader than base [fig. A, 2].

obovoid An obovate solid.

obtuse Broadly pointed, more than 90° [fig. A, 3].

operculate With a lid.

orbicular Circular in outline [fig. A, 2].

ovate Outline of an egg with base broader than apex [fig. A, 2].

ovoid An egg-shaped solid [fig. C, 3].

papilla / papillae (pl.) Small protuberance of a cell, by a local thickening of the cell wall [fig. B, 4].

papillose Having papillae.

paraphyllum / paraphyllia (pl.) Small, filiform or laminar outgrowths, sometimes branched, scattered on the stem [fig. 77, 2].

paraphysis / paraphyses (pl.) Hyaline, usually uniseriate, hair intermixed among antheridia or archegonia.

paroicous Monoicous plant with the antheridia just below the archegonia but in separated inflorescences [fig. C, 2].

patent In leaves, spreading from stem at an angle of 45° or more [fig. A, 1].

pedicellate Stalked.

pellucid Transparent or translucent.

pendulous Drooping and inclined like the capsules of *Bryum* [fig. C, 3].

percurrent Extending to the apex but not beyond [fig. B, 3].

perforate Pierced through.

perichaetial Referring to the perichaetia.

perichaetium / perichaetia (pl.) Cluster of ± modified leaves enclosing the archegonia.

perigonial Referring to the perigonium.

perigonium / perigonia (pl.) Cluster of ± modified leaves enclosing the antheridia [fig. 43, 15].

peristome A circular structure, generally divided into teeth, arranged in a single or double row around the mouth of the capsule [fig. 52, 16]. See also *endostome* and *exostome*.

persistent Not falling, remaining attached.

piliferous Having hair-point.

pinnate With numerous, spreading branches on opposite sides of the stem [fig. 76, 1].

pleurocarpous Moss with stems usually prostrate, producing perichaetia and sporophytes laterally [fig. 71, 5].

plica / plicae longitudinal furrow or pleat.

plicate With longitudinal furrows or pleats [fig. 63, 13].

plumose **1.** Closely and regularly pinnate. **2.** Feathery.

polyoicous Said of a species, in which there coexists the dioicous form with any type of monoicous form.

pore **1.** A small aperture in the wall of some cells; e.g., in leaf hyaline cells and hyalodermis of *Sphagnum* [fig. 2, 2-4]. **2.** In leaves, pit or hole in the wall opening to the wall of an adjacent cell [fig. B, 4].

porose Having pores [fig. B, 4].

primary stem The main stem, often creeping and prostrate or rhizome-like.

primordium / primordia An organ in its earliest stage of differentiation.

prismatic Shaped like a prism.

procumbent Laying flat on the ground but not attached by rhizoids.

propagule / propagules (pl.) Body serving for vegetative reproduction of the plant, with the appearance of a reduced bud, branch, or leaf [fig. 66, 22; 42, 3]. See also *bulbil* and *gemma*.

propaguliferous Having propagules.

prorate Having papillae or mamillae borne at the tips of cells, or formed by projecting cell ends [fig. B, 4].

prostome Rudimentary structure outside to the peristome, usually adherent to the teeth.

prostrate Lying flat on the ground; creeping.

protonema / protonemata (pl.) The juvenile stage of the gametophyte, a filamentous or thalloid structure resulting from spore germination.

proximal Near the base or point of attachment (opposed to *distal*).

pseudoparaphyllum / pseudoparaphyllia (pl.) Small, unistratose, filiform or foliose outgrowths, restricted to the areas of the stem around branch primordia or branch base [fig. 74, 17].

pseudopodium In *Sphagnum* and *Andreaea*, an elongation of the stem serving the function of a seta.

pyriform Pear-shaped [fig. C, 3].

radiculose Covered with rhizoids.

recurved 1. Curved downward and backwards. **2.** In leaves, referring to margins curved backwards (opposed to *incurved*).

reflexed Bent down and inwards, generally referring to leaf margins or leaves on a stem [fig. A, 1].

reniform kidney-shaped.

resorption Disappearance or erosion of parts of cell walls, e.g., the hyaline cells of *Sphagnum* leaves.

reticulate Forming a network.

retort cells In *Sphagnum*, elongated, flask-shaped, hyalodermis cells with a short projecting distal neck terminating in a pore [fig. 4, 2].

revoluble Rolling away, referring to an annulus that falls in a broken ring.

revolute Rolled downwards and backwards, referring to a leaf margin [fig. C, 1].

rheophilous Living in running water.

rhizoidal Referring to the rhizoids.

rhizoids Branched, root-like, slender filaments that arise from stem and usually anchor the gametophyte to the substratum.

rhizomatous Having a slender underground stem, horizontal and creeping.

rhizome A horizontal, subterranean stem giving rise to erect secondary stems.

rhomboidal Shaped like a rhombus [fig. B, 4].

ringed Having a thickened ring surrounding a pore; e.g., *Sphagnum*.

riparian Growing by rivers and streams.

rosette A compact cluster of leaves that surrounds the stem tip [fig. 54, 16].

rostellate Ending in a short point, like a small beak [fig. C, 4].

rostrate Narrowed into a slender, long point, like a long beak [fig. C, 4].

rudimentary Incompletely developed.

rugose With transverse wrinkles or undulations [fig. 79, 1].

saxicolous Growing on rocks.

scabrous Rough.

secondary stems Stems branching from primary stem.

secund Said of leaves or branches strongly turned to one side [fig. A, 1; 82, 11].

segment The main division of the endostome.

septate Having partitions.

septum / septa (pl.) Thin lamina dividing a cell [fig. 3, 13].

serrulate Minutely serrate.

sessile Without stalk.

seta / setae (pl.) Part of sporophyte holding the capsule.

setaceous Bristle-like.

sheath A widened leaf base that surrounds the stem [fig. 8, 13].

sheathing Surrounding and clasping the stem.

sigmoid Doubly curved in opposite directions, S-shaped [fig. 11, 2].

sinuose Wavy or uneven, applied to leaf margins or cell walls [fig. B, 4].

spathulate Spatula-shaped, narrow at base and gradually broad above [fig. A, 2].

spinose With sharp, pointed teeth; also very high, sharp leaf cell papillae or mamillae.

spinule / spinulae (pl.) Small spine.

spinulose Minutely spiny, having short, sharp teeth.

spore A unicellular, haploid reproductive body produced in the sporangium as a result of meiosis.

sporophyte The spore-bearing, diploid generation, remaining attached to the gametophyte.

spreading Leaf forming an angle of 45° or more with the stem [fig. A, 1].

squarrose Leaves spreading at right angles, strongly curved back at an angle of 90° or more [fig. A, 1].

stellate Star-shaped.

stem The main axis in mosses.

stereids Cells thick-walled and with small lumen found in groups (stereid bands) in the nerve or stem cortex of some mosses [fig. C, 1].

stolon Horizontal, main stem, having erect secondary stems or branches, arching and rooting at points touching the substrate.

stoloniferous Producing stolons.

stoloniform Referring to stoloniferous stems [fig. 84, 16].

stoma / stomata (pl.) Minute, epidermal opening of the capsule, usually at base, surrounded by two kidney-shaped cells. The Funariaceae have single cells with opening in the centre [fig. 48, 30].

stria / striae (pl.) Fine ridges or lines.

striate Having striae [fig. 21, 4].

strumose Capsule with a swelling (struma) at one side of its base [fig. C, 3].

sub- Prefix meaning “nearly”, “almost”, or “somewhat”.

subula / subulae (pl.) A conic, long, slender point. In leaves, it is often mainly occupied by the nerve.

subulate Ending in a subula [fig. A, 3].

sulcate Strongly plicate, with deep longitudinal furrows or grooves.

sulcus / sulci (pl.) A groove or furrow.

supra-alar cells Leaf cells immediately above the alar cells.

synoicous Monoicous plant with antheridia and archegonia mixed in the same inflorescence [fig. C, 2].

terricolous Growing on soil.

thalloid Flattened, resembling a thallus.

tomentose Woolly, densely radiculose.

tomentum / tomenta (pl.) A felt-like covering made up of abundant rhizoids.

tooth / teeth (pl.) **1.** Sharp, small projections on margin of leaf. **2.** The divisions of either a single peristome or of the exostome of a double peristome.

triangular In the shape of a triangle [fig. A, 2].

trigones Triangular or circular intracellular wall thickenings, found at the point where three or more cells meet.

tristichous With leaves arranged in 3 rows [fig. 21, 7].

truncate Abruptly cut off at the apex.

tuft Growth form with stems erect but radiating at the edges, e.g., *Orthotrichum*.

turbinate Shaped like a spinning top, narrow at base and wide above [fig. C, 3].

turf Growth form with stems erect, parallel and close together; often covering extensive areas.

turgid Plump or swollen.

urceolate Urn-shaped; applied to capsules constricted below a wide mouth and abruptly narrowed to the seta.

urn Spore bearing portion of a capsule [fig. C, 3].

vaginula Minute sheath surrounding the base of the seta, derived from the wall of the archegonium, remaining after the separation of the calyptra [fig. 48, 9].

ventral The upper leaf surface (opposed to *dorsal*).

ventricose Bulging on one side below.

vermicular Worm-shaped, long, narrow and wavy; usually applied to cells [fig. B, 4].

verrucose Warty or roughened.

wart A small, ± rounded elevation or protuberance.

warty Covered with small wart-like protuberances.

wefts A loosely interwoven, often ascending growth form, e.g. *Thuidium*.

xerophilous Growing in dry places.

COLLECTION, IDENTIFICATION AND PRESERVATION OF BRYOPHYTES

Collection. A suitable season for collecting bryophytes is subject to the geographical situation and the altitude of the studied area and always depends on humidity. The best moment is the day after a rainy day when the plants are spread and show best their macroscopic characters. Hygrophilous species can be found in good condition throughout the year. Saxicolous, epiphytic and terricolous species grow well in shaded and sheltered montane areas but when exposed and under long drought conditions (frequent in the Mediterranean region) they can appear damaged. Annual plants, which complete their cycle between winter and spring, are characteristic of exposed soils in the lowlands.

Specimens should be collected as complete as possible; the ideal would be sporophyte-bearing material but in the Iberian Peninsula many species are never or only rarely found with sporophytes. In those perennial species that thrive and spread by vegetative reproduction alone, whether by propaguliferous gemmae or by gametophytic fragmentation, usually the characters of the gametophyte are enough for identification. Annual species develop rapidly and always complete their life cycle; they should be collected with mature sporophytes for determination.

For bryophyte collecting a knife is very useful to remove specimens adhering to rock or bark. Also indispensable is a hand-lens of 8x or 10x magnification to verify if the sample collected is complete and in good condition, since good material is essential for successful determination. Each sample should be placed in a numbered paper packet for later study, with as much information as possible, especially locality, ecology, altitude and date, being written in a field notebook. After collection, material should be exposed on absorbent paper for drying.

Identification. For examination of dry material it is necessary to moisten the plant, when it will recover its natural form, after which the different parts can be separated for study. Bryophytes retain this facility of recovery from desiccation for a long time. For microscopical observation leaves or any other plant part should be placed on a microscope slide, a drop of water added and a cover-slip applied. Lactophenol (50% lactic acid and 50% phenol) is a recommended mounting medium since it clears the cytoplasm thus making it easier to observe such characters as cell shape and size, especially in nerve and stem sections.

Conservation and storage. Specimens are often small and it is advisable to place these in specially folded paper packets to avoid losing them. A numbered label with the identity of the specimen, its locality, ecology, altitude, collector's name, date and any other useful data, should be attached to the outer flap of the packet. For better conservation, the paper packets may be glued onto paper sheets which are taxonomically or alphabetically arranged, and placed in closed boxes, thus forming an herbarium. Most species have no conservation problems but some may be attacked by insects and for this reason periodic fumigation is recommended.

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Synonyms are in cursive type. An * placed next to a synonym indicates it is the accepted name in Hodgetts *et al.* (2020). An annotated checklist of bryophytes of Europe, Macaronesia and Cyprus, *Journal of Bryology*, 42:1, 1-116.

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