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A synopsis of the Italian bryophyte vegetation

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Abstract – A compilation of the bryophyte *syntaxa* known to date from Italy is presented. The 135 associations and 28 subassociations are included in 19 alliances, 42 orders and 12 bryosociological classes. All the *syntaxa* reported were critically revised from the nomenclatural and syntaxonomical point of view. In the syntaxonomical scheme, for higher phytosociological units (classes, orders and alliances), the ecological features are summarized. The synonyms used in Italy and the characteristic and differential species of each syntaxon are also included. Finally, the distribution of each association and subassociation in the Italian administrative regions is given using the numerical references assigned to the corresponding bibliographic source in References.

Bryophytes / Italy / phytosociology / synsystematics / syntaxonomy

INTRODUCTION

The first bryosociological studies in Italy date back to the middle of the twentieth century and are mostly based on the research carried out by Giacomini, who first studied the bryophyte vegetation applying the phytosociological method (Giacomini 1939, 1950). After a few additional papers on bryophyte vegetation, poorly significant from a phytosociological point of view, no other study was carried out in Italy for almost thirty years. Then investigations started again and have considerably increased since 1990.

The most significant studies regard some important naturalistic areas, i.e. the Italian Alps, the Circeo National Park (C Italy), the Aspromonte massif (S Italy), Mt Etna, as well as peculiar ecosystems such as coastal dunes, badlands, fumaroles, urban and aquatic ecosystems. The aim of this paper was to revise and assemble all recent and old bryosociological studies in order to update the available data and provide an overview on the Bryophyte vegetation of Italy.

In the last years Vegetation Science has evolved to accommodate a complete set of information on plant communities and, therefore, gained the value and significance of an ecological model that contributes many tools for nature conservation initiatives. Thus, similarly to vascular plant sociology, it was considered indispensable to gather all the available bryosociological data into a synsystematical scheme.

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THE ITALIAN BRYOPHYTE VEGETATION

The bryophyte vegetation of Italy is represented by 135 phytosociological associations referred to 12 phytosociological classes. Many associations are well-known in Central Europe with radiations towards Southern Europe, and are characterized by species with wide distribution areas. Among these, we quote some alpine and subalpine associations, found on the high areas of the most elevated Italian mountain ranges. The Mediterranean associations are equally important and mostly occur in Southern Italy and Sicily; they are mainly referred to the phytosociological class *Barbuletea unguiculatae*.

Barbuletea unguiculatae is a terricolous, thermophytic and mostly basophytic class including 41 associations in Italy and referred to all the orders and alliances validly described to date. In Italy they are located mainly in the lowland and hilly belt and only occasionally in the montane belt, in natural and especially anthropic and urban areas. Some examples are found among the associations of the alliance *Grimaldion fragrantis*, such as *Barbuletum convolutae*, which is typical of beaten pathways; *Lunularietum cruciatae*, widespread in gardens and green areas; *Didymodonto vinealis-Tortuletum muralis* on urban walls, as well as the associations of *Phascion cuspidati*, such as *Riccio crystallinae-Sphaerocarpetum michelii*, also occurring in gardens and uncultivated areas. Within this class it is worth emphasizing the occurrence, in some strongly xeric areas of Calabria and Sicily, of the associations of *Tortulo brevissimae-Aloinetalia bifrontis* that exhibits Mediterranean, Irano-Turanian and Saharo-Arabian ranges.

The presence of the acidophytic and orophilous classes *Ceratodonto purpurei-Polytrichetea piliferi* and *Cladonio digitatae-Lepidozietea reptantis*, mostly occurring on the Italian Alps and the high areas of Mt Etna, is also significant. In particular, the former class includes associations rich in bryochamephytes (overwintering on the substrate), that typically grow on loose, dry and scarcely humified soils, while the latter includes associations that colonize moist and strongly humified substrates. As regards the class *Ceratodonto purpurei-Polytrichetea piliferi* the most widespread association is *Racomitrio-Polytrichetum piliferi*, the less orophilous is *Polytricho piliferi-Bartramietum strictae*, a Mediterranean association occurring in Italy only on Mt Etna. The class *Cladonio digitatae-Lepidozietea reptantis*, despite including many associations described on different substratum types, is today poorly represented in Italy. For this class we quote the Mediterranean montane alliance *Pohlion crudae*, described from some high montane areas of Mt Etna.

Another terricolous class including sciophytic syntaxa, is *Pleurochaeto squarrosae-Abietinelletea abietinae*, which is represented in Italy by its two alliances: the Central-European *Abietinellion abietinae*, signaled only in the Italian Alps (Giacomini, 1950), and the Mediterranean-Atlantic *Homalothecio aurei-Pleurochaetion squarrosae*, which is mainly distributed in Sicily.

The terri-saxicolous, montane and alpine class *Hylocomietea splendentis* comprises associations typically found in the undergrowth of montane and alpine woods. In Italy it is only represented by the climacic association *Pleurozietum schreberi*, recorded in the Lombardy and Trentino Alto Adige regions.

The saxicolous bryophyte vegetation is represented by the acidophytic class *Grimmietea alpestris* and the basophytic classes *Grimmietea anodontis*, *Ctenidietea mollusci* and *Neckeretea complanatae*. Within the class *Grimmietea alpestris* the most common association is the thermophytic *Grimmietum commutato-campestris*, which represents the first stage of bryophyte colonization

on acid rocks; its presence in the North of the Peninsula is an example of a Northern radiation of a thermophytic syntaxon. Conversely, the occurrunce in Sicily of the association *Racomitrio heterostichi-Grimmietum donnianae*, referred to the alliance *Andreaeion rupestris*, represents the southernmost radiation of this alpine alliance in the Mediterranean region.

The class *Grimmietea anodontis* is represented in Italy by xerophytic and markedly xerophytic associations, growing in natural or urban and anthropic areas at low altitudes; in Italy it is more uniformly distributed from north to south than the mesophytic and meso-hygrophytic *Ctenidietea mollusci*, the last reported only from Sicily and northern Italy. The class *Neckeretea complanatae* includes mesophytic to hygrophytic associations which, unlike the class *Ctenidietea mollusci*, grow on different types of substrates (rock outcrops, bark) rich in humus in areas with high air humidity. The most widespread association is *Anomodonto viticulosi-Leucodontetum sciuroidis*, occurring in northern and central Italy and sporadically in Sicily.

The class *Platyhypnidio-Fontinaletea antipyreticae* groups pioneer hydrophytic and hygro-hydrophytic, permanently submerged or more often amphibian associations. The associations of the order *Leptodictyetalia riparii* are widely represented in Italy, unlike the montane and subalpine associations of the order *Hygrohypnetalia*. The most widespread association is *Oxyrrhynchietum rusciformis*, an anphibian community colonizing rocky surfaces covered or washed by running water.

The class *Frullanio dilatatae-Leucodontetea sciuroidis* includes the strictly epiphytic associations, among which *Syntrichietum laevipilae* and *Leptodonto smithii-Leucodontetum sciuroidis* are widely represented in Italy.

Finally, the most particular bryosociological class is the endemic *Campylopodetea vaporarii*, described in Brullo *et al*. (2004) and validly published in Privitera & Puglisi (2006). The associations of this class are found in some fumarole stands of Ischia and Pantelleria Islands where they grow in sites with microenvironmental conditions of the tropical type. They are characterized by the occurrence of endemic and tropical species, *i.e. Rhynchostegium strongylense* (Bott.) Buck *et* Privitera, *Trematodon longicollis* and *Calymperes erosum*, the last one occurring in Europe only in some fumaroles of Pantelleria (Privitera & Puglisi, 2009).

Bryosociological research has not been uniformly performed in the Italian regions. Some regions have been extensively studied, while many others have been less prospected, and others (such as Liguria, Tuscany, Molise and Puglia) not at all. This discontinuity is due to the limited number of Italian bryosociological researchers and also because the study of the vegetation has been considered outdated even by botanists. Nevertheless, the phytosociological study has recently been revalued for its use in conservation and ecological fields. In fact, the study of bryophyte communities of a territory also provides useful information about the state of naturalness and health of the territory.

Sicily is the Italian region that is bryosociologically most investigated. Many typically xero-thermophytic Mediterranean as well as mountain bryophyte communities have been found there. The Italian Alps have been fairly studied mainly due to the interesting research carried out by Giacomini (1939, 1950, 1953), even though these data need an update. Conversely, some central and southern regions have been scarcely investigated or not investigated at all, and in the future we will mainly concentrate our studies in these territories with the purpose of filling the current gaps.

As regards the syntaxa reported in this paper, *Barbuletea unguiculatae* is the most represented class, since it includes a great number of associations widespread in the Mediterranean region. The class *Frullanio dilatatae-Leucodontetea sciuroidis* is quite widespread throughout Italy, although its reports are fewer than those of *Barbuletea unguiculatae*. Conversely, several higher units (class or order) are still poorly or only locally known in Italy. Among these we quote the ecologically very wide class *Cladonio digitatae-Lepidozietea reptantis*, which we consider much more frequent in Italy than currently known, particularly in the temperate region. Likewise, in the same bioclimatic region the climacic communities of the class *Hylocomietea splendentis*, to date represented in Italy only by *Pleurozietum schreberi*, must be further searched for in the mountain and alpine territories in the forests undergrowth. As for the class *Platyhypnidio-Fontinaletea antipyreticae*, the order *Hygrohypnetalia* is also scarcely known in Italy and further investigations in the high mountain cold streams are needed to assess its extension in the country. Among the narrowly distributed syntaxa the class *Grimmietea alpestris* has many associations that have been only reported from Mt Etna, although they are also expected to occur on the high Italian mountain ranges. Finally, the class *Ceratodonto purpurei-Polytrichetea piliferi*, reported only from the extreme north and south of Italy, could be more widespread on loose and dry soil of mountain areas.

Despite the research so far carried out in Italy, much work is still needed in order to have a complete range of the bryophyte communities. Therefore, this study intends to encourage further investigations throughout the Peninsula, considering that the phytosociological approach can be very useful also for the management of natural resources. Currently, these data are being increasingly requested for the application of international environmental Conventions and, in particular, the implementation of the Habitats Directive and the Management of the Natura 2000 Network in Italy.

SYNTAXONOMICAL SCHEME FOR ITALY

The following syntaxonomical scheme exclusively reports bryophyte *syntaxa* and does not include the bryo-chormophytic phytosociological units. All the *syntaxa* reported to date from Italy were revised from a nomenclatural and synsystematic point of view according to the International Code of Phytosociological Nomenclature (Weber *et al*., 2000). Some *syntaxa*, reported as communities in the original bibliography or referred to invalid associations were validly recognized and here referred to legitimately accepted *syntaxa* (the related references are marked in the scheme with an asterisk *). Moreover, some bryophyte communities not referable to any valid association, have not been here reported for requiring further investigation. For the synsystematic and syntaxonomy we mostly followed Marstaller (2006). The nomenclature of the species follows Hill *et al*. (2006) for mosses and Ros *et al*. (2007) for liverworts and hornworts.

In the scheme we report the synonyms used in Italy, including some additions to Marstaller (2006) and some ascriptions of old phytosociological data to associations today validly recognized.

For each of the higher phytosociological units (alliances, orders and classes), a summary of the ecological affinities is included between [ ] square brackets. The synonyms used in Italy are given between ( ) round brackets. For each syntaxon, the characteristic and differential species are indicated too.

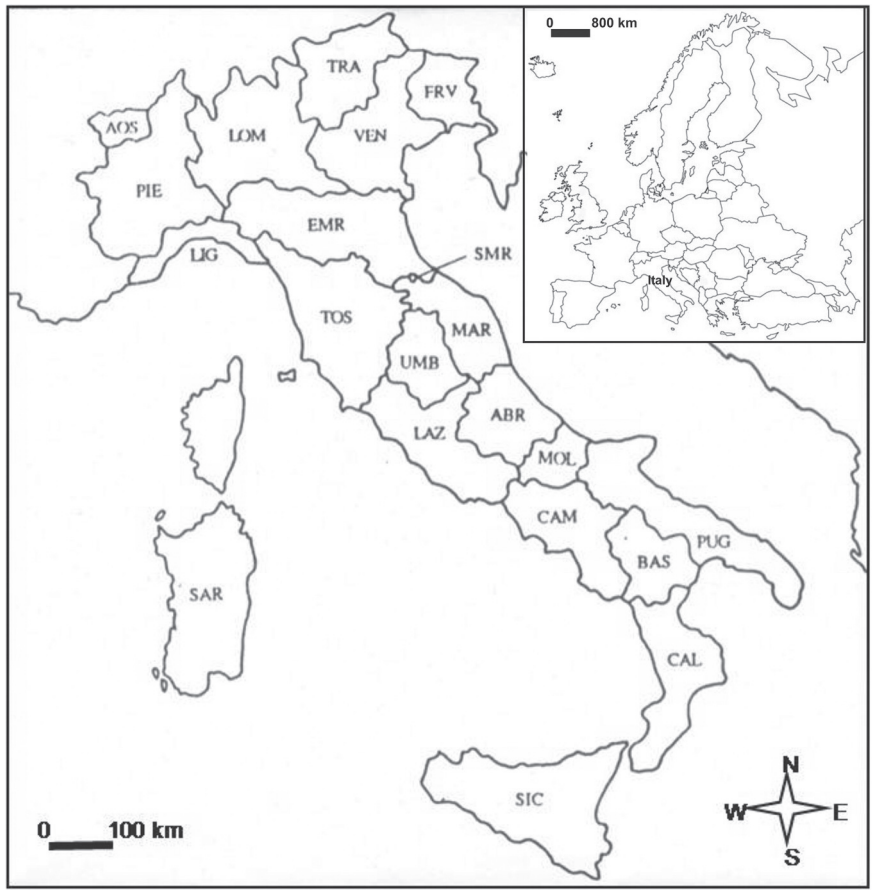

Fig. 1. The administrative regions of Italy.

For each association and subassociation, the distribution in the Italian administrative regions together with the corresponding bibliographic data is reported. The Italian regions are designated with the following abbreviations, from north to south: AOS Val d'Aosta; PIE Piemonte; LOM Lombardia; TRA Trentino Alto Adige; VEN Veneto; FRV Friuli Venezia Giulia; LIG Liguria; EMR Emilia Romagna; TOS Toscana; MAR Marche; UMB Umbria; LAZ Lazio; ABR Abruzzo; MOL Molise; CAM Campania; PUG Puglia; BAS Basilicata; CAL Calabria; SAR Sardegna; SIC Sicilia (Fig. 1); the numbers alongside each abbreviation between [ ] brackets correspond to the corresponding references.

PLATYHYPNIDIO-FONTINALETEA ANTIPYRETICAE Philippi 1956

(Syn.: *Fontinaletea antipyreticae* v. Hübschmann 1957)
Brachythecium rivulare, *Chiloscyphus polyanthos, Dichodontium pellucidum, Hygroamblystegium fluviatile, Platyhypnidium ripariodes*
[Epilithic, aquatic to amphiphytic]

HYGROHYPNETALIA Krajina 1933
(Syn.: *Brachythecietalia plumosi* Philippi 1956)
Schistidium agassizii, S. platyphyllum, S. rivulare, Hygrohypnum molle, H. eugyrium, H. styriacum, Marsupella emarginata, Plagiothecium platyphyllum, Scapania subalpina
[In cool and acid waters of montane to alpine belts]

RACOMITRION ACICULARIS v. Krusenstjerna 1945
(Syn.: *Scapanion undulatae* Philippi 1956)
Fissidens pusillus, Jungermannia pumila, Racomitrium aciculare, Scapania undulata
[In montane and subalpine belts]

- *Scanietum undulatae* Schwickerath 1944
  Scapania undulata (*Marsupella emarginata, Fontinalis squamosa var. squamosa, Nardia compressa*)
  – *typicum* - CAL [**7**; **46**; **67**], SIC [**4**; **39**; **53**]
  – *fontinalietosum antipyreticae* Philippi 1956 - TRA [**68*** sub *Scapanietum undulatae* subass. *fontinalietosum antipyreticae* Schmidt 1993 nom. illeg.]
  D: *Fontinalis antipyretica*

LEPTODICTYETALIA RIPARII Philippi 1956
(Syn.: *Fontinalietalia antipyreticae* v. Hübschmann 1957)
Hygroamblystegium tenax, Hygrohypnum luridum, Leptodictyum riparium, Oxyrrhynchium speciosum. D: *Fontinalis antipyretica*
[In warm and neutral to basic waters of lowland and hilly areas]

PLATYHYPNIDION RUSCIFORMIS Philippi 1956
(Syn.: *Rhynchostegion riparioidis* Waldheim *ex* v. Hübschmann 1957)
[In running waters or splashed areas, moderately sciophytic]

- *Oxyrrhynchietum rusciformis* Gams *ex* v. Hübschmann 1953
  (Syn.: *Platyhypnidietum ripariodis* Gams *ex* v. Hübschmann 1953 *nom. mut.*)
  Platyhypnidium riparioides
  – *typicum* - TRA [**68**], MAR [**8**; **9**], UMB [**9**; **13**], CAL [**7**;**46**], SIC [**39**; **41**; **47**; **53**; **59**; **60**]
  – *thamnobryetosum alopecuri* v. Hübschmann 1967 - SIC [**41**; **53**]
  D: *Thamnobryum alopecurum*
  – *scapanietosum undulatae* Marstaller 1987 – TRA [**68**]
  D: *Scapania undulata*
  – *cratoneuretosum commutati* Schmidt 1993 – TRA [**68**]
  D: *Palustriella commutata*

FONTINALION ANTIPYRETICAE W. Koch 1936
[In slow-flowing waters, mesotrophic to eutrophic]

- *Fontinaletum antipyreticae* Kaiser *ex* Frahm 1971 – SAR [**55**], SIC [**39**; **53**; **59**]
  (Syn.: *Fontinaletum antipyreticae* Kaiser 1926 *nom. nud.*)
  Fontinalis antipyretica

CINCLIDOTION FONTINALOIDIS Philippi 1956
(Syn.: *Cinclidoto-Fissidention crassipedis* v. Hübschmann 1957)
Bryum gemmiparum, *Cinclidotus riparius, Fissidens crassipes* subsp. *crassipes*, *F. rufulus, Hyophila involuta*
[In fast-flowing water, photophytic]

- *Cinclidotetum fontinaloidis* Gams *ex* v. Hübschmann 1953 – SIC [**30**; **39**; **47**; **53**]
  (Syn.: *Fissidenti-Cinclidotetum riparii* Allorge *ex* v. Hübschmann 1967, *Fissidenti-Cinclidotetum riparii* Allorge 1921 *nom. inval.*)
  Cinclidotus fontinaloides

- *Cinclidotetum aquatici* Philippi 1956 – TRA [**68**]
  Cinclidotus aquaticus
- *Leptodictyo riparii-Fissidentetum crassipedis* Allorge *ex* Philippi 1956 – SIC [**47**; **53**; **59**; **39**** sub *Leskeo-Leptodictyetum riparii* (v. Krusenstjerna 1945) v. Hübschmann 1957]
  Fissidens crassipes subsp. *crassipes*, *Leptodictyum riparium*
- *Hyophiletum ehrenbergii* v. Hübschmann *ex* Marstaller 1987 – SIC [**39**; **59**; **60**]
  (Syn.: *Hyophiletum eherenbergii* v. Hübschmann 1957 *nom. inval.*)
  Barbula bolleana
- *Cinclidoto fontinaloidis-Dialytrichietum mucronatae* Giacomini 1950 – FRV [**19**; **23**]
  Dialytrichia mucronata, Stegonia latifolia

BRACHYTHECION RIVULARIS Hertel 1974
Brachythecium rivulare, Didymodon spadiceus
[In fast-flowing water, from the lowland to the alpine belt]

- *Brachythecio rivularis-Hygrohypnetum luridi* Philippi 1965
  Brachythecium rivulare
  (Syn.: *Brachythecietum rivularis* Herzog ex Walther 1969)
  – *typicum* – TRA [**68**]
  – *amblystegietosum riparii* Marstaller 1987 – SIC [**47**]
  D: *Leptodictyum riparium*

CERATODONTO PURPUREI-POLYTRICHETEA PILIFERI Mohan 1978

Ceratodon purpureus, Pohlia nutans, Polytrichum piliferum
[Pioneer, terricolous, meso-xerophytic and xerophytic, mostly photophytic, acidophytic, oligotrophic, on sandy and gravely soil of montane areas]

POLYTRICHETALIA PILIFERI v. Hübschmann 1975
[See class]

CERATODONTO PURPUREI-POLYTRICHION PILIFERI Waldeim *ex* v. Hübschmann 1967
Ceratodon purpureus, *Racomitrium canescens* subsp. *canescens*, *R. elongatum*
(*Ceratodonto-Polytrichion piliferi* Šmarda 1947 *nom. illeg.*)
[Strongly oligotrophic, cryophytic to mesothermophytic]

- *Racomitrio-Polytrichetum piliferi* v. Hübschmann 1967
  Polytrichum piliferum
  – *typicum* – SIC [**40**; **47**; **53**; **63**]
  – *pleuridietosum acuminati* Privitera 1990 – SIC [**40**; **53**]
  D: *Pleuridium acuminatum*
  – *racomitrietosum canescentis* Privitera & Puglisi 1996 – PIE [**19**** sub *Racomitrietum canescentis* Giacomini 1950 nom. illeg.], SIC [**47**; **53**]
  D: *Racomitrium canescens* subsp. *canescens*
- *Politricho piliferi-Racomitrietum ericoidis* Privitera *et* Puglisi 1996 – SIC [**47**; **53**]
  Racomitrium ericoides
- *Polytricho piliferi-Bartramietum strictae* Héras-Ibánez, Ros *et* Guerra 1989 – SIC [**47**; **53**]
  Bartramia stricta

• *Polytrichetum juniperini* Krusenstjerna 1945 – LOM [**18***sub *Polytrichum alpinum-Polytrichum juniperium*-Ass.]
Polytrichum juniperinum

RACOMITRION LANUGINOSI v. Krusenstjerna 1945
[Post-pioneer, terri-saxicolous, on stony or gravelly soil]

• *Racomitrietum lanuginosi* v. Krusenstjerna 1945 – SIC [**47**; **53**]
Racomitrium lanuginosum
(Syn.: *Racomitrietum aetnensis* Privitera *et* Puglisi 1996)

CAMPYLOPODION POLYTRICHOIDIS Giacomini 1950
Campylopus atrovirens, C. fragilis, C. pilifer subsp. *pilifer, C. subulatus*
[Scarcely oligotrophic, thermophytic, adapted to warm microsites, on soil and rocks covered by soil]

• *Campylopodetum polytrichoidis* Giacomini 1950 – LOM [**19**; **23**]
C. pilifer subsp. *pilifer*

CLADONIO DIGITATAE-LEPIDOZIETEA REPTANTIS
Ježek *et* Vondrácek 1962

Anastrophyllum minutum, Cephalozia bicuspidata, Cephaloziella hampeana, Diplophyllum obtusatum, Jungermannia leiantha, Lophocolea heterophylla, Lophozia ventricosa, Mnium hornum, Plagiothecium denticulatum var. denticulatum, P. laetum, P. piliferum, Pohlia elongata var. elongata, Scapania crassiretis, S. lingulata, S. mucronata, Sematophyllum demissum, Tritomaria exsecta, T. exsectiformis
[Humicolous, humo-epilithic, epiphytic, sapro-lignicolous, acidophytic, mesophytic, hygrophytic or hygro-hydrophytic, in hilly to alpine belt]

DIPLOPHYLLETALIA ALBICANTIS Philippi 1963
Bartramia ithyphylla, Cephaloziella massalongi, C. phyllacantha, C. stellulifera, Pohlia proligera, P. annotina, P. crudoides, Pseudotaxyphyllum elegans, Scapania helvetica, S. scandica
(Syn.: *Dicranelletalia heteromallae* Philippi 1956)
[Humicolous, humo-epilithic, post-pioneer]

DICRANELLION HETEROMALLAE Philippi 1963
Atrichum undulatum, Dicranella heteromalla, D. subulata, Ditrichum heteromallum, D. lineare, D. pusillum, Diplophyllum obtusifolium, Jungermannia gracillima, Lophozia bicrenata, Pellia neesiana, Pohlia drummondii, P. lutescens, Scapania curta
[Terri-humicolous, mesophytic, in hilly to montane belt]

• *Eurhynchietum praelongi* Nörr 1969 – LAZ [**54**]
Kindbergia praelonga

• *Pogonatetum aloidis* v. Krusenstjerna *ex* Philippi 1956 – LAZ [**54**], SIC [**39**; **53**]
Pogonatum aloides

• *Scapanio compactae-Polytrichetum juniperini* Privitera 1990
Scapania compacta, D:Polytrichum juniperinum
- *typicum* - SIC [**40**; **53**]
- *bryetosum alpini* Privitera 1990 – SIC [**40**; **53**]
D: *Bryum alpinum*

• *Schistostegetum osmundaceae* Giacomini 1939 – LOM [**18**; **23**]
Schistostega pennata

• *Fossombronio angulosae-Phaeocerotetum bulbiculosi* Guerra, Gil *et* Varo 1981 – LAZ [**54**]
Fossombronia angulosa, Phymatoceros bulbiculosus

DIPLOPHYLLION ALBICANTIS Philippi 1956
Cynodontium bruntonii, C. polycarpon, Diplophyllum albicans, Heterocladium heteropterum
[Humo-epilithic, mesophytic, sciophytic, in montane belt]

• *Bartramietum pomiformis* v. Krusenstjerna 1945 – SIC [sub *Bartramietum pomiformis* v. Krusenstjerna ex v. Hübschmann 1967: **40**; **47**; **53**]
Bartramia pomiformis

• *Rhabdoweisietum fugacis* Schade *ex* Neumayr 1971 – LOM [**18*** sub *Rhabdoweisia fugax*-Ass.], SIC [**47**; **53**]
Rhabdoweisia fugax

• *Mnio horni-Bartramietum hallerianae* Marstaller 1984 – LOM [**18*** sub *Hypnum cupressiforme-Bartramia halleriana*-Ass.; **19**; **23**]
Bartramia halleriana

• *Mielichhoferietum nitidae* Giacomini 1939
Mielichhoferia mielichhoferiana
– *typicum* – LOM [**18**]
– *dicranelletosum heteromallae* Giacomini 1939 – LOM [**18**]
D: *Dicranella heteromalla*

POHLION CRUDAE Privitera *et* Puglisi 1996
Brachytheciastrum collinum, Isopterygiopsis pulchella, Pohlia cruda, P. elongata var. *elongata*
[Terri-humicolous, mesophytic, sciophytic to markedly sciophytic, in montane to alpine belt]

• *Pohlietum crudae* Privitera *et* Puglisi 1996
Pohlia cruda
– *typicum* – SIC [**47**; **53**]
– *timmietosum bavaricae* Privitera *et* Puglisi 1996 – SIC [**47**; **53**]
D: *Timmia bavarica*

• *Bartramietum ithyphyllae* v. Krusenstjerna 1945 – LOM [**23**], SIC [sub *Pohlio crudae-Bartramietum ithyphyllae* Privitera *et* Puglisi 1996: **47**; **53**]
Bartramia ithyphylla

• *Pohlio crudae-Amphidietum mougeotii* Privitera *et* Puglisi 1996 – SIC [**47**; **53**]
D: *Amphidium mougeotii*

• *Pohlio annotinae-Brachythecietum velutini* Privitera *et* Puglisi 1996 – SIC [**47**; **53**]
Brachytheciastrum velutinum var. *velutinum*

CLADONIO DIGITATAE-LEPIDOZIETALIA REPTANTIS
Ježek *et* Vondrácek 1962
Blepharostoma trichophyllum, Callicladium haldadianum, Cladonia digitata, Cephalozia catenulata, C. connivens, C. leucantha, C. lunulifolia, Dicranum fuscescens, Lepidozia reptans, Lophozia incisa, *Plagiothecium laetum*
[Lignicolous (epixilic and saprolignic), sciophytic, in deadwood]

TETRAPHIDION PELLUCIDAE v. Krusenstjerna 1945
Barbilophozia attenuata, Bazzania tricrenata, B. trilobata, Dicranodontium asperulum, D. denudatum, Dichodontium pellucidum, Dicranum flexicaule, Kurzia sylvatica, Leucobryum glaucum, Odontoschisma denudatum, Tetraphis pellucida

[Lignicolous, saprolignic, on tree bases and shallow roots in deadwood with advanced stages of decay]

• *Aulacomnietum androgyni* v. Krusenstjerna 1945 – LAZ [**54**]
Aulacomnium androgynum

DICRANETALIA SCOPARII Barkman 1958
Callicladium haldanianum, Hypnum andoi
[Epiphytic, sciophytic, post-pioneer to climacic]

DICRANO SCOPARII-HYPNION FILIFORMIS Barkman 1958
Dicranum montanum, D. scoparium, Dicranoweisia cirrata, Hypnum cupressiforme var. *filiforme, Ptilidium pulcherrimum*
[Air mesophytic, on mid-trunks, subcontinental]

• *Dicrano scoparii-Hypnetum filiformis* Barkman 1949 – LOM [**18***sub *Dicranum scoparium*-Ass.]
Dicranum scoparium, Hypnum cupressiforme var. *filiforme*

ISOTHECION MYOSUROIDIS Barkman 1958
Isothecium myosuroides
[Hygrophytic, on tree bases, subatlantic]

• *Mnio horni-Isothecietum myosuroidis* Barkman 1958 – SIC [**31**]
Isothecium myosuroides

DICRANELLETALIA CERVICULATAE v. Hübschmann 1957
Dicranella cerviculata
[Turficolous, on mineralized peat]

DICRANELLION CERVICULATAE v. Hübschmann 1957
[See order]

• *Dicranello cerviculatae-Campylopodetum pyriformis* Herzog *ex* v. Hübschmann 1957 – LOM [**18**; **23**]
Campylopus pyriformis, Dicranella cerviculata

PLEUROCHAETO SQUARROSAE-ABIETINELLETEA ABIETINAE
Marstaller 2002

[Terricolous and humicolous, basophytic, photophytic, on deep and often limestone soil]

PLEUROCHAETO SQUARROSAE-ABIETINELLETALIA ABIETINAE Marstaller 2002
Pleurochaete squarrosa, Syntrichia papillosissima, S. ruralis var. *ruraliformis.* D: *Syntrichia calcicola, S. ruralis* var. *ruralis*
[See class]

ABIETINELLION ABIETINAE Giacomini 1950
[Photophytic, on silty-limestone soil, climacic vegetation dominated by pleurocarpous mosses]

- *Abietinelletum abietinae* Stodiek 1937 – AOS [**19**], PIE [**19**], LOM [**19**], FVG[**19**], VEN [**19**]
  Abietinella abietina, Homalothecium lutescens, Hypnum cupressiforme var. *lacunosum, Rhythidium rugosum, S. ruralis* var. *ruraliformis*
  (Syn. *Abietinelleto abietinae-Pleurochaetetum squarrosae* Giacomini 1950)

HOMALOTHECIO AUREI-PLEUROCHAETION SQUARROSAE
(Ros *et* Guerra 1987) Marstaller 1993
Cheilothela chloropus, Homalothecium aureum, Rhynchostegium megapolitanum, Scleropodium touretii, Scorpiurium circinatum, Tortella humilis
[Thermophytic, on sandy-calcareous and quite loose soil, post-pioneer vegetation with Mediterranean-atlantic distribution]

- *Pleurochaeto squarrosae-Tortuletum ruralis* Brullo, Lo Giudice *et* Privitera 1991 – SAR [**55**], SIC [**47**; **53**; **59**; **60**; **66**]
  Syntrichia ruralis var. *ruralis*
- *Tortello inclinatae-Tortuletum ruraliformis* Brullo, Lo Giudice *et* Privitera 1991 – VEN [**5**], EMR [**5**]
  Syntrichia ruralis var. *ruraliformis, Tortella inclinata* var. *inclinata*
- *Rhynchostegietum megapolitani* Puglisi 1995 – CAL [**58**], SIC [**29**; **45**; **47**; **49**; **53**; **56**]
  Rhynchostegium megapolitanum
- *Homalothecio aurei-Pleurochaetetum squarrosae* Ros & Guerra 1987 – SIC [**27**]
  Homalothecium aureum
- *Pleurochaeto squarrosae-Cheilotheletum chloropodis* Privitera *et* Puglisi 1996 – SIC [**29**; **47**; **53**]
  Cheilothela chloropus
- *Selaginello denticulatae-Timmielletum barbuloidis* Cano, Ros *et* Guerra 1997
  Selaginella denticulata, Timmiella barbuloides
  – *typicum* – LAZ [**54**], CAL [**51**], SIC [**62**]
  – *fissidentetosum taxifolii* Privitera *et* Puglisi 2009 – LAZ [**54**]
  D: *Fissidens taxifolius subsp. taxifolius*
- *Scorpiurietum circinati* Giacomini 1950
  Scorpiurium circinatum
  – *typicum* – FVG [**19**], VEN [**19**]
  – *homalietosum lusitanicae* Giacomini 1950 – FVG [**19**]
  D: *Homalia lusitanica*

HYLOCOMIETEA SPLENDENTIS Marstaller 1992

[Terricolous, humicolous, on deep soil, sciophytic, climacic vegetation, in montane to alpine belt]

HYLOCOMIETALIA SPLENDENTIS Gillet *ex* Vadam 1990
Hylocomiastrum umbratum, Plagiochila asplenioides, Plagiomnium affine, Rhytidiadelphus squarrosus, R. triquetrus, Thuidium tamariscinum
[See class]

PLEUROZION SCHREBERI v. Krusenstjerna 1945
Hylocomium splendens, Pseudoscleropodium purum, Pleurozium schreberi.
D: *Barbilophozia barbata, Dicranum scoparium, Polytrichastrum alpinum, P. formosum, Tritomaria quinquedentata*

[Acidophytic, humicolous, mesophytic to meso-hygrophytic, climacic vegetation]

- *Pleurozietum schreberi* Winiewski 1930 – LOM [**18***** sub *Hylocomium triquetrum-Hylocomiun proliferum-Hylocomium schreberi*-Ass.], TRA [**3**]
  Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis

BARBULETEA UNGUICULATAE Mohan 1978

Barbula unguiculata, Bryum dichotomum, B. gemmilucens, B. ruderale, Didymodon fallax, Riccia sorocarpa var. *sorocarpa*
(Syn.: *Barbuletea unguiculatae* v. Hübschmann 1967 *nom. inval.*)

[Pioneer on superficial soil, terricolous, thermophytic, photophytic, basophytic to subneutrophytic, with xerophytic tendence, on natural or disturbed soil]

BARBULETALIA UNGUICULATAE v. Hübschmann 1960

Aloina ambigua, Didymodon acutus, D. luridus, D. vinealis, Fissidens viridulus var. *viridulus, Entosthodon pulchellus, E. muhlenbergii, Microbryum curvicollum, M. starckeanum, Pseudocrossidium hornschuchianum, Timmiella anomala, Trichostomum brachydontium, T. crispulum*

[Xerophytic and meso-xerophytic, on naked soil or protosoil, widespread in Southern and Central Europe]

GRIMALDION FRAGRANTIS Šmarda *et* Hadàc 1944

Bryum gemmiferum, B. radiculosum, Didymodon cordatus, Encalypta vulgaris, Mannia fragrans, Phascum cuspidatum var. *cuspidatum, P. cuspidatum* var. *piliferum, Pottiopsis caespitosa, Protobryum bryoides, Tortula lanceola, Pseudocrossidium replicatum, Weissia controversa* var. *controversa*
(Syn. *Phascion mitraeformis* Waldheim 1944, *Pleurochaetion squarrosae* Neumayr 1971)

[Oligotrophic, xerophytic, on dry and basic soil, mostly in disturbed sites]

- *Barbuletum convolutae* Hadàc *et* Šmarda 1944 – LAZ [**54**], SIC [**1**; **21**; **26**; **32**; **47**; **49**; **53**; **56**; **60**; **62**]
  Barbula convoluta var. *convoluta, Didymodon acutus, Protobryum bryoides*
- *Trichostomo crispuli-Aloinetum aloidis* Guerra *et* Varo 1981 – CAL [**51**], SIC [**21**; **27**; **29**; **47**; **53**; **59**; **60**; **62**; **66**]
  Aloina aloides, Trichostomum crispulum
- *Weissietum tortilis* Neumayr 1971
  Weissia condensa var. *condensa*
  – *typicum* – SIC [**32**; **47**; **49**; **53**; **62**]
  – *pottietosum crinitae* Lo Giudice & Privitera 1989 – SIC [**32**; **47**; **53**]
  D: *Tortula viridifolia*
- *Tortelletum inclinatae* Stodiek 1937 – LOM [**19*** sub *Abietinello abietinae-Pleurochaetetum squarrosae* Giacomini 1950 *tortelletosum inclinatae* Giacomini 1950], SIC [**47**; **53**]
  Tortella inclinata
- *Weissietum controversae* Marstaller 1988 – SIC [**47**; **53**; **56**]
  Weissia controversa var. *controversa*
- *Didymodonto vinealis-Tortuletum muralis* Privitera *et* Puglisi 1996 – LAZ [**54**], CAL [**51**], SIC [**16**; **21**; **27**; **47**; **48**; **49**; **53**; **56**; **59**; **60**; **62**]
  D: *Tortula muralis*
- *Riccietum atromarginato-lamellosae* Ros *et* Guerra 1987 – SIC [**1**; **29**; **53**]
  Riccia lamellosa, R. atromarginata

- *Astometum crispi* Waldheim 1947 – LAZ [**54**], SIC [**29**; **53**]
  Weissia brachycarpa, W. longifolia
- *Aloinetum rigidae* Stodiek 1937 – SIC [**26**; **53**]
  Aloina rigida
- *Tortuletum revolventis* Marstaller 1980 – SIC [**27**; **37**; **38**; **53**]
  Tortula revolvens
- *Trichostomo brachydontii-Didymodonetum vinealis* Privitera *et* Puglisi 1989
  Trichostoum brachydontium. D: *Didymodon vinealis*
  – *typicum* – LAZ [**54**], CAL [**58**], SIC [**31**; **43**; **53**; **60**]
  – *cheilotheletosum* Privitera *et* Puglisi 1989 – SIC [**43**; **53**]
  D: *Cheilothela chloropus, Bryum dichotomum*
- *Lunularietum cruciatae* Giacomini 1950 – LOM [**19**], SIC [**21**; **26**; **27**; **35**; **53**; **56**; **60**; **62**]
  Lunularia cruciata
- *Crossidio squamiferi-Aloinetum aloidis* Gil 1997 – CAL [**51**], SIC [**27**]
  D: *Crossidium squamiferum* var. *squamiferum*
- *Tortulo subulatae-Syntrichietum ruralis* Cano, Ros, Guerra *et* Garcìa-Zamora 1999 – SIC [**21**]
  D: *Syntrichia ruralis* var. *ruralis, Tortula subulata*

PHASCION CUSPIDATI Waldheim *ex* v. Krusenstjerna 1945
Acaulon muticum, Anthoceros punctatus, Bryum gemmilucens, B. rubens, B. violaceum, B. subapiculatum, B. tenuisetum, Ephemerum minutissimum, E. serratum, Fossombronia mittenii, Phascum cuspidatum var. *cuspidatum, Riccia glauca* var. *glauca, R. bifurca, R. ciliata, R. warnstorfii var. warnstorfii, Sphaerocarpos michelii, Tortula modica*
[On disturbed silty-clay soil with strong human impact, nitrophytic, eutrophic, spring vegetation]

- *Riccio sorocarpae-Funarietum fascicularis* Lecointe 1978 – SIC [**21**; **26**; **27**; **47**; **53**]
  Entosthodon fascicularis
- *Riccio glaucae-Anthocerotetum crispuli* Koppe *ex* Neumayr 1971 – SIC [**26**; **47**; **53**]
  (Syn.: *Riccio glaucae-Anthocerotetum laevis* Stefureac, Popescu *et* Lungu 1955, *Riccio-Anthocerotetum punctati* F. Koppe 1955 *nom. inval.*)
  Anthoceros agrestis, Fossombronia wondraczekii, Phaeoceros carolinianus, P. laevis
- *Riccio crystallinae-Sphaerocarpetum michelii* Lo Giudice *et* Bonanno 2010 SIC [**27**; **53**; **1**; **21**; **26***** sub community with *Riccia crystallina* and *Sphaerocarpos michelii*]
  Riccia cristallina, Sphaerocarpos michelii
- *Dicranelletum rubrae* Giacomini 1939
  Dicranella varia, Pohlia wahlenbergii var. *wahlenbergii*
  – *typicum* – LOM [**18**; **23**]
  – *pellietosum fabbronianae* Giacomini 1939 – LOM [**18**]
  D: *Jungermannia atrovirens, Leiocolea collaris, Pellia endiviifolia*

CEPHALOZIELLO BAUMGARTNERI-SOUTHBYION NIGRELLAE Guerra *et* Gil 1982
Cephaloziella baumgartneri, Gymnostomum calcareum, G. viridulum, Gyroweisia reflexa, G. tenuis, Southbya nigrella, S. tophacea. D: Tortula marginata

[Terri-saxicolous, meso-xerophytic, in shallow rock crevices, submediterranean]

- *Gymnostomo luisieri-Southbyetum nigrellae* Guerra *et* Gil 1982 corr. Ros *et* Guerra 1987 – CAL [**51**], SIC [**21**; **26**; **27**; **29**; **49**; **53**; **62**]
  Gymnostomum viridulum
  (Syn.: *Gymnostomo calcarei-Southbyetum nigrellae* Guerra & Gil 1982)
- *Gyroweisio reflexae-Southbyetum nigrellae* Guerra *et* Gil *ex* Marstaller 2006 – LAZ [**54**]
  Gyroweisia reflexa

TORTELLION FLAVOVIRENTIS Guerra *ex* Guerra *et* Puche 1984
Tortella flavovirens var. *flavovirens.* D: *Trichostomum brachydontium*
(*Tortellion flavovirentis* Guerra 1982 *nom. inval.*)

[Arenicolous and psammophytic, on fine textured oligotrophic and scarcely compact soil, typically found along coastal maritime areas; Mediterranean-Atlantic distribution]

Tortelletum papillosissimae Puglisi 2010 – SIC [**62**]
Tortella flavovirens var. *papillosissima*

Tortello flavovirentis-Bryetum torquescentis Privitera *et* Lo Giudice 1988
Bryum torquescens
– *typicum* – CAL [**5**], SAR [**5**], SIC [**5**; **36**; **42**; **43**; **44**; **45**; **47**; **53**; **59**]
– *bryetosum radiculosi* Brullo, Lo Giudice *et* Privitera *ex* Marstaller 2006 – SIC [**5**]
D: *Bryum radiculosum*

- *Tortello flavovirentis-Bryetum dunensis* Guerra *et* Puche 1984 – SAR [**5**], SIC [**5**; **36**; **42**; **43**; **53**; **59**]
  Bryum dichotomum (syn.: *Bryum dunense*)
- *Tortello flavovirentis-Pottietum crinitae* Privitera *et* Lo Giudice 1988 – SIC [**42**; **53**; **59**]
  Tortula viridifolia
- *Tortello flavovirentis-Bryetum algovici* Privitera *et* Lo Giudice 1988 – SIC [**42**; **53**; **59**]
  Bryum algovicum var. *algovicum*
- *Tortello flavovirentis-Barbuletum commutatae* Privitera *et* Lo Giudice 1988 – SIC [**42**; **53**; **59**]
  Barbula convoluta var. *sardoa*
- *Tortello flavovirentis-Trichostometum crispuli* Brullo, Lo Giudice *et* Privitera 1991 – LAZ [**54**], BAS [**5**], SAR [**5**], SIC [**44**; **45**; **53**; **64**]
  D: *Trichostomum crispulum*
- *Acaulo fontiqueriani-Bryetum gemmilucentis* Lo Giudice *et* Galesi 2001 – SIC [**29**; **53**]
  Acaulon fontiquerianum, Bryum gemmilucens

MANNION ANDROGYNAE Ros *et* Guerra 1987
Mannia androgyna, Oxymitra incrassata, R. gougetiana, R. nigrella, Targionia hypophylla, T. lorbeeriana

[Spring vegetation rich in thalloid liverworts, exochomophytic and chasmochomophytic, subneutrophytic, Mediterranean]

- *Plagiochasmo rupestris-Targionietum hypophyllae* v. Hübschmann 1971 – SIC [**47**; **53**]
  Plagiochasma rupestre, Targionia hypophylla

- *Riccio nigrellae-Oxymitrietum paleaceae* Ros *et* Guerra 1987 – SIC [**29**; **47**; **53**; **62**]
  Oxymitra incrassata, Riccia nigrella
- *Fissidenti incurvi-Funarietum curvisetae* During 1981 – SIC [**21**]
  Funariella curviseta. D: *Fissidens viridulus* var. *incurvus*
- *Reboulio hemisphaericae-Targionietum hypophyllae* Gil 1997 – SIC [**62**]
  Reboulia hemisphaerica

TORTULO BREVISSIMAE-ALOINETALIA BIFRONTIS (Ros *et* Guerra 1987) *ex* Puglisi 2010

Acaulon dertosense, Aloina bifrons, Crossidium aberrans, C. crassinerve, Dicranella howei, Didymodon australasiae, D. sicculus, Fossombronia caespitiformis subsp. caespitiformis, Riccia crustata, Tortula brevissima,
(Syn.: *Tortulo brevissimae-Aloinetalia bifrontis* Ros & Guerra 1987 *nom. inval.*)

[Markedly xerophytic, photophytic, with Mediterranean, Irano-Turanian and Saharo-Arabian distribution]

ALOINO BIFRONTIS-CROSSIDION CRASSINERVIS Ros *et* Guerra 1987 *ex* Marstaller 2006

Acaulon casasianum, Aloina bifrons, Crossidium crassinerve, C. geheebii, C. laxefilamentosum, C. seriatum, Syntrichia caninervis var. caninervis, Tortula brevissima
(Syn.: *Aloino-Crossidion crassinervis* Ros & Guerra 1987 nom. inval.)

[On clay or loam soil, often rich in carbonates]

- *Pterygoneuretum subsessilis* Brullo, Privitera *et* Puglisi 1991 – SIC [**29**; **53**]
  Pterygoneurum subsessile
- *Acaulo triquetri-Tortuletum brevissimae* Ros *et* Guerra 1987 – CAL [**50**; **51**], SIC [**27**; **62**]
  Acaulon triquetrum, Tortula brevissima
- *Crossidio crassinervis-Aloinetum aloidis* Frey, Herrnstadt *et* Kürschner 1990
  Crossidium crassinerve., D*: Aloina aloides*
  – *typicum* – CAL [**51**; **57**], SIC [**21**; **29**; **53**; **62**]
  – *aschismetosum carniolici* Privitera *et* Puglisi 1999 – CAL [**51**]
  D: *Aschisma carniolicum*
- *Grimmio mesopotamicae-Tortuletum obtusatae* Frey *et* Kürschner 1992 – CAL [**52**]
  Grimmia capillata
- *Aloino bifrontis-Tortuletum atrovirentis* Brullo, Privitera *et* Puglisi 1991 – SIC [**62**]
  D: *Tortula atrovirens*

POTTIO COMMUTATAE-RICCION CRUSTATAE Ros *et* Guerra 1987 *ex* Marstaller 2006

Entosthodon hungaricus, Microbryum davallianum, M. starckeanum, Tortula modica, T. pallida, Riccia crustata, Tortula vahliana

[On saline soil]

- *Crossio crassinervis-Pottietum commutatae* Ros *et* Guerra 1987 – SIC [**36**; **62**]
  Microbryum davallianum
- *Pottio pallidae-Riccietum crustatae* Cano, Guerra *et* Ros 1997 – SIC [**62**]
  Tortula pallida

FUNARIETALIA HYGROMETRICAE v. Hübschmann 1957
Bryum klinggraeffii, Dicranella schreberiana, D. staphylina, Pohlia melanodon
[Nitrophytic to highly nitrophytic, on soil or ruderal substrate rich in minerals]

FUNARION HYGROMETRICAE Hadàc *in* Klika *ex* v. Hübschmann 1957
Funaria hygrometrica, Leptobryum pyriforme, Marchantia polymorpha
[Pioneer, on soil recently burnt, rich in nitrates, in ruderal places]

• *Funarietum hygrometricae* Engel 1949 – CAL [**58**], SIC [**21**; **26**; **27**; **35**; **36**; **43**; **47**; **49**; **56, 62, 64**]
(Syn. *Funarietum hygrometricae* Gams 1927 *nom. nud.*)
Funaria hygrometrica

PHYSCOMITRIELLION PATENTIS v. Hübschmann 1957
Physcomitrium pyriforme, Pohlia bulbifera, Pseudephemerum nitidum
[Hygrophytic, on silty soil flooded in winter, photophytic, nitrophytic, dominated by annual acrocarpous]

• *Riccio cavernosae-Physcomitrelletum patentis* Allorge *ex* v. Hübschmann 1957 corr. v.d. Dunk 1972
Physcomitrella patens, Riccia cavernosa
– *typicum* – TRA [**12**]
– *riccietosum frostii* Cortini Pedrotti & Aleffi 1990 – LOM [**12**], TRA [**12**], ABR [**2**]
D: *Riccia frostii*

GRIMMIETEA ALPESTRIS Hadàc *et* Vondrácek in Ježek *et* Vondrácek 1962

(Syn.: *Racomitrietea heterostichi* Neumayr 1971, *Grimmio-Racomitrietea heterostichi* Hertel *ex* Mohan 1978 p.p.)
[Pioneer, epilithic, acidophytic, rich in bryochamaephytes]

GRIMMIETALIA ALPESTRIS Šmarda 1944
Grimmia arenaria, G. muehlenbeckii, Racomitrium affine, R. heterostichum, R. sudeticum
(Syn.: *Grimmietalia commutatae* Šmarda *et* Vaněk *in* Klika & Hadàc *ex* Šmarda 1947; *Grimmietalia commutatae* Šmarda *et* Vaněk *in* Šmarda 1947, *Racomitrietalia heterostichi* Philippi 1956)
[From lowland to alpine belts]

GRIMMION COMMUTATAE v. Krusenstjerna 1945
Braunia alopecura, Grimmia trichophylla, G. lisae, Hedwigia ciliata var. ciliata, H. stellata, Ptychomitrium nigrescens, Schistidium confertum
(Syn.: *Hedwigion albicantis* Philippi 1956 *nom. inval.*)
[Xerophytic to meso-xerophytic, hilly and montane belts]

• *Hedwigietum stellatae* Privitera *et* Puglisi 1996
Hedwigia stellata
– *typicum* – SIC [**14*** sub *Hedwigia ciliata*-community; **47**; **53**]
– *orthotrichetosum rupestris* Marstaller 2006 – SIC [**47**; **53*** sub *Hewigio-Orthotrichetum rupestris* Varo, Zafra *et* Mateo 1988]
D: *Orthotrichum rupestre*

• *Hedwigietum albicantis* Allorge *ex* Vanden Berghen 1953 – SAR [**55**]
Hedwigia ciliata var. *ciliata*
(Syn.: *Hedwigietum albicantis* Allorge 1922 *nom. inval.*)

- *Grimmietum commutato-campestris* v. Krusenstjerna 1945
  Grimmia laevigata, G. ovalis
  – *typicum* – LOM [**18***sub *Grimmia campestris-Grimmia commutata*-Ass.; **19**; **23**], VEN [**19**], SIC [**26**; **35**; **47**; **53**; **56**]
  – *braunietosum alopecurae* Giacomini 1950 – LOM [**19**; **56**], TRA [**19**; **56**]
  D: *Braunia alopecura*
- *Grimmietum longirostris* Nörr 1969 – SIC [**47**; **53**]
  (Syn.: *Grimmietum ovatae* Nörr 1969)
  Grimmia longirostris
- *Coscinodontetum cribrosi* v. Hübschmann *ex* Marstaller 1986 – SIC [**47**; **53**; **63**]
  Coscinodon cribrosus
- *Grimmietum montanae* Marstaller 1984 – SIC [**47**; **53**]
  Grimmia montana
- *Hedwigio ciliatae-Orthotrichetum rupestris* Varo, Zafra *et* Mateo 1988 – SAR [**55**]
  Orthotrichum rupestre
- *Ptychomitrietum polyphylli* v. Hübschmann 1971 – LOM [**19**; **23**]
  Ptychomitrium polyphyllum

GRIMMION DECIPIENTIS Varo *et* Zafra 1990
[Mesophytic, from lowland to montane belts]

- *Grimmietum decipientis* Varo, Zafra *et* Mateo 1988 – SIC [**23**; **47**; **53**]
  Grimmia decipiens

ANDREAEION PETROPHILAE Šmarda 1944
Cynodontium fallax, C. suecicum, Dicranoweisia crispula, Kiaeria blyttii, Grimmia apiculata, G. donniana, G. elongata, G. funalis, G. incurva, Racomitrium fasciculare, R. microcarpon
(Syn.: *Andreaeion rupestris* v. Krusenstjerna & Šmarda in Klika & Hadàc *ex* Klika 1948)
[Cryophytic, subalpine and alpine belts]

- *Racomitrio heterostichi-Grimmietum donnianae* Privitera *et* Puglisi 1996 - SIC [**47**; **53**]
  Grimmia donniana
- *Gymnomitrietum concinnati* Herzog *ex* Philippi 1956 – LOM [**23**; **56**]
  Gymnomitrion concinnatum, G. obtusum
- *Grimmietum elatioris* Gams 1927 – SIC [**61**]
  Grimmia elatior

GRIMMIETEA ANODONTIS Hadàc *et* Vondrácek *in* Ježek *et* Vondrácek 1962

[Pioneer, epilithic, basophytic, xerophytic, photophytic]

GRIMMIETALIA ANODONTIS Šmarda *et* Vanek *ex* Klika 1948
(Syn.: *Schistidietalia apocarpi* Hertel 1974, *Grimmietalia anodontis* Šmarda 1947, *Schistidietalia apocarpi* Ježek *et* Vondrácek 1962)
Tortula muralis, Syntrichia montana, Grimmia pulvinata
[See class]

GRIMMION TERGESTINAE Šmarda *ex* Klika 1948
(Syn.: *Schistidion apocarpi* Hertel 1974, *Grimmion tergestinae* Šmarda 1947, *Schistidion apocarpi* Ježek *et* Vondrácek 1962)

Didymodon rigidulus, Grimmia crinita, G. dissimulata, G. pulvinata, Hypnum vaucheri, Pseudocrossidium obtusulum, P. revolutum, Schistidium apocarpum, S. brunnescens subsp. *brunnescens, S. brunnescens* subsp. *griseum, S. crassipilum, S. dupretii, S. elegantulum* subsp. *elegantulum, S. helveticum, S. robustum, S. grande, S. trichodon* var. *trichodon, S. umbrosum*

[See class]

- *Tortuletum marginatae* v. Hübschmann 1973 – LAZ [**54**], SIC [**21**; **47**; **53**; **56**; **59**; **60**; **62**; **66**]
  Tortula marginata
- *Schistidio apocarpi-Grimmietum pulvinatae* Privitera *et* Puglisi 1996 – CAL [**58**], SIC [**47**; **49**; **53**; **41***] sub *Grimmia pulvinata-Tortula muralis*-Ass. v. Hübschmann 1950]
  D: *Grimmia pulvinata*
- *Orthotricho anomali-Grimmietum pulvinatae* Stodiek 1937
  Orthotrichum anomalum, O. cupulatum var. *cupulatum*
  – *typicum* – TRA [**3**], ABR [**22*** sub *Grimmia pulvinata-Orthotrichum anomalum*-Groupment tab. 8], SIC [**27**; **31**; **33**; **53**]
  – *bryetosum canariensis* Lo Giudice, Privitera *et* Puglisi 1992 – SIC [**33**; **53**]
  D: *Bryum canariense, Microbryum starckeanum*
- *Grimmietum capillatae* Lo Giudice *et* Cristaudo 2002 – SIC [**27**; **28**; **53**]
  Grimmia capillata
- *Grimmietum orbicularis* Allorge *ex* Demaret 1944 – TRA [**11**], CAL [**58**], SIC [**21**; **27**]
  Grimmia orbicularis
- *Syntrichio calcicolae-Grimmietum anodontis* Giacomini 1939 nom. invers. propos. – LOM [**18**; **23**]
  (Syn.: *Grimmio anodontis-Syntrichietum calcicolae* Giacomini 1939)
  Grimmia anodon
- *Pseudoleskeelletum catenulatae* Ježek *et* Vondràcek 1962 – TRA [**3**]
  Pseudoleskeella catenulata. D: *Pseudoleskeella nervosa*
- *Grimmietum tergestinae* Šmarda *ex* Marstaller 1983 – PIE [**19**; **23**]
  Grimmia tergestina
- *Tortuletum muralis* Waldheim 1944 – SIC [**21**; **27**]
  Tortula muralis

CROSSIDION SQUAMIFERI Giacomini 1950
Crossidium squamiferum var. *squamiferum*
[Thermophytic, markedly xerophytic]

- *Crossidietum squamiferi* Giacomini 1950
  Crossidium squamiferum var. *squamiferum*
  – *typicum* – AOS [**19**; **23**], PIE [**19**; **23**], FRV [**19**; **23**], VEN [**19**; **23**], SIC [**47**; **53**; **62**]
  – *syntrichietosum spuriae* Giacomini 1950 – PIE [**19**]
  D: *Syntrichia caninervis* var. *gypsophila*
  – *grimmietosum tergestinae* Giacomini 1950 – PIE [**19**], LOM [**19**]
  D: *Grimmia tergestina*
- *Tortuletum atrovirentis* Giacomini 1950 – PIE [**19**; **23**], SIC [**21**; **47**; **53**]
  Tortula atrovirens. D: *Tortula inermis*

• *Grimmietum crinitae* v. Hübschmann ex Marstaller 2005 – LOM [**19***sub Grimmieto rel. 141 pag. 29]
Grimmia crinita

CTENIDIETEA MOLLUSCI v. Hübschmann *ex* Grgić 1980

[Epilithic, basophytic, mesophytic to meso-hygrophytic]

CTENIDIETALIA MOLLUSCI Hadàc *et* Šmarda *ex* Klika 1948
(Syn.: *Ctenidietalia mollusci* Hadàc *et* Šmarda in Klika *et* Hadàc 1944 *nom. inval.*)
Barbula crocea, Blindia caespiticia, Cololejeunea calcarea, Ditrichum flexicaule, D. gracile, Encalypta streptocarpa, E. rhaptocarpa var. *rhaptocarpa, E. alpina, Fissidens dubius, Jungermannia atrovirens, Orthothecium intricatum, Pedinophyllum interruptum, Preissia quadrata, Scapania aequiloba, Tortella tortuosa*
[See class]

FISSIDENTION GRACILIFOLII Neumayr 1971 corr. Marstaller 2001
(Syn.: *Fissidention pusilli* Neumayr 1971)
Amblystegium confervoides, Didymodon glaucus, Fissidens gracilifolius, Leptobarbula berica, Seligeria acutifolia, S. brevifolia, S. calycina, Tortula obtusifolia
[Pioneer, lithophytic, sciophytic]

• *Rhynchostegielletum algirianae* Giacomini 1950 – LOM [**19**], VEN [**19**], SIC [**47**; **48**; **53**; **60**; **62**]

CTENIDION MOLLUSCI Ştefureac *ex* Klika 1948
(Syn.: *Ctenidion mollusci* Ştefureac 1941 *nom. dub.*)
Anoectangium aestivum, Campyliadelphus chrysophyllum, Campylophyllum halleri, Plagiobryum zieri, Plagiopus oederianus var. oederianus, Platydictya jungermannioides, Scapania aspera, S. calcicola, Timmia bavarica, Tortella inclinata var. *densa, Tortula mucronifolia. D: Athalamia hyalina, Hymenostylium recurvirostrum* var. *recurvirostrum, Trichostomum brachydontium*
[Post-pioneer, in rock crevices, sciophytic, mesophytic, rich in exochomophytes and chasmophytes]

• *Encalypto streptocarpae-Fissidentetum cristati* Neumayr 1971 – TRA [**3**], SIC [**47**; **53**]
Fissidens dubius, Encalypta streptocarpa

• *Ctenidietum mollusci* Stodiek 1937 - TRA [**3**], ABR [**22*** sub *Ctenidio molluscii-Homalothecietun philippeani* tab. 4], SIC [**33**; **47**; **53**]
Ctenidium molluscum

• *Gymnostometum rupestris* Poelt 1954 – LOM [**18*** sub *Gymnostomum rupestre-Plagiopus oederi*-Ass., **19, 23**]
Gymnostomum aeruginosum var. *aeruginosum*

• *Gymnostometum calcarei* Giacomini 1950 – FRV [**19**], SIC [**62**]
Gymnostomum calcareum

DISTICHION CAPILLACEI Gjaerevoll 1956
Amblyodon dealbatus, Barbula bicolor, Cyrtomnium hymenophylloides, Distichium inclinatum, Encalypta alpina, E. longicolla, E. rhaptocarpa var. *rhaptocarpa, Hypnum bambergeri, H. hamulosum, H. revolutum* var. *revolutum, Lophozia grandiretis, Meesia uliginosa, Mnium lycopodioides, Orthothecium chryseon, O. strictum, Sauteria alpina, Saelania glaucescens, Scapania cuspiduligera, Tritomaria polita, T. scitula, Timmia austriaca*

[Cryophytic, sciophytic, in rock crevices and on rock outcrops covered by soil]

- *Solorino saccatae-Distichietum capillacei* Reimers 1940 – TRA [**3**], SIC [**33**; **53**]
  (Syn.: *Distichietum capillacei* (Greter 1936) Reimers 1940, Syn. p.p. *Encalyptetum rhabdocarpae* Hébrard 1973)
  Distichium capillaceum

NECKERETEA COMPLANATAE Marstaller 1986

(Syn.: *Tortulo-Homalothecietea sericei* Hertel *ex* Mohan 1978 p.p.)

[Humo-epilithic, cortico-humicolous, basophytic, subneutrophytic, mesophytic to hygrophytic, sciophytic, rich in pleurocarpous mosses and leafy chamaephytic liverworts, post pioneer to climacic]

NECKERETALIA COMPLANATAE Ježek *et* Vondrácek 1962
Amblystegium subtile, Cirriphyllum crassinervium, Homalothecium sericeum, Metzgeria furcata, Neckera pennata, N. pumila, Plasteurhynchium striatulum, Porella arboris-vitae, P. platyphylla, Zygodon viridissimus

[Humo-epilithic, air hygrophytic]

NECKERION COMPLANATAE Šmarda *et* Hadàc *ex* Klika 1948
(Syn.: *Neckerion complanatae* Hadàc *et* Šmarda 1944; *Neckerion complanatae* Šmarda *et* Hadàc *in* Klika *et* Hadàc 1944 *nom. inval.*, *Anomodontion europaeum* Barkman 1958 *nom. illeg.*)
Amblystegium subtile, Anomodon rostratus, A. viticulosus, Brachythecium geheebii, B. laetum, Didymodon insulanus, D. sinuosus, Homalia trichomanoides, Homalothecium philippeanum, Mnium marginatum, M. stellare, Oxystegus tenuirostris, Plagiomnium cuspidatum, Rhynchostegium murale, Sciuro-Hypnum flotowianum, Sciuro-Hypnum populeum, Thuidium delicatulum, T. recognitum

[Montane and subalpine belts, with C European distribution *optimum*]

- *Homalothecio sericei-Porelletum platyphyllae* Størmer *ex* Duda 1951 – SIC [**33**; **53**]
  (Syn.: *Homalothecio-Madothecetum platyphyllae* (Størmer 1938) Hertel 1974, *Homalothecio-Porelletum platyphyllae* Størmer 1938 *nom inval.*)
  Homalothecium sericeum, Porella platyphylla
- *Anomodontetum attenuati* (Barkman 1958) Peciar 1965 – FRV [**17***** sub *Neckero-Anomodontetum viticulosi* (Gams 1927) Szafran 1955]
  Anomodon attenuatus
- *Anomodonto viticulosi-Leucodontetum sciuroidis* Wisniewski 1930
  – *typicum* – TRA [**34*** sub *Neckera complanata*-Gesellschaft tab. 10 rel. 1, 2, 4], VEN [**34*** sub *Neckera complanata*-Gesellschaft tab. 10 rel. 3], LAZ [**54**], SIC [**33**; **53**]
  (Syn.: *Neckero-Anomodontetum* (Wisniewski 1929) Philippi 1965; *Neckeretum crispae* Philippi 1965 p.p., Neckeretum crispae (Kaiser 1926) Herzog & Höfler 1944, *Neckero-Anomodontetum viticulosi* Szafran 1955)
  Neckera complanata
  – *drepanocladetosum adunci* Privitera *et* Puglisi 2009 – LAZ [**54**]
  D: *Drepanocladus aduncus*
- *Isothecietum myuri* Hilitzer 1925 – LOM [**18*** sub *Isothecium viviparum-Hypnum cupressiforme*-Ass. ; **19**], TRA [**34*** sub *Isothecium myurum-Gesellschaft* tab. 10 rel. 17-18], SIC [**41**; **53**; **31*** sub *Anomodonto-Isothecietum vivipari* Lippmaa 1935]
  Isothecium alopecuroides

- *Pteryginandretum filiformis* Hilitzer 1925 – LOM [**34***sub *Leskeella nervosa*-Gesellschaft tab. 12 rel. 9, 13, 14], VEN [**34***sub *Leskeella nervosa*-Gesellschaft tab. 12 rel. 1, 8, 11, 12], TRA [**3**; **34***sub *Leskeella nervosa*-Gesellschaft tab. 12 rel. 2-7, 10, 15, 16]
  Pseudoskeella nervosa. D: Pteryginandrum filiforme var. *filiforme*

PLASTEURHYNCHION MERIDIONALIS Guerra *et* Varo 1981
Neckera menziesii, Plasteurhynchium meridionale, P. striatulum, Pterogonium gracile. D: *Rhynchostegium confertum*, *Scleropodium touretii*
[Mediterranean distribution]

- *Homalothecio sericei-Neckeradelphetum menziesii* (Varo, Guerra *et* Gil 1977) Guerra *et* Varo 1981 – SIC [**33**; **53**]
  Neckera menziesii
- *Pterogonietum gracilis* Giacomini 1950 nom. mut. propos.
  (Syn.: *Pterogonietum ornithopodioidis* Giacomini 1950)
  Pterogonium gracile
  – *typicum* – PIE [**19**], LOM [**19**]
  – *madothecetosum obscurae* Giacomini 1950 – PIE [**19**], LOM [**19**]
  D: *Porella arboris-vitae, P. platyphylla*
- *Leptodontetum smithii* Wattez ex Marstaller 1992
  – *typicum* – LOM [**20**; **19***sub *Pterogonietum gracilis* Giacomini 1950 subass. *leptodontetosum smithii* Giacomini 1953 *nom. inval.*]
  Leptodon smithii
  – *homalietosum besseri* Marstaller 2006 – LOM [**20**]
  Neckera besseri

ANTITRICHETALIA CURTIPENDULAE Šmarda *et* Hadàc *in* Klika *et* Hadàc 1944
(Syn: *Neckeretalia pumilae* Barkman 1958 p.p.)
Antitrichia curtipendula, Lobaria polmonaria. D: *Pterigynandrum filiforme* var. *filiforme*
[Cortico-humicolous, mesophytic to hygrophytic, in dense woods of the montane belt]

ANTITRICHION CURTIPENDULAE v. Krusenstjerna 1945
(Syn.: *Antitrichion curtipendulae* (Ochsner 1928) Barkman 1958 *nom. illeg.*)
[See order]

- *Antitrichietum curtipendulae* Waldheim 1944 – SIC [**25**; **53**]
  (Syn.: *Antitrichietum curtipendulae* Frey *et* Ochsner 1926 *nom. nud.*, *Antitrichietum curtipendulae* Størmer 1938)
  Antitrichia curtipendula
- *Neckero pumilae-Metaneckeretum menziesii* Lo Giudice 1991 – SIC [**25**; **53**]
  D: *Neckera menziesii*

FRULLANIO DILATATAE-LEUCODONTETEA SCIUROIDIS Mohan 1978

(Syn.: *Hypnetea cupressiformis* Ježek *et* Vondràcek 1962)
Frullania dilatata, Microlejeunea ulicina, Neckera pumila, Radula complanata, R. lindenbergiana, Zygodon rupestris
[Epiphytic, in living woods, pioneer or post-pioneer]

ORTHOTRICHETALIA Hadàc *in* Klika *et* Hadàc 1944
(Syn: *Neckeretalia pumilae* Barkman 1958 p.p., *Leucodontetalia sciuroidis* v. Hübschmann 1952)
Leucodon sciuroides var. *sciuroides, Orthotrichum affine, O. diaphanum, O. lyellii, O. obtusifolium, O. pulchellum, O. speciosum* var. *speciosum, Pylaisia polyantha*
[See class, European]

SYNTRICHION LAEVIPILAE Ochsner 1928
(Syn.: *Tortulion laevipilae* Ochsner 1928)
Orthotrichum diaphanum, O. obtusifolium, O. philibertii, O. tenellum, Syntrichia papillosa
[Xerophytic, thermophytic, photophytic, in open woods or on isolated trees; Central and Southern European]

- *Syntrichietum laevipilae* Ochsner 1928 – LOM [**34*** sub *Tortula papillosa-Tortula laevipila*-Gesellschaft tab. 2 rel. 9, 14], TRA [**34*** sub *Tortula papillosa-Tortula laevipila*-Gesellschaft tab. 2 rel. 6-8, 10, 11, 15], VEN [**34*** sub *Tortula papillosa-Tortula laevipila*-Gesellschaft tab. 2 rel. 5, 12, 13], FRV [**17**], LAZ [**54**], SIC [**25**; **56**; **27**]
(Syn.: *Orthotricho-Tortuletum laevipilae* Allorge 1922, *Tortuletum laevipilae* Ochsner 1928 nom mut.)
Syntrichia laevipila, S. papillosa

FABRONION PUSILLAE (Barkman 1958) Gil *et* Guerra 1981
Fabronia ciliaris, Habrodon perpusillus, Leptodon smithii, Leucodon sciuroides var. *morensis.* D*: Pterogonium gracile*
[Thermophytic, meso-xerophytic, less xerophytic than *Syntrichion laevipilae*, in open woods or on isolated trees; Mediterranean]

- *Leptodonto smithii-Leucodontetum sciuroidis* Privitera *et* Puglisi 1996 – LOM [**19*** sub *Leptodon smithii*-community; **34*** sub *Leptodon smithii*-Gesellschaft tab. 7 rel. 1-4, 7, 8, 11-13, 18-21], TRA [**19*** sub *Leptodon smithii*- community; **34*** sub *Leptodon smithii*-Gesellschaft tab. 7 rel. 10, 15], VEN [**19*** sub *Leptodon smithii*-Ass.; **34*** sub *Leptodon smithii*-Gesellschaft tab. 7 rel. 5, 6, 9, 14, 16], UMB [**10*** sub *Leptodontetum smithii* Jäggli 1933 nom. inval. tab. 1 rel. 1-19], LAZ [**54**; **24**], SAR [**55**], SIC [**47**; **53**]
Leucodon sciuroides var. *sciuroides,* D: *Leptodon smithii*
- *Fabronietum pusillae* Ochsner 1936 – SIC [**25**; **48**; **53**]
Fabronia pusilla
- *Cryphaeetum arboreae* Barkman 1958 – LOM [**34*** sub *Zygodon viridissimus*-Gesellschaft tab. 6 rel. 20-23], SIC [**25**; **15*** sub *Ulota crispa*-community *Tab. 1 rill. 5-9*; **65*** sub *Cryphaea heteromalla*-Community; **53**]
Cryphaea heteromalla
- *Fabronietum octoblepharis* Giacomini 1950 – LOM [**19**; **34*** sub *Fabronietum ciliaris* Giacomini 1950 nom mut. tab. 4 rel. 1, 4-6; **23**; **20**], TRA [**34*** sub *Fabronietum ciliaris* Giacomini 1950 nom mut. tab. 4 rel. 2, 3, 7, 8]
Fabronia ciliaris
- *Neckero complanatae-Eurhynchietum striatuli* Cortini Pedrotti 1988 – UMB [**10**]
Plasteurhynchium striatulum

ULOTION CRISPAE Barkman 1958
Orthotrichum acuminatum, O. gymnostomum, O. patens, O. scanicum, O. straminеum. D: Hypnum andoi, Metzgeria furcata, Neckera pumila
[Mesophytic or meso-hygrophytic, in dense woods, sciophytic]

- *Orthotrichetum lyellii* Allorge *ex* Lecointe 1975 – SIC [**27**; **47**; **53**; **41** sub *Orthotrichetum lyellii* Lecointe 1975]
  Orthotrichum lyellii
- *Ulotetum crispae* Ochsner 1928 – SIC [**15*** sub *Ulota crispa*-community Tab. 1 rel. 1-4; **25**; **43**; **53**]
  Ulota crispa
- *Orthotrichetum striati* Gams 1927 – SIC [**25**; **47**; **53**]
  (Syn.: *Orthotrichetum speciosi* Barkman 1958, *Orthotrichetum speciosi* (Jäggli 1934) Barkman 1958)
  Orthotrichum speciosum var. *speciosum, O. striatum*
- *Pylaisietum polyanthae* Felföldy 1941 – SIC [**47**; **53**]
  Pylaisia polyantha

CAMPYLOPODETEA VAPORARII Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006

(Syn.: *Campylopodetea vaporarii* Brullo, Privitera & Puglisi 2004 nom. inval.)
Archidium alternifolium, Campylopus pilifer subsp. *vaporarius*, *Rhynchostegium strongylense, Trematodon longicollis*

[Terricolous or terri-saxicolous, thermophytic, subhygrophytic to hygrophytic, acidophytic, fumarole sites of Mediterranean region]

CAMPYLOPODETALIA VAPORARII Brullo, Privitera *et* Puglisi 2004 *ex* Privitera & Puglisi 2006
(Syn.: *Campylopodetalia vaporarii* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
[See class]

CAMPYLOPODION VAPORARII Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006
(Syn.: *Campylopodion vaporarii* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
[See class]

- *Campylopodetum vaporarii* Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006
  (Syn.: *Campylopodetum vaporarii* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
  Campylopus pilifer subsp. *vaporarius*
  – *typicum* – CAM [**6**], SIC [**6**]
  – *campylopodetosum pyriformis* Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006 – SIC [**6**]
  (Syn.: *campylopodetosum pyriformis* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
  D: *Campylopus pyriformis*
- *Calymperetum erosi* Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006 – SIC [**6**]
  (Syn.: *Calymperetum erosi* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
  Calymperes erosum
- *Isopterygio teneri-Cyperetum polystachyi* Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006
  (Syn.: *Isopterygio teneri-Cyperetum polystachyi* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
  Isopterygium tenerum, Cyperus polystachyus
  – *typicum* – CAM [**6**]

– *epipterygietosum tozeri* Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006 – CAM [**6**]
(Syn.: *epipterygietosum tozeri* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
D: *Epipterygium tozeri*
– *grimmietosum lisae* Brullo, Privitera *et* Puglisi 2004 *ex* Privitera *et* Puglisi 2006 – CAM [**6**]
(Syn.: *grimmietosum lisae* Brullo, Privitera *et* Puglisi 2004 *nom. inval.*)
D: *Grimmia lisae*

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