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A new key to the genus *Orthotrichum* Hedw. in Europe and the Mediterranean Region

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Abstract – An updated key for the identification of the 49 *Orthotrichum s.l.* taxa (45 species and 4 varieties) present in Europe, North Africa, Macaronesia and Western Asia, including the species in genus *Nyholmiella*, is provided. *Orthotrichum leblebicii*, described from Turkey, is synonymized with the Mediterranean *O. vittii.*

Bryophyta / Orthotrichaceae / *Nyholmiella* / Taxonomy / northern Africa / Macaronesia / western Asia

INTRODUCTION

In the course of the last two decades, bryological exploration of the Mediterranean basin and European areas subject to Mediterranean or sub-Mediterranean climate has contributed to the discovery of a relatively high number of new species and varieties within the genus *Orthotrichum* (Lara & Mazimpaka, 1993; Lara *et al.*, 1994a, 1996, 1999b, 1999c, 2000a; Mazimpaka *et al.*, 1999b; Draper *et al.*, 2003). In addition, some taxa have been reinstated (Mazimpaka *et al.*, 2000b; Cortini Pedrotti & Lara, 2001), and numerous chorologically relevant records have been published (Martínez-Abaigar *et al.*, 1995; Lewinsky-Haapasaari *et al.*, 1996; Mazimpaka *et al.*, 1997, 1999a, 2000a; Garilleti *et al.*, 1998, 1999, 2002; Heras & Infante, 1998; Sotiaux *et al.*, 1998; Lara *et al.*, 1999a, 2000b, 2001, 2003, 2004a, 2004b, 2008; Heylen & Walraevens, 2001; Papp & Sabovljevic, 2003; Akatova *et al.*, 2004; Blockeel, 2004; van der Pluijm, 2004; Bardat & Boudier, 2006; Draper *et al.*, 2006, 2008). Consequently the known range of many European species has been extended widely through the continent and the Mediterranean basin, even to areas where their presence formerly could not be expected. With the recent find of *O. consobrinum* Cardot in Turkey and Spain (Lara *et. al.*, in preparation), and the synonymization of *Orthotrichum leblebicii* Erdağ, Kürschner & Parolly (see below), the genus *Orthotrichum s. l.* now comprises a total of 45 species and 4 varieties in the study area, and in

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number of species it is one of the largest moss genera represented in Europe (Hill *et al.*, 2006) and surrounding territories.

For many years our research team has worked on a synthetic key of European and Mediterranean *Orthotricha.* The worldwide key for the genus by Lewinsky (1993) and that for Europe (Lewinsky-Haapasaari, 1995) are relatively recent and valuable contributions. However, they do not reflect the current state of knowledge of the genus in the Mediterranean. For recent changes, the key for Europe by Frey *et al.* (2006) is the most complete and updated one, but some taxa are not dichotomously treated. Other keys to this genus are available for Europe and surroundings (Pierrot, 1978; Lara *et al.*, 1994b, 2007; Cortini Pedrotti & Lara, 2001; Erdağ & Kürschner, 2002; Smith, 2004; Casas *et al.*, 2006), but all of them are partial and regionally circumscribed. After having tested a preliminary key distributed among several European colleagues some years ago, we now propose a new dichotomous key for the genus *Orthotrichum* in Europe, the Mediterranean basin and Macaronesia, with the aim of providing an easy identification tool that includes all the novelties, useful throughout this vast territory.

To make the identification easier, the new key has been organized into groups of species that share morphologically distinctive and taxonomically significant characters. It is an artificial grouping that does not pretend to reflect the phylogenetic relationships among taxa. Thus, for instance, all the species of Group II possess immersed stomata and are related to those of Group VII, but they have been preferably separated since they can be well discriminated by means of their gametophyte characters, and their separation makes the key easier to use. It is possible that a partial coincidence may eventually be found between the groups established here and the subgenera defined in *Orthotrichum* by Lewinsky (1993). The nomenclature follows Hill *et al.* (2006), with the exception of subgenus *Orthophyllum* Delogne, for which we follow the criteria of Goffinet *et al.* (2004) who treat it as genus *Nyholmiella* Holmen & Warncke *in* Damsholt *et al.* For bryological terms Magill (1990) has been followed. Descriptions and illustrations of the species can be found in Lewinsky-Haapasaari (1995, 1998) and, for recently described species, in the corresponding publications.

KEY TO THE EUROPEAN AND MEDITERRANEAN SPECIES OF *ORTHOTRICHUM S. L.*

1. Upper leaves with margins incurved or plane, sometimes slightly recurved in the middle or inferior part or only on one leaf side. . . . . **GROUP I**
1'. Upper leaves with both margins recurved in the greater part of their length 2

2. Leaves with the apex differentiated into a hyaline acumen or hair point, or broadly obtuse or rounded (sometimes additionally mucronate or dentate) . . . . . **GROUP II**
2'. Leaf apices not differentiated in this way, acuminate, acute or narrowly obtuse 3

3. Stomata phaneropore (superficial) 4
3'. Stomata cryptopore (immersed) 5

4. Capsules exserted (seta exceeding perichaetial leaves) . . . . . **GROUP III**
4'. Capsules immersed or emergent (seta totally concealed by the perichaetium) . . . . . **GROUP IV**

5. Capsules exserted (seta exceeding perichaetial leaves) . . . . . **GROUP V**
5'. Capsules immersed or emergent (seta totally concealed by the perichaetium) 6

6. Exostome teeth erect or patent when dry; capsules 16-ribbed (sometimes with 8 long and 8 short ribs), rarely with only 8 ribs . . . . . **GROUP VI**
6'. Exostome teeth recurved (touching the urn) when dry; capsules more or less strongly 8-ribbed . . . . . **GROUP VII**

GROUP I – Leaves with margins incurved or plane.

1. Leaves with margins plane, lanceolate, linear-lanceolate or ligulate, more or less flattened although keeled, with or without propagules. 2
1'. Leaves with margins incurved or involute, ovate-lanceolate or oblong and concave, with numerous propagules, especially on the adaxial leaf side 4

2. Leaves linear-lanceolate, with basal cells long rectangular, with thickened, sinuose walls; frequently with conspicuous and abundant brown propagules . . . . . ***O. lyellii***
2'. Leaves lanceolate or almost ligulate, with basal cells shortly rectangular, thin and scarcely or not sinuose-walled; propagules lacking 3

3. Endostome segments smooth, linear, up to 3/4 the teeth length; stomata broadly covered by exothecial cells; leaves acute, frequently sharply narrowed into a short acumen, straight or little flexuose when dry; lamina with scattered bistratose bands . . . . . ***O. consobrinum***
3'. Endostome segments striate, with wide base, up to 1/2 the teeth length; stomata little covered by exothecial cells; leaves with obtuse or acute apex, not sharply narrowed into a short acumen, flexuose and often contorted when dry; lamina entirely unistratose. . . . . ***O. microcarpum***

4. Leaf margins erect-incurved; upper leaf cells usually with a single central papilla, simple or apically branched, very rarely with 2 papillae; capsules emergent, with double peristome .. ***Nyholmiella obtusifolia*** (*O. obtusifolium*)
4'. Leaf margins involute; upper leaf cells with 2-3 papillae; capsules immersed, peristome lacking. . . . . ***Nyholmiella gymnostoma*** (*O. gymnostomum*)

GROUP II – Leaves with both margins recurved; apex differentiated into a hyaline acumen or broadly obtuse or rounded.

1. Leaves with hyaline acumen, formed by elongated cells 2
1'. Leaves without hyaline acumen, sometimes with 1 or 2 apical hyaline not elongated cells forming a minute apiculus 3

2. Hyaline acumen long and very conspicuous; leaf cells bulging and thin-walled; 16 exostome teeth whitish; capsules yellowish with faint or scarcely prominent ribs. . . . . ***O. diaphanum***

2'. Hyaline acumen short (less than 0. 4 mm), sometimes little visible; leaf cells not bulging and more or less thick-walled; exostome with 8 pairs of orange teeth that in old capsules can split partially and become irregularly recurved; capsules orange with well marked and prominent ribs . . . . . ***O. vittii***

3. Leaves broadly lanceolate, at least some apices clearly dentate; plants robust, larger than 1 cm, growing on tree bases, roots and rocks subject to periodic floods . . . . . ***O. rivulare***
3'. Leaves oblong, ovate-oblong or ovate-lanceolate, apices not dentate, sometimes papillose-crenulate, mucronate or not; plants smaller, less than 1 cm, growing in diverse environments 4

4. Upper leaf cells 16-24 μm in diameter, smooth or almost so, often bulging on both sides; some leaf apices clearly mucronate due to 1(2) protruding cells; mosses growing on substrata subject to periodic floods . . . . . ***O. sprucei***
4'. Upper leaf cells 10-14 μm in diameter, more or less papillose, not bulging; leaf apices not mucronate, although sometimes with a distal prominent papilla; epiphyte mosses from xerophytic habitats 5

5. Leaves oblong or oblong-lanceolate, clearly concave; mosses having a compact habit, especially when young 6
5'. Leaves lanceolate, with oblong base and rest of lamina ligulate, fairly concave; mosses having a gracile (not compact) habit . . . . . **group VII**

6 Endostome segments densely papillose; capsules not or scarcely constricted below mouth when dry, exothecium pale yellowish with orange ribs; capsule mouth star-shaped when dry (zenithal view) . . . . . ***O. macrocephalum***
6' Endostome segments smooth; capsules more or less constricted below mouth when dry, exothecium uniformly brown; capsule mouth ring-shaped when dry (zenithal view) . . . . . ***O. crenulatum***

GROUP III – Leaves with both margins recurved; apices acuminate, acute or narrowly obtuse. Stomata phaneropore; capsules exserted.

1. Peristome almost lacking (only some basal exostomial cells present); capsule mouth puckered when dry, constricted by short brown or blackish ribs . . . . . ***O. ibericum***
1'. Peristome well developed, capsules with mouth open when dry, exothecium smooth or with ribs not closing the mouth when dry 2

2. Exostome teeth erect or patent when dry; endostome segments rudimentary or absent in capsules just after dehiscence . . . . . ***O. laevigatum***
2'. Exostome teeth recurved (touching the urn) when dry; endostome segments well developed in capsules just after dehiscence, although in some cases short and easily falling off. 3

3. Endostome segments broad (each as wide as a tooth of each exostome pair), oblong and with the margins sinuous or irregular; capsules smooth or with fine ribs, narrowly cylindrical or long fusiform when dry. . . . . ***O. vladikavkanum***
3'. Endostome segments slender, linear and with entire margins; capsules ribbed, although sometimes shortly so, cylindrical when dry, sometimes shortly so . . 4

4. Endostome segments clearly ornamented; capsules long cylindrical, ribs usually little marked in the upper half, leaves acuminate . . . . . ***O. speciosum*** var. ***speciosum***

4'. Endostome segments smooth or slightly papillose; capsules more or less long cylindrical or oblong, with well marked ribs in the upper half or in their whole length; leaves usually broadly acute 5

5. Exostome teeth entire, not lacunose; endostome segments short and deciduous, capsules short or long cylindrical, sulcate in the upper half, with the neck almost as long as the urn and longitudinally plicate when dry . ***O. pylaisii***

5'. Exostome teeth cancellate and fenestrate; endostome segments long and persistent; capsules oblong or shortly cylindrical, strongly sulcate along their whole length, with the neck shorter than the urn and usually not plicate when dry . . . . . ***O. sordidum***

GROUP IV – Leaves with both margins recurved; apices acuminate, acute or narrowly obtuse. Stomata phaneropore; capsules immersed or emergent.

1. Peristome formed by remains of exostome teeth or only by endostome segments; capsules fusiform, sulcate in the upper part by short but well marked ribs, with the mouth puckered and more or less close when dry. 2

1'. Peristome with exostome teeth well developed; capsules cylindrical, oblong or ovate, smooth or variably sulcate, with the mouth open when dry. 3

2. Capsules immersed or scarcely emergent, with 8 endostome segments incurved, thick and papillose on both sides; leaves long acuminate with elongate apical cells. . . . . ***O. acuminatum***

2'. Capsules broadly emergent, only some basal exostome cells present, endostome lacking; leaves acuminate or acute, with apical cells elliptic or rounded. . . . . ***O. ibericum***

3. Exostome teeth erect or patent when dry, translucent and glossy; leaves almost always with bistratose areas or bands in the upper half of lamina . . ***O. rupestre***

3'. Exostome teeth recurved (touching the urn) when dry, opaque and dull; leaves entirely unistratose 4

4. Exostome of 16 independent teeth, uniformly recurved when dry. 5

4'. Exostome of 8 persistent teeth pairs or with the teeth pairs splitting and irregularly recurved when dry 6

5. Endostome of 16 segments thick, strongly papillose, with the margins irregular; exostome teeth entire, not lacunose, densely papillose; leaves frequently long acuminate; capsules smooth. . . . . ***O. striatum***

5'. Endostome lacking or with remains of 8 smooth segments; exostome teeth lacunose, tending to split along the median line, with scattered thick papillae and lines; leaves acute; capsules with short ribs, more or less marked near the mouth . . . . . ***O. shawii***

6. Exostome teeth pairs splitting after the detachment of the lid, recurved and irregularly twisted and sometimes overlapping when dry (fragile and most frequently broken in old capsules); cell portions of exostome teeth ornamented by radial lines; capsule mouth star-shaped when dry (zenithal view); lid usually plane at base . . . . . ***O. tortidontium***

6'. Exostome teeth in 8 persistent pairs, if tending to split, then teeth not twisted irregularly when dry; exostome papillose or with irregular lines, rarely with radial lines; capsule mouth ring-shaped when dry; lid usually convex at base.. 7

7. Calyptrae densely hairy; capsules long cylindrical, not or scarcely constricted below mouth when dry; exostome teeth revolute when dry, touching the capsule only by the tips . . . . . ***O. speciosum*** - 8

7'. Calyptrae sparsely hairy; capsules ± oblong or shortly cylindrical, usually constricted below mouth when dry; exostome teeth recurved and usually appressed against the urn when dry. 9

8. Capsules semi-emergent, with the ribs well marked along the whole urn length; seta shorter than capsule; mature calyptrae oblong-conic, with green-yellowish hairs; forming compact cushions in Mediterranean thermophilic woods . . . . . ***O. speciosum*** var. ***brevisetum***

8'. Capsules fully emergent, usually with ribs marked only in the upper urn half; seta equal to or longer than capsule; mature calyptrae conic or fusiform, with golden or discoloured hairs; generally forming loose cushions in Eurosiberian or Mediterranean mountainous woods . . . . . ***O. speciosum*** var. ***speciosum***

9. Capsules sulcate in the upper half, short or long cylindrical, with the neck as long as the urn and longitudinally plicate when dry; endostome segments short and deciduous . . . . . ***O. pylaisii***

9'. Capsules strongly sulcate along the urn whole length, oblong or shortly cylindrical, with the neck shorter than the urn and usually not plicate when dry; endostome segments long and persistent 10

10. Exostome teeth fenestrate at the apex, often also partially perforate along the median line, with the apical third differentially ornamented (more openly papillose and with scattered lines); endostome segments smooth or slightly reticulate-papillose. . . . . ***O. sordidum***

10'. Exostome teeth entire, often with a cancellate aspect due to apical thickenings, but not or very rarely lacunose, without perforations in the median tooth line, nor differential ornamentation in the apical third; endostome segments clearly ornamented by thick lines and/or papillae . . . . . ***O. affine***

GROUP V – Leaves with both margins recurved, apices acuminate, acute or narrowly obtuse. Stomata cryptopore; capsules exserted.

1. Exostome teeth recurved (touching the urn) when dry, leaves flexuose, sometimes moderately contorted when dry, epiphytic mosses 2

1'. Exostome teeth erect or patent when dry; leaves erect, not contorted when dry; saxicolous or more rarely epiphytic mosses 3

2. Peristome pale yellow; exothecial bands 4-5 cells wide; stomata confined to the inferior capsule half; calyptrae usually covering entirely the capsule, oblong-conic, yellowish and clearly plicate . . . . . ***O. consimile***
2'. Peristome reddish-orange; exothecial bands 2(3) cells wide; stomata mostly in the upper capsule half; calyptrae not covering the capsule base, campanulate, smooth or hardly plicate and frequently with brown longitudinal stripes . . . . . ***O. pulchellum***

3. Capsules orange, oblong-cylindrical or cylindrical, not or scarcely constricted below mouth when dry, usually long exserted; mosses growing on dry calcareous rocks, and less frequently on siliceous rocks or as an epiphyte . . . . . ***O. anomalum***
3'. Capsules brown, oblong or ovate-oblong, clearly constricted below mouth when dry, hardly exserted; mosses growing only on rocks in arctic zones, or on river and stream banks 4

4. Leaves oblong-ligulate, generally partially bistratose in the upper part, often with a glaucous appearance due to the presence of abundant and branched tall papillae; capsules usually 8-striate, endostome lacking or formed by rudimentary segments; vaginula with few, sparsely papillose hairs; mosses from arctic environments. . . . . ***O. pellucidum***
4'. Leaves oval-lanceolate to oblong-lanceolate, unistratose, greenish, not glaucous; capsules usually conspicuously 16-striate; endostome with segments well developed and usually coloured; vaginula naked; mosses growing in riparian environments from temperate areas . . . . ***O. cupulatum*** var. ***riparium***

GROUP VI – Leaves with both margins recurved, apices acuminate, acute or narrowly obtuse. Stomata cryptopore; capsules immersed or emergent. Exostome teeth erect or patent when dry.

1. Leaves totally or partially bistratose in the upper third 2
1'. Leaves unistratose, at most with some bistratose bands scattered in the upper part 3

2. Leaves oblong-ligulate with obtuse apex, often very papillose; capsules broadly emergent, usually 8-ribbed; exostome teeth with abundant thick papillae; vaginula with some papillose hairs; gametophytes dull green; mosses growing in arctic environments . . . . . ***O. pellucidum***
2'. Leaves broadly lanceolate or oval-lanceolate and subacute, scarcely papillose; capsules immersed to semi-emergent, 16-ribbed (8 ribs usually weak and shorter); exostome teeth predominantly striate, more rarely smooth; vaginula naked; gametophytes blackish; mosses growing in Mediterranean environments. . . . . ***O. cupulatum*** var. ***bistratosum***

3. Spores large, diameter 37-43 μm . . . . . ***O. urnaceum***
3'. Spores smaller, diameter less than 25 μm. 4

4. Vaginula with long papillose hairs; leaves acute or shortly acuminate . . . . . ***O. urnigerum***
4'. Vaginula naked or with some short hairs, leaves obtuse or broadly acute . . . 5

5. Leaves oblong-ligulate, glaucous due to tall and branched papillae; capsules usually 8-ribbed; vaginula hairy; mosses growing in arctic environments ..... ***O. pellucidum***

5'. Leaves lanceolate to oblong-lanceolate, greenish or rarely glaucous due to presence of papillae; capsules usually 16-ribbed; vaginula naked; mosses growing in various environments ..... ***O. cupulatum* p. p.** - 6

6. Calyptrae naked or almost so; endostome segments well developed and coloured; capsules broadly emergent ..... ***O. cupulatum*** var. ***riparium***

6'. Calyptrae more or less hairy; segments lacking or short and hyaline; capsules immersed or variously emergent 7

7. Capsules small and rounded; exostome teeth densely covered by thick papillae ..... ***O. cupulatum*** var. ***fuscum***

7'. Capsules large, ovate or pyriform; exostome teeth striate or papillose-striate ..... ***O. cupulatum*** var. ***cupulatum***

GROUP VII - Leaves with both margins recurved, apices acuminate, acute or narrowly obtuse. Stomata cryptopore; capsules immersed or emergent; exostome teeth recurved when dry.

1. Endostome wheel-shaped, with broad segments fused in the upper third forming an annular structure ..... ***O. callistomum***

1'. Endostome segments linear, free in the upper third (sometimes irregularly connected by thin transverse appendices) 2

2. Mosses hydrophilic, growing on substrata periodically flooded; leaves broadly lanceolate, with the apex blunt and dentate; plants robust, 1-2 cm tall ..... ***O. rivulare***

2'. Mosses xerophytic, mostly growing in dry environments; leaves narrowly lanceolate or with ovate base and the rest of lamina ligulate, and the apex acute or obtuse, rarely with some lateral teeth; plants in general less than 1 cm tall (except *O. handiense*) 3

3. Exothecial bands 2(3) cells wide; capsules not or scarcely constricted below mouth when dry and empty 4

3'. Exothecial bands 4 or more cells wide; capsules more or less constricted below mouth when dry and empty 5

4. Pairs of exostome teeth easily splitting each into two when recurved; endostome of 16 segments (sometimes the intermediate reduced), often appendiculate; capsules pale-yellow; vaginula naked; some leaves with apex sinuate, dentate or channeled..... ***O. scanicum***

4'. Pairs of exostome teeth remaining fused when recurved; endostome of 8 non-appendiculate segments; capsules brown-orange, rarely pale brown; vaginula generally with some long hairs; leaf apex acute, with margin entire .. ***O. patens***

5. Endostome with at least some segments completely erect when dry, slightly ornamented by striae at base; plants with dimorphic branches; leaves of female branches with broadly oval base and lamina ligulate, with margins recurved for the greater part of their length; leaves of male branches smaller, with the base little widened, and margins plane or little recurved in the middle; capsule neck very long . . . . . ***O. rogeri***

5'. Endostome with the segments incurved when dry, smooth or papillose, without striae at base; plants with branches and leaves similar; capsule neck short or long 6

6. Stomata confined to the middle and upper capsule half, if all in the middle, then some almost uncovered to half covered by slightly thick-walled exothecial cells 7

6'. Stomata mostly in the lower capsule half, if all in the middle, then broadly covered by strongly thick-walled, often prominent, exothecial cells 12

7. Exostome teeth pairs early splitting after the fall of the lid, irregularly recurved when dry; endostome of 16 strongly papillose segments. Leaves lanceolate, not differentiated at the apex; capsules yellowish, broadly emergent and strongly constricted below mouth when dry; lower stomata usually broadly covered by exothecial cells . . . . . ***O. hispanicum***

7'. Exostome teeth pairs regularly recurved and not splitting (except in very old capsules); other characters not occurring in the same combination 8

8. At least some leaves sharply narrowed into a short and acute acumen consisting of green, not differentiated cells; calyptrae with a few thick and papillose hairs; endostome segments yellowish or orange . . . . . ***O. philibertii***

8'. Leaves gradually narrowed into an obtuse or acute apex; calyptrae naked (rarely with some thin and short, smooth or scarcely papillose hairs); endostome segments almost always hyaline 9

9. Upper leaves mostly with oval base and linear or ligulate lamina; endostome usually of 16 segments, the intermediate often shorter, even vestigial; all stomata scarcely covered by exothecial cells 10

9'. Upper leaves lanceolate or oblong-lanceolate, sometimes almost elliptic and sharply narrowed in the upper part into a short ligulate lamina; endostome of 8 segments; stomata little to half covered by exothecial cells 11

10. Endostome of 16 segments of equal length, linear and strongly incurved when dry; exostome teeth ornamented in the lower half by a thin reticulum, from which some papillae hardly protrude; capsule base ventricose, sharply contracted into seta; leaf apex concave-carinate, often cucullate when dry . . . . . ***O. casasianum***

10'. Endostome of 8 long main segments and 8 intermediate clearly shorter and less incurved, sometimes rudimentary segments; exostome teeth ornamented in the lower half by thick, somewhat prominent and dense papillae; capsule gradually contracted into seta; leaf apex plane, not cucullate when dry . . . . . ***O. pallens***

11. Capsule ovoid or pyriform when moist, sharply contracted into seta; segments broad at base, 1/2 to 3/4 as long as the exostome teeth; stomata scarcely covered by exothecial cells . . . . . ***O. schimperi***

11'. Capsule oblong-cylindrical when moist, gradually contracted into seta; segments linear, almost as long as the exostome teeth; at least some stomata half-covered 12

12. Capsules with ribs marked only in the upper half; exostome teeth fused in pairs only at base and irregularly recurved when dry; lid conic-mammillate; endostome clearly papillose; mosses robust, 1-2 cm tall, Canarian endemic . . . . . ***O. handiense***

12'. Capsules with ribs well marked in their whole length; exostome teeth pairs remaining intact and regularly recurved when dry; lid rostrate, plane or convex at base; endostome smooth or ornamented by scarcely visible lines or papillae; mosses smaller and slender; in general less than 1 cm tall, widely distributed 13

13. Some leaves with the apex narrowed into a channelled apiculus formed by the involute margins or with only one margin erect-incurved, the other leaves obtuse or dentate; vaginula naked; propagules frequent on old leaves; calyptrae with papillose hairs concentrated in the apical zone . . . ***O. tenellum***

13'. Leaves acute, the apex not differentiated in this way; vaginula hairy or naked; propagules infrequent; calyptrae naked or with papillose hairs scattered throughout their surface, rarely concentrated in the apical zone 14

14. Exostome teeth with dense papillae in the lower part and the upper part striate-papillose, less densely ornamented; endostome segments frequently with transverse thickenings; leaf papillae usually tall and frequently branched; calyptrae with thick and papillose hairs, in general also strongly papillose on the plicae . . . . . ***O. alpestre***

14'. Exostome teeth uniformly papillose, ornamentation of the upper part not contrasting with that of the lower part; endostome segments rarely with transverse thickenings; leaves variously papillose; calyptrae smooth or very slightly papillose, naked or with thin and scarcely papillose hairs. 15

15. Vaginula with long and papillose hairs; calyptrae hairy, capsule neck long defluent . . . . . ***O. stramineum***

15'. Vaginula without long and papillose hairs, naked or with abundant, short and smooth hairs; calyptrae naked or with a few short and scattered hairs; capsule neck short, not exceeding 1/3 of the urn length 16

16. Vaginula usually with abundant short and smooth hairs; mature capsules with exothecial bands brown-reddish in the upper third, conspicuously contrasting with the rest of exothecium; stomata usually covered by broadly prominent exothecial cells; upper leaves lanceolate. . . . . ***O. stellatum***

16'. Vaginula naked; mature capsules with brown exothecial bands whose colour does not contrast with the rest of exothecium; stomata usually surrounded by scarcely prominent exothecial cells; upper leaves oblong-lanceolate or broadly lanceolate, sometimes almost elliptic with the upper part sharply narrowed into a short ligulate lamina . . . . . ***O. pumilum***

Taxonomical note

Orthotrichum leblebicii Erdağ, Kürschner & Parolly was recently described from material from Southern Turkey (Erdağ *et al*., 2004), and characterized as a moss having leaves similar to those of *O. diaphanum* Schrad. *ex* Brid. and *Orthotrichum vittii* F. Lara, Garilleti *et* Mazimpaka, but with superficial stomata. Re-examination of the type material of *Orthotrichum leblebicii* (AYDN 1141!) has shown that it actually coincides with *O. vittii* in all its characters. As for the stomata, they are sometimes apparently superficial in the Turkish material, but the degree of cover in *O. vittii* varies from the typically immersed form to stomata so little covered that they may appear superficial. Therefore a synonymization of *Orthotrichum leblebicii* with *O. vittii* is here proposed.

Orthotrichum vittii F. Lara, Garilleti *et* Mazimpaka *in* Lara *et al*., *The bryologist* 102: 53. f. 1-22. 1999.

Orthotrichum leblebicii Erdağ, Kürschner *et* Parolly, *Nova Hedwigia* 78. f. 1-2: 518. 2004, **syn. nov.**

ALPHABETIC LIST OF THE TAXA INCLUDED IN THE KEY

Genus *Orthotrichum* Hedw.

O. acuminatum H. Philib.
O. affine Schrad. *ex* Brid.
O. alpestre Bruch *et* Schimp.
O. anomalum Hedw.
O. callistomum Fisch.-Oost. *ex* Bruch *et* Schimp.
O. casasianum F. Lara, Garilleti *et* Mazimpaka
O. consimile Mitt.
O. consobrinum Cardot
O. crenulatum Mitt.
O. cupulatum Hoffm. *ex* Brid.
var. ***bistratosum*** Schiffn.
var. ***fuscum*** (Venturi) Boulay
var. ***riparium*** Huebener
O. diaphanum Schrad. *ex* Brid.
O. gymnostomum Bruch *ex* Brid. (*vide sub Nyholmyella*)
O. handiense F. Lara, Garilleti *et* Mazimpaka
O. hispanicum F. Lara, Garilleti *et* Mazimpaka
O. ibericum F. Lara *et* Mazimpaka
O. laevigatum J.E. Zetterst.
O. lyellii Hook. *et* Taylor
O. macrocephalum F. Lara, Garilleti *et* Mazimpaka
O. microcarpum De Not.
O. obtusifolium Brid. (*vide sub Nyholmyella*)
O. pallens Bruch *ex* Brid.
O. patens Bruch *ex* Brid.
O. pellucidum Lindb.
O. philibertii Venturi

O. pulchellum Brunt.
O. pumilum Sw. *ex* anon.
O. pylaisii Brid.
O. rivulare Turner
O. rogeri Brid.
O. rupestre Schleich. *ex* Schwägr.
O. scanicum Grönvall
O. schimperi Hammar
O. shawii Wilson
O. sordidum Sull. *et* Lesq.
O. speciosum Nees
var. ***brevisetum*** F. Lara, Garilleti *et* Mazimpaka
O. sprucei Mont.
O. stellatum Brid.
O. stramineum Hornsch. *ex* Brid.
O. striatum Hedw.
O. tenellum Bruch *ex* Brid.
O. tortidontium F. Lara, Garilleti *et* Mazimpaka
O. urnaceum Müll. Hal.
O. urnigerum Myrin
O. vittii F. Lara, Garilleti *et* Mazimpaka
O. vladikavkanum Venturi

Genus *Nyholmiella* Holmen & Warncke

N. gymnostoma (Bruch *ex* Brid.) Holmen *et* Warncke
N. obtusifolia (Brid.) Holmen *et* Warncke

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