

**A new bryophytic community from the mountains of southern Spain and Morocco:
*Tortulo subulatae-Syntrichietum ruralis***

María J. CANO, Rosa María ROS, Juan GUERRA & Pedro GARCÍA-ZAMORA

Departamento de Biología Vegetal (Botánica), Facultad de Biología,
Universidad de Murcia, 30100 Murcia, España; mcano@fcu.um.es

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Abstract — *Tortulo subulatae-Syntrichietum ruralis* is proposed as a new bryophytic association from high mountain grasslands of southern Spain and Morocco. This new community is described and characterized. © ADAC / Elsevier, Paris

bryophyte vegetation / SE Spain / Morocco / Mediterranean region

Resumen — Se propone una nueva asociación briofítica, *Tortulo subulatae-Syntrichietum ruralis*, de pastizales de alta montaña del sur de España y Marruecos. La nueva comunidad es descrita y caracterizada. © ADAC / Elsevier, Paris

vegetación briofítica / SE España / Marruecos / región Mediterránea

INTRODUCTION

Although the terricolous vegetation from southeastern Spain is relatively well-known (e.g. Ros & Guerra, 1987; Cano *et al.*, 1997; García-Zamora, 1997), very little has been published on acrophilous communities. This is especially true of those which occur in the oro-Mediterranean belt, since this termotype is not very extensive in the study area.

A vegetation transect made in Sierra de Filabres in Almería province (2 168 m), revealed a community in orophilous pastures which was characterized floristically by *Syntrichia ruralis* (Hedw.) F. Weber & D. Mohr (which does not include *Syntrichia calcicola* J.J. Amann species), *S. ruralis* var. *arenicola* (Braithw.) J.J. Amann, *Tortula subulata* Hedw., *Tortula subulata* var. *subinermis* (Bruch & Schimp.) Wilson and frequently by *Encalypta vulgaris* Hedw., *Pseudocrossidium hornschuchianum* (Schultz) R.H. Zander, *Didymodon* Hedw. *sp. pl.* and *Pterygoneurum ovatum* (Hedw.) Dixon, in addition to other annual taxa. The same floristic composition has been observed in other provinces of southern Spain, such as, Alicante, Granada Jaén and Murcia, where the community grows in the same ecotypes, and in the Rif, High Atlas and Middle Atlas of Morocco. With this paper, we provide new data about the bryophytic vegetation of Northern Africa, since, to date, only the paper of Ros *et al.* (1990) has been published.

Tab. 1. *Tortulo subulatae-Syntrichietum ruralis* ass. nov.

Relevé number	1	2	3	4	5	6	7
Size of relevé (dm ²)	4	9	4	4	25	4	4
Cover value (%)	50	30	60	70	85	80	70
Inclination (°)	0	0	20	0	0	0	0
Exposure	-	-	N	-	-	-	-
Number of species	4	4	5	5	5	5	6
Altitude (hm)	18.9	16	21.6	24	10	16	21
Characteristic species of association (<i>Tortulo-Syntrichietum ruralis</i>)							
<i>Syntrichia ruralis</i> (including var. <i>arenicola</i>)	3	1	1	2	4	3	1
<i>Tortula subulata</i> (including var. <i>subinermis</i>)	1	-	1	1	-	-	2
Characteristic species of alliance (<i>Grimaldion fragrantis</i>)							
<i>Encalypta vulgaris</i>	-	-	-	-	-	-	-
<i>Pterygoneurum ovatum</i>	-	-	1	-	-	1	+
<i>Pseudocrossidium hornschuchianum</i>	-	-	-	-	+	-	-
<i>Pleurochaete squarrosa</i>	-	-	-	-	-	-	-
<i>Didymodon vinealis</i>	-	-	-	-	-	-	-
<i>Phascum cuspidatum</i> (included var. <i>retortifolium</i>)	-	-	-	-	-	1	-
<i>Pottia lanceolata</i>	-	-	-	-	-	-	-
<i>Didymodon luridus</i> 1 in 17 and + in 19; <i>Didymodon insulanus</i> 3 in 19.							
Characteristic species of order and class (<i>Barbuletales unguiculatae</i> , <i>Barbuletea unguiculatae</i>)							
<i>Bryum bicolor</i>	-	-	3	-	+	2	3
<i>Bryum torquescens</i>	-	-	+	-	+	-	1
<i>Homalothecium aureum</i>	-	-	-	-	-	-	-
<i>Bryum dunense</i>	-	-	-	-	-	-	-
<i>Didymodon acutus</i>	-	-	-	-	1	-	-
<i>Bryum canariense</i> 1 in 9; <i>Weissia</i> sp. + in 10; <i>Didymodon rigidulus</i> 1 in 11 and 1 in 13; <i>Riccia sorocarpa</i> 1 in 12; <i>Barbula convoluta</i> 3 in 13 and 1 in 18; <i>Barbula unguiculata</i> 1 in 16 and 1 in 17; <i>Didymodon fallax</i> 1 in 16 and 1 in 17; <i>Pottia bryoides</i> + in 16 and 2 in 17; <i>Didymodon australasiae</i> + in 19; <i>Tortula atrovirens</i> + in 19.							
Other species:							
<i>Ceratodon purpureus</i>	1	3	-	+	-	-	-
<i>Bryum argenteum</i>	-	1	-	1	-	2	+
<i>Bryum</i> sp.	1	1	-	3	-	-	-
<i>Syntrichia intermedia</i> 1 in 9; <i>Bryum alpinum</i> 1 in 14; <i>Funaria hygrometrica</i> 1 in 14; <i>Pohlia</i> sp.+ in 16.							

Relevés origin. - 1. Morocco, Middle Atlas, Jbel Bou Iblanc, mountain refuge of Taffert, 33°39'N 4°09'W; 2. Morocco, Rif, Jbel Bouhalla, 35°08'N 5°08'W; 3, 7, 8. Spain, Almería, Sierra de Filabres, Calar Alto (Gérgal), WG3920; 4. Morocco, High Atlas, 5 km before Oukaimeden, 31°14'N 7°49'W; 5. Spain, Alicante, Puerto de Benifallim (Benifallim), YH2680; 6. Spain, Granada, Puerto del Pinar (Puebla de Don Fadrique), WH4551; 9 y 17. Spain, Murcia, Sierra de los Alamos, Cenajo del Agua Cernida (Moratalla), WH8829; 10. Morocco, Middle Atlas, Jbel Tazzeke, 34°03'N 4°09'W; 11. Morocco, High Atlas, Oukaimeden, 31°12'N 7°51'W;

METHODOLOGY

The bryophyte vegetation was studied using the plant sociology methods of Braun-Blanquet (1979). Only the cover-abundance index was used. The sociability index

Tab. 1 (suite)

	8	9	10	11	12	13	14	15	16	17	18	19	
	4	4	4	4	9	25	16	16	9	4	4	25	
	70	30	60	40	30	90	80	60	60	50	80	90	
	30	20	10	0	0	0	10	5	0	20	15	30	
NW	N	N	-	-	-	-	N	E	-	E	N	N	
	6	6	6	6	6	8	8	8	9	9	10	11	
	20	10	14	25.5	17	13	17	12	17	10	13	11	
	1	+	2	1	1	1	2	1	3	+	2	1	V
	4	-	1	-	-	1	1	-	-	-	+	1	III
	1	-	-	2	1	1	1	+	-	-	1	-	II
	+	-	-	-	-	-	-	-	-	1	-	-	II
	-	-	-	-	1	+	-	2	+	1	+	-	II
	-	1	-	-	-	-	-	+	-	1	2	+	II
	-	+	-	-	-	2	-	1	-	-	1	-	II
	-	-	-	1	-	-	-	-	+	-	-	-	I
	-	-	-	-	-	-	-	-	-	2	+	+	I
	2	-	-	2	1	-	-	2	1	-	-	3	III
	-	-	-	-	-	-	-	-	-	-	-	3	II
	-	1	+	-	-	-	-	+	+	-	-	-	II
	-	-	-	-	-	-	2	-	-	-	3	-	I
	-	-	-	-	-	-	-	1	-	-	+	-	I
	-	-	3	+	+	-	3	-	-	-	-	-	II
	+	-	-	-	-	-	1	-	-	-	-	1	II
	-	-	1	-	-	+	-	-	-	-	-	-	II

12: Spain, Jaén, Sierra de Segura, way from caserío Don Domingo to Pontones (Santiago-Pontones), WH2911; 13: Spain, Jaén, Sierra de Cazorla, near Cañada de las Fuentes (Peral de Becerro), WG0287; 14: Spain, Almería, Sierra de Filabres, barranco del Maguillo (Bacares), WG4122; 15: Spain, Alicante, Sierra de Mariola, near radio masts (Agres), Y111694; 16: Spain, Jaén, Sierra de Segura, arroyo de los Corrales (Santiago de la Espada), WH2705; 18: Spain, Murcia, Sierra de Moratalla, Puntal de la Vicja (Moratalla), WH7923; 19: Spain, Almería, Sierra de Filabres, Cerro de Santiago (Olula de Castro), WG4511.

was not taken into account because of the protonematic moss growth. Cover-abundance was estimated according to the following scales: +: <1 %; 1: 1–10 %; 2: 10–25 %; 3: 25–50 %; 4: 50–75 %; 5: 75–100 %.

The nomenclature followed for the communities was that of Marstaller (1993), for mosses and liverworts, that of Corley *et al.* (1981), Corley & Crundwell (1991) and Grolle (1983) except in the case of *Syntrichia* Brid. genus, for which Zander (1993) was followed.

DESCRIPTION OF THE COMMUNITY

Tortulo subulatae-Syntrichietum ruralis ass. nov.

Syntype: Tab. 1, holosyntype: Relevé 8.

This new community occurs in stony grasslands of high mountain zones, which are frequently nitrified, exposed and sunny. The community is terricolous, xerophilous and photophilous and grows in both acidic and basic soils. In the studied area, it appears in the supra- and oro-Mediterranean belts, with dry ombrotype, from 1000 m in Alicante and Murcia to 2550 m in some localities of the High Atlas in Morocco.

The relatively high coverage that the association shows in some cases, with a mean value of 62.4 %, is of particular note. Characteristic species usually grow in clearings of *Poetea bulbosae* Rivas Goday & Rivas-Martínez in Rivas Martínez 1978, almost always in the domain of shrubs of *Erinacetalia anthyllidis* Quézel 1951. The community comprises a great number of colonist taxa. This life strategy is shown by the characteristic species of the association, *Syntrichia ruralis* (including var. *arenicola*) (V) and *Tortula subulata* (including var. *subinermis*) (III). Other colonist species characteristic of the alliance, order and class are *B. bicolor* Dicks. (III), *Pseudocrossidium hornschurchianum* (II), *Bryum torquescens* Bruch & Schimp. (II) and different species of the genus *Didymodon* (*D. vinealis* (Brid.) R.H. Zander (II), *D. luridus* Hornsch. ex Spreng. (I), *D. fallax* (Hedw.) R.H. Zander (I), etc.). Moreover, some perennial species, e.g. *Pleurochaete squarrosa* (Brid.) Lindb. (II) and short-lived shuttle species such as *Encalypta vulgaris* (II) and *Pterygoneurum ovatum* (II) are present. The high frequency of colonist species can be attributed to the climatic conditions to which the community is exposed, with snow covering the area during a great part of the year. At the end of spring the community can be rich in annual shuttle species such as *Phascum cuspidatum* Hedw. (I) and *Pottia bryoides* (Dicks.) Mitt. (I) as the snow melts and temperatures increase.

The new community can grow in basic and acidic soils. In the latter case, acidophilous species such as *Ceratodon purpureus* (Hedw.) Brid. (relevés 1, 2, 4, 10–12 and 14) and *Bryum alpinum* With. (relevé 14) are usually present. The presence of *Bryum argenteum* Hedw., *Phascum cuspidatum* s. l. and in some cases *Funaria hygrometrica* Hedw., suggests relatively high levels of nitrification in the soils occupied by this association.

An analysis of the chorological elements of the species in the community described shows that the most frequent elements are the temperate (37.5 %), followed by Mediterranean (including submediterranean) (31.3 %) and oceanic-Mediterranean (including suboceanic-submediterranean, submediterranean-suboceanic, oceanic-submediterranean) (25 %). The lowest percentages are the subboreal (3.1 %) and cuoceanic-subtropical (3.1 %). The chorological nomenclature are taken from Düll (1983, 1984, 1985).

The community's most appropriate syntaxonomic position seems to be in the *Grimaldion fragrantis* Smarda & Hadac 1944 alliance, belonging to *Barbuletalia unguiculatae* Hübschmann 1960 order and *Barbuletea unguiculatae* Mohan 1978 class. Another association of this alliance to which it could be related is *Trichostomo-Didymodontetum vinealis* Privitera & Puglisi 1989 because of the abundance of species

belonging to *Didymodon* and *Pseudocrossidium* Williams genera. However this community's climatic optimum is the thermo- and meso-Mediterranean belt (Privitera & Puglisi, 1989). An association with a very similar floristic composition, *Pleurochaeto-Tortuletum ruralis* Brullo, Lo Giudice & Privitera 1991 included in the alianza *Homalothecio-Pleurochaetion squarrosae* (Ros & Guerra, 1987) Marstaller 1993 alliance, has been described. This association is known from Greece and Turkey (Brullo *et al.*, 1991), Sardinia (Privitera *et al.*, 1996) and Sicily (Privitera & Puglisi, 1996) and occurs from 600 to 1 100 m, and exceptionally up to 1 700 m, as in Mt. Etna (Sicily). Although, the thermophilous species, *Pleurochaete squarrosa*, is very frequent in the above-described community, it is relatively rare in the community described here. Furthermore, this species is only present in the relevés, both Spanish and Moroccan, taken below 1 300 m.

In southern Spain, this community can merge with two associations: *Homalothecio-Pleurochaetum squarrosae* Ros & Guerra 1987 in basic soils and *Homalothecio-Scleropodietum touretii* inéd. in neutral or acidic soils. Both communities grow in deep soils and have a more mesophilous character than *Tortulo-Syntrichietum ruralis*. Moreover, their altitudinal range is lower. They rarely appear above 2 000 m. Another association included in the *Grimaldion fragrantis* Smarda & Hadac alliance is *Trichostomo-Aloinetum aloidis* Guerra & Varo 1981, which presents the same level of xerophily as the new community. However, the genus *Syntrichia* is not usually represented in its floristic composition and its altitudinal range is always lower, being frequent in the thermo- and meso-Mediterranean belts and only occasionally occurring in the supra-Mediterranean belt.

At present, this new community is only known from the orophilous areas of southern Spain (Alicante, Almería, Granada, Jaén and Murcia) and Morocco (Rif, Middle Atlas and High Atlas) (Fig. 1).

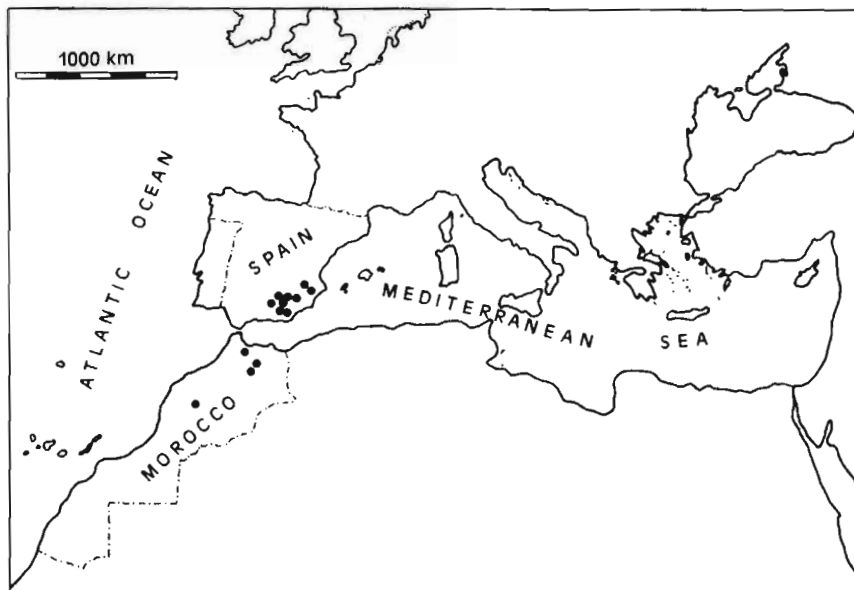


Fig. 1. Distribution of the *Tortulo subulatae-Syntrichietum ruralis* association.

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