Contribution to the bryophyte flora of Morocco:
the Anti-Atlas catalogue

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Abstract – The bryophytes of the Anti-Atlas (Morocco) are catalogued. 88 bryophytes (69 mosses and 19 liverworts) are reported from bibliographic and new collections, of which three are new records for Africa (Didymodon sicculus M.J. Cano, Ros, García-Zamora & J. Guerra, Syntrichia minor (Bizot) M.T. Gallego, J. Guerra, M.J. Cano, Ros & Sánchez-Moya and Tortula muconifera W. Frey, Kürschner & Ros), one for the Maghreb (Hymenostylium hildebrandii (Mull. Hal.) R.H. Zander) and one for Morocco (Weissia condensa var. armata M.J. Cano, Ros & J. Guerra).

Bryophyte flora / Northern Africa / Canary Islands / Morocco / Anti-Atlas

INTRODUCTION

The Anti Atlas is situated in southern Morocco, extending from the Ifni coast to the proximity of Tafilalt (Fig. 1). It is separated from the High Atlas by the Sous Valley and Dadès Wadi. It is generally lower than the High Atlas, although the Jbel Sarhro reaches 2712 m. Geologically, it is formed by Precambrian and Paleozoic materials, which are strongly folded, providing a tabular landscape due to the horizontal position of the strata. Sometimes these materials are covered of Mesozoic and Cenozoic materials (Ruiz-Laso, 1986). Thus, the lithological base of the study area is mainly composed of schists, calcareous rocks, quartzites, basalts and granites.

The northwestern part has a dry Mediterranean climate, with mild temperature due to the influence of the Atlantic, with an average annual rainfall of about 100-300 mm, which increases with height. However, most of the southern and eastern parts of the Anti-Atlas present an arid or Saharan Mediterranean climate, with large differences in temperature between days and nights and an average annual rainfall of less than 150 mm (Charco, 1999).

Despite these conditions, the flora and vegetation of the Anti-Atlas is highly interesting, because of Macaronesian and dry-tropical influence on its western side and Saharian affinities toward the east and south. The vegetation is dominated by Argania spinosa Skeels, which, in the west, where the influence of the

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Atlantic Ocean is greatest, is associated with some cactiform species of the genus *Euphorbia* (*E. resinifera* Berg, *E. echinus* Hook. f. & Coss.). In more continental conditions, *Acacia gummosa* Willd. appears together with *Ziziphus lotus* (L.) Lam., which is frequent in the small depressions where humidity is retained for a longer time than in surrounding areas. Also of note are the *Quercus rotundifolia* Lam. forest in Jbel Leskt and the relict *Dracaena draco* subsp. *aigal* Benabd & Cuzin populations in the Jbel Imaiz, the latter associated with other rare or endemic species such as *Laurus azorica* (Seub.) Franco, *Olea marocana* Greuter & Burdet or *Aeonium arboreum* (L.) Webb & Berthel. (Benabd & Cuzin, 1997). Where the influence of the Sahara is strongest, a savannah of *Acacia ehrenbergiana* Hayne and *A. raddiana* Savi appears.

From a bryological point of view, the Anti-Atlas has been neglected. Thus, very few sites have been studied, in which only 16 liverworts and 18 mosses have been reported. The first records about the bryophytes of the Anti-Atlas were those of Werner (1932), who reported two mosses in a wider work on the cryptogamic flora of Morocco. In subsequent contributions, Maire & Werner (1934) mentioned three bryophytes and Gattefossé & Werner (1935) mentioned in addition four mosses and five liverworts. Later, Meylan (1937) described a new species, *Physcomitrium marocanum* Meyl., from material collected in this area.

Other contributions were made by Jovet-Ast (1955a,b, 1956) who cited eight hepatics, some of them new for the area. Jelenc (1955), in his compiled work of the bryophytes from North Africa, mentioned the presence of some bryophytes from this area and afterward reported two more mosses and hepatics (Jelenc, 1967).

More recently Bischler (1978) mentioned the presence of *Plagiochasma rupestre* (J.R.Forst. & G.Forst.) Steph., and Frahm (1988) cited five bryophytes. Other previous records from the Anti-Atlas were from Jbel Siroua, which is included by some authors in the Anti-Atlas and by others as a part of the High-Atlas. In this study, we have not considered the Jbel Siroua belonging to the Anti-Atlas, because the species of bryophytes which grow in the higher part of this mountain show more affinity with those of the High-Atlas mountains.

In this paper, we report the list of bryophytes collected during two bryological expeditions to the Anti-Atlas that took place in April 2000 by M.J. Cano, J.A. Jiménez & R.M. Ros and in March 2001 by M.J. Cano & J. Muñoz. Also, all the bryophytes cited in the bibliography of this area and some material collected by R.R. Brooks, C. Dunn, J.R. Edmondson & M. Leblanc, which were kindly sent by S.L. Jury (University of Reading), have been included. With this work, we continue with our contributions to deepen on the knowledge of the bryophyte flora.

Tab. 1. Main range extensions represented by the recent discoveries in the Anti-Atlas.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Range extension</th>
<th>Previous distribution in Africa</th>
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<tbody>
<tr>
<td><em>Didymodon secundus</em></td>
<td>Africa</td>
<td></td>
</tr>
<tr>
<td><em>Hymenostylium hildebrandi</em></td>
<td>Maghreb</td>
<td>Somalia</td>
</tr>
<tr>
<td><em>Syntrichia minor</em></td>
<td>Africa</td>
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<tr>
<td><em>Tortula mucronifera</em></td>
<td>Africa</td>
<td></td>
</tr>
<tr>
<td><em>Weissia condensa var. armata</em></td>
<td>Morocco</td>
<td>Algeria</td>
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</table>
and vegetation of the main mountain ranges of Morocco (Ros et al., 2000; Jiménez et al., 2002, b).

The catalogue of the study area includes 88 taxa, of which 69 are mosses and 19 liverworts. Based on the checklist to Dirkse et al. (1993), O’Shea (1999), Ros et al. (1999) and Wigginton (2002), three are new for Africa, one for the Maghreb (Morocco, Algeria and Tunisia), one for Morocco and forty-four for the Anti-Atlas. Also, Syntrichia minor (Bizot) M.T. Gallego, J. Guerra, M.J. Cano, Ros & Sánchez-Moya is reported for the first time from the Canary Islands. The most significant records are summarized in Table 1.

Of the thirty-four bryophytes reported in the literature, 19 were not found by us. Most of them correspond to liverworts cited by Jovet-Ast, whose identifications we consider reliable. We have not been able to study the old collections, except some of them which were published by Cano et al. (2000).

The nomenclature is based on that of Ros et al. (1999) except in the case of some taxa that have been subject to more recent changes. For each taxon, the numbers of the localities where they were found (according to Table 2) are given, followed by a brief description of the habitat occupied in the study area and previous reports, if any. In the cases of new records, distribution of the species and additional comments are also included. All the specimens cited are deposited in MUB.

**LIST OF BRYOPHYTES FROM THE ANTI-ATLAS**

**Mosses**

*Acaulon* sp. — Site: 10. — On bare soil in an almond tree crop. This sample presents the same gametophytic characters as *Acaulon fontiquierianum* Casas & Sérgio with its typical inflated ventral costa cells. However, due to the absence of sporophytes, we prefer not to describe this taxon as a new record for the African continent.


*Aloina bifrons* (De Not.) Delgad. — Sites: 1, 3, 5. — On bare soils. In Morocco it had only been cited by Gallego et al. (1999). New for the Anti-Atlas.


*Aloina rigida* (Hedw.) Limpr. — Sites: 1, 3, 4, 6, 7, 8, 9, 12, 14, 16, 22, 23. — On open soils, in fissures of travertine, scree, and soils accumulated at the bases of calcareous, quartzitic or igneous rocks. Previously, it was cited *sub Aloina stellata* Kindb. by Gattefossé & Werner (1935) from Arba des Ait Baha and Taderrast, valley of oued Massa.

*Anacolia webbii* (Mont.) Schimp. — Reported by Jelenc (1955) from Jebel Leskt.


*Barbula unguiculata* Hedw. — Site: 1. — Soil accumulated at the edge of an irrigation channel. New for the Anti-Atlas.
Bartramia stricta Brid. — Sites: 6, 7, 9, 11, 14, 15. — Ledges and soil accumulated at the bases of quartzitic or igneous rocks. Also reported by Jelenc (1955) from Agadir n° Tafert and Jebel Leskt.


Bryum argenteum Hedw. — Sites: 3, 5, 6, 8, 9, 10, 11, 12, 13, 27. — Fissures, ledges, scree, soils accumulated at the bases of calcareous, quartzitic and igneous rocks and open soils. New for the Anti-Atlas.

Bryum bicolor Dicks. — Sites: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 15, 20, 21, 22. — Dry soils, ledges, fissures and soils accumulated on calcareous or igneous rocks. Also reported from Sidi Moussa, near Aghou (Gattefossé & Werner, 1935).


Bryum muehlenbeckii Bruch & Schimp. — Sites: 6, 24. — Scree and wet rocks in stream. In the Northern Africa, this species had only been reported from Jebel Toubkal, High Atlas (Ros et al., 2000). New for the Anti-Atlas.

Bryum radiculosum Brid. — Sites: 1, 16. — Scree and soil accumulated at the edge of an irrigation channel. New for the Anti-Atlas.


Crossidium aberrans Holz. & E.B. Bartram — Sites: 1, 11, 12, 13, 14, 15, 16, 18, 19, 20, 26, 28. — Open soils, fissures, scree, ledges and soils accumulated at the bases of calcareous or igneous rocks. New for the Anti-Atlas.

Crossidium crassinerve (De Not.) Jur. — Sites: 3, 8, 13, 16, 18, 22, 28. — Scree, ledges of calcareous or igneous rocks and bare soils. New for the Anti-Atlas.

Crossidium laevidulum Thér. & Trab. — Sites: 1, 2, 3, 5, 8. — Small depressions or open soils and soil accumulated at the bases of calcareous rocks. New for the Anti-Atlas.

Crossidium squamiferum (Viv.) Jur. — Sites: 1, 2, 3, 5, 6, 8, 9, 11, 13, 14, 15, 16, 20, 22, 23, 26. — Fissures, ledges, scree, soils accumulated at the bases of calcareous, quartzitic or igneous rocks and open soils. New for the Anti-Atlas.

Didymodon acus (Brd.) K. Saito — Reported by Maire & Werner (1934) sub. Barbula acuta (Brd.) Brid. from Djebel Inter.

Didymodon australasiae (Hook. & Grev.) R.H. Zander — Sites: 1, 2, 3, 6, 7, 8, 9, 12, 13, 14, 15, 16, 20, 21, 22, 23, 26, 27, 28. — Scree, ledges, and soils accumulated at the bases of calcareous, quartzitic or igneous rocks and open soils. New for the Anti-Atlas.

Didymodon insulanus (De Not.) M.O. Hill — Sites: 11, 12. — Fissures of quartzitic rocks and soil under Quercus rotundifolia. New for the Anti-Atlas.

Didymodon rigidulus Hedw. — Sites: 1, 3, 4, 6, 8, 11, 13, 14, 15, 16, 20, 23. — Bare soils, scree, ledge, soils accumulated at the bases of calcareous or igneous rocks or at the edge of an irrigation channel. New for the Anti-Atlas.

Didymodon siculcus M.J. Cano, Ros, García-Zamora & J. Guerra — Sites: 17, 27. — On soil accumulated at the edge of an irrigation channel and ledge of basalt rock. It is similar to D. luridus but can be distinguished by its leaves occasionally bistratose, with papillose, 6-14 mm wide upper laminar cells, rectangular basal cells and recurved margins from near the apex to the base. Hitherto, it was only known from southeastern Iberian Peninsula (Cano et al., 1996; Sánchez-Moya & Cano, 1999), Balearic Islands (Cano et al., 2001) and Greece (Blockeel et al., 2002). New record for Africa.


Encalypta vulgaris var. mutica Brid. — Reported by Jelenc (1955) sub Encalypta vulgaris var. obtusifolia (Funck) Husn. from Jebel Sarhro, Amalou n’mannsour.

Entostodon hungaricus (Boros) Loeske — Reported by Meylan (1937) sub Physcomitrium maroccanum Meyl. from oued Noun.

Fabronia pusilla Raddi — Site: 12. — Ledge of basalt rock. Also, reported by Werner (1932) from Tizi-n-Tarhantine.


Fissidens crispus Mont. — Reported by Gattefossé & Werner (1935) sub Fissidens herzogii from gorges of Taderrast, S. oued Massa.

Fissidens sublimatus Grout — Site 27. — Crevice of basalt rock. This species has recently been reported from Rif Cordillera and High Atlas in Morocco and Canary Islands (Ros et al., 2001). New for the Anti-Atlas.

Funaria muhlenbergii Turner — Reported by Jelenc (1955) sub Funaria dentata var. mediterranea (Lindb.) J.J. Amann from Jebel Inter.

Funaria pulchella H.Philip. — Reported by Frahm (1988) between Touroy and Achouria, along the Tinerhir-Tafillalt road.


Grimmia laevigata (Brid.) Brid. — Sites: 6, 7, 11, 12, 13, 15, 21. — Exposed quartzitic or igneous rocks. Also reported from Taliouine, Tizi n’Taratine sub Grimmia campestris Burch. ex Hook. (Werner, 1932).


Grimmia pulvinata (Hedw.) Sm. — Sites: 2, 11, 12, 26, 28. — Ledges of basalt rock or quartzitic rocks. New for the Anti-Atlas.

Gymnostomum sp. — Jelenc (1955) reported Hyophylla perpusilla Thér. & Trab. from Ait el Hadj. We have not been able to study this record. However, according to Cano et al. (2000), the type material of Hyophylla perpusilla corresponds to a species of Gymnostomum (G. lanceolatum M.J. Cano, Ros & J. Guerra or G. mosis (Lorentz) Jur. & Milde) with bistratose margined leaves.

Gymnostomum viridulum Brid. — Sites: 1, 8, 11, 14, 16, 27. — Scree, ledge of igneous rocks and soil accumulated at the edge of an irrigation channel. Also reported from S of Agadir along road S509 2-3 km S. of Ait Baha, Tafroute and between Touroy and Achouria, along the road Tinerhir-Tafillalt sub Gymnostomum luisieri (Sérgio) Sérgio ex Crundw. (Frahm, 1988).

Hymenostylium hildebrandti (Müll. Hal.) R.H. Zander (Fig. 2). — Site: 27. — Ledge of basalt rock. It can be distinguished from other species of
*Hymenostylium* by its lingulinate to short-lanceolate or spatulate leaves and obtuse or acute apex (Müller, 1876). According to Kürschner (1998), it is a paleotropical species known only from Somalia and Yemen. In these localities, the species grows mainly in xero-tropical habitats influenced by the summer monsoons, together with other tropical species such as *Pleurochaete malacophylla* (Müll. Hal.) Broth., *Lejeunea aethiopica* E.W. Jones, *Tortula porphyreoneura* (Müll. Hal) C.C. Towns., etc. In the Jebel Sarhro, the tropical influence is less, growing in association with more xerophytic species such as *Didymodon australasiae*, *Pottia starckeanana* (Hedw.) Müll. Hal., *Targionia hypophylla* L. and *Tortula atrovirens* (Sm.) Lindb. With this record, the distribution area of *H. hildebrandtii* is extended to the northwestern part of Africa. New record for the Maghreb.


**Pleurochaete squarrosa** (Brid.) Lindb. — Sites: 2, 6, 9, 11, 12, 13, 15. — Ledges and soil accumulated at bases of calcareous and basalt rocks. New for the Anti-Atlas.


**Pottia starckeanana agg.** (Hedw.) Müll. Hal. — Site: 12. — On bare soil.

**Pseudocrossidium hornschuchianum** (Schultz) R.H. Zander — Sites: 6, 9, 13. — Scree and soil at the base of igneous or quartzitic rocks. New for the Anti-Atlas.

**Pterygoneurum ovatum** (Hedw.) Dixon — Sites: 5, 23. — Small depression in open soil and fissures of travertine. New for the Anti-Atlas.

**Schistidium flaccidum** (De Not.) Ochyra — Site: 11. — Ledge of basalt rock. New for the Anti-Atlas.
Scleropodium touretii (Brid.) L.F. Koch — Site: 11. — Ledge of basalt rock. Also, reported by Jelenc (1955) sub Scleropodium illecebrum Schimp. from Jebel Leskot.


Syntrichia caninervis Mitt. — Sites: 21, 23. — On igneous rock and fissures of travertine. This species has recently been reported from Morocco (Gallego et al., in press). New for the Anti-Atlas.

Syntrichia caninervis var. gypsophila (J.J. Amann ex G. Roth) Ochyra — Site: 3. — On bare soil. This taxon has recently been reported from Morocco (Gallego et al., in press).


Syntrichia minor (Bizot) M.T. Gallego, J. Guerra, M.J. Cano, Ros & Sánchez-Moya. (Fig. 3) — Sites: 11, 15. — Soil on granitic or basalt rock. It is close to Syntrichia virescens (De Not.) Ochyra, but can mainly be distinguished by the type of papillosity on the laminal leaf cells (1 pedicellate and branched papillae per cell, which is 12-17 mm in length, in S. minor and 2-4(5) bifurcate papillae, whose length does not exceed 5 mm in S. virescens). Previously, it was reported from Lebanon, Cyprus and Spain (Gallego et al., 2000) and recently from Greece (Blockeel et al., 2002). Also, we report this species from the Canary Islands [La Palma, Caldera de Taburiente, Mirador de los Andenes, 28°46′N 17°32′W, 2350 m., 2 Aug 2000, M.J. Cano s.n.]. New record for Africa.


Fig. 3. Distribution of Syntrichia minor (Bizot) M.T. Gallego, J. Guerra, M.J. Cano, Ros & Sánchez-Moya.
**Syntrichia princeps** (De Not.) Mitt. — Sites: 11, 12. — Soil under *Quercus roundifolia*. New for the Anti-Atlas.

**Syntrichia ruralis** (Hedw.) F. Weber & D. Mohr — Reported by Jelenc (1967) from Agadir n’Tigert (Agadir n’Tiferch?) sub *Tortula ruralis* (Hedw.) P. Gaertn., B. Mey. & Scherb.

**Scorpiurium deflexifolium** (Solms) M. Fleisch. & Loeske — Site: 6. — Soil accumulated at the bases of igneous rocks. New for the Anti-Atlas.

**Tortula atrivirens** (Sm.) Lindb. — Sites: 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 21, 22, 23, 26, 27, 28, 29. — Bare soils, fissures, scree, ledges and soils at the base of calcareous, quartzitic or igneous rocks. Also reported from Jebel Ighern (Jelenc, 1955). In the study area, we have found some samples buried in soil, showing leaves with supracostal filaments, 2(3) cells high (sites 3, 5 and 8). This form has been described as *Crossidium davidiae* Catches. (Cano et al., 1993; Dirkse & Bouman, 1995; Stern, 1995), but we think that, at least for the material from Morocco, it is only a modification of *T. atrivirens* in very dry conditions.

**Tortula cuneifolia** (With.) Turner — Sites: 6, 9, 11, 12. — Bare soil, scree and soil at the bases of quartzite and basalt rocks. Also reported by Gattefossé & Werner (1935) from Arba des Ait Baha.

**Tortula inermis** (Brid.) Mont. — Sites: 11, 12, 15, 21, 22, 26, 28. — Ledges, fissures or soil accumulated on calcareous or igneous rocks. Also reported from Jbel Sarhro, Tizi’n Tazazerte by Jelenc (1967).

**Tortula mucronifera** W. Frey, Kürschner & Ros (Fig. 4) — Sites: 26, 28. — Ledges and fissure of basalt rock. It is easily characterized by its ovate-elliptic to lingulate-spathulate leaves, with revolute margins, mucronate apex, costa thickened ventrally by a row of 3-4 elongated, swollen, papillose cells and a short peristome of 32 filiform, irregular by broken, not twisted teeth. Although the material from Morocco has no sporophyte, we have been able to identify the species on the basis of its gametophytic characters. It was only known from Saudi Arabia, Yemen and Oman, where it was collected on calcareous and sandy soils, between limestone and basalt rocks, in extreme dry areas (Frey et al., 1994). In the Anti-Atlas it grows in very similar habitats associated with *Crossidium aberrans*, *C. crassinerve*, *C. squamiferum*, *Didymodon australisae*, *Tortula atrivirens* and *Weissia condensa* var. *armata* M.J. Cano, Ros & J. Guerra. Like *Hymenosystylum hildebrandtii*, this species shows a very interesting disjunction between the xerophytic areas of the Southwestern Asia and Northernwestern Africa. **New record for Africa.**

**Tortula muralis** Hedw. — Sites: 3, 28. — Bare soils. New for the Anti-Atlas.

**Tortula revolvens** (Schimp.) G. Roth — Sites: 1, 3, 13, 16. — Bare soils, ledge and soil accumulated at the bases of calcareous rocks. New for the Anti-Atlas.

**Trichostomum brachydontium** Bruch — Sites: 7, 8. — Scree and soil accumulated at the bases of igneous rocks. New for the Anti-Atlas.

**Weissia condensa** var. *armata* M.J. Cano, Ros & J. Guerra — Sites: 2, 20, 26, 28. — On ledge of calcareous rock and fissure of basalt rock. This taxon is very close to *Weissia condensa* (Voit.) Lindb. var. *condensa* from which it can be distinguished by the less Incurvate leaves and the presence of long and branched papillae over the median ventral lamina surface and near the costa. It was previously only known from Tadzhikistan and the Iberian Peninsula sub *W. papillosissima* Laz. (Moya et al., 1995). Recently, it has been recorded from Algeria (Cano et al., 2000) and Balearic Islands (Cano et al., 2001). New record for Morocco.
Liverworts

_Athalamia spathysii_ (Lindenb.) S. Hatt. — Reported by Gattefossé & Werner (1935) sub _Clevea spathysii_ (Lindenb.) Müll. Frib. from Taderrast, gorges of oued Massa.

_Fossumbronia angulosa_ (Dicks.) Raddí — Reported by Jelenc (1955) from Jebel Leskt.

_Fossumbronia wondraczekii_ (Corda) Lindb. — Reported by Maire & Werner (1934) from Jebel Intar.


_Lunularia cruciata_ (L.) Lindb. — Sites: 6. — Soil accumulated at the bases of igneous rocks. Also cited between Touroy and Achouria, along the road Tinerhir-Tafilalt (Frahm, 1988).

_Mannia androgyna_ (L.) A. Evans — Reported by Gattefossé & Werner (1935) from Jebel Leskt, Arbas des Ait Baha and Ida ou Gnidiif.

_Oxymitra incassata_ (Brot.) Sérgio & Sim-Sim — Site: 9. — Scree on quartzite. Also cited from oued Massa sub _Oxymitra paleacea_ Bisch. ex J. Lindb. (Jovet-Ast, 1955a,b).

_Plagioclasma rupestre_ (J.R. Forst. & G. Forst.) Steph. — Sites: 2, 9. — Screes and soil accumulated at the bases of limestone or quartzitic rocks. Also reported from _Adar Ou Amane_ sub _Ayonia rupestre_ J.R. Forst. by Maire & Werner (1934) and Jelenc (1967), Anti-Atlas (Bischler, 1978) and Tafroute (Frahm, 1988).

_Riccia atromarginata_ Levier — Sites: 1, 2, 3, 5, 16. — Bare soils, scree and soil accumulated at the bases of limestone rocks. Also cited 38 km N. of Tiznit,
on the path from Tassila to the Agadir-Tiznit road, oued Massa (Jovet-Ast, 1955a,b).

*Riccia cavernosa* Hoffm. — Reported by Frahm (1988) between Touroy and Achouria, along the Tinerhir-Tafilalt road.

*Riccia ciliata* Hoffm. — Reported from Taderrast, gorges of oued Massa (Gattefossé & Werner, 1935) and oued Noun (Jelenc, 1955).

*Riccia crustata* Trab. — Reported from oued Massa, near the bridge on the Tiznit road and near the mouth of oued Massa (Jovet-Ast, 1955b).

*Riccia goutetiana* Durieu & Mont. var. *armatissima* Liever ex Müll. Frib. — Sites: 2, 8, 9. — Scree on quartzitic rocks and bare soils. Also reported from Taderrast, gorges of oued Massa *sub Riccia erinacea* Schiffrn. (Gattefossé & Werner, 1935).

*Riccia lamellosa* Raddi. — Sites: 1, 2, 3, 5, 8, 9, 13, 15, 16, 18, 20, 22, 26, 27. — Bare soils, scree, ledges and soils accumulated at the bases of calcareous, quartzitic or basaltic rocks. Also reported from 38 km N of Tiznit, on the path from Tassila to the Agadir-Tiznit road, oued Massa, near the bridge on the Tiznit road, near the mouth of oued Massa (Jovet-Ast, 1955a,b) and Taderrast, gorges of oued Massa (Gattefossé & Werner, 1935).


*Riccia sorocarpa* Bisch. — Sites: 6, 9, 12. — Scree and soil accumulated at the bases of quartzitic rocks. Also reported on the path from Tassila to the Agadir-Tiznit road, oued Massa, near the bridge on the Tiznit road (Jovet-Ast, 1955a,b), Taderrast, gorges of oued Massa (Gattefossé & Werner, 1935) and Jebel Inter (Maire & Werner, 1934).

*Riccia trabutiana* Steph. — Site: 1. — Soil accumulated at the bases of calcareous rocks. Also reported by Jovet-Ast (1955a) *sub Riccia atromarginata* var. *glabra* Liever ex Müll. Frib. on the path from Tassila to the Agadir-Tiznit road and near the mouth of oued Massa.

*Riccia trichocarpa* Howe — Reported from oued Massa, near the bridge on the Tiznit road (Jovet-Ast, 1955b).

*Targionia hypophylla* L. — Sites: 1, 2, 6, 7, 8, 9, 11, 12, 13, 14, 15, 27. — Scree, ledges or soils accumulated at the bases of calcareous, quartzitic or igneous rocks. Also reported from Adrar Ou Amane (Maire & Werner, 1934; Jelenc, 1967) and oued Massa, near the bridge on the Tiznit road *sub Targionia lorbeeriana* Müll. Frib. (Jovet-Ast, 1955a, 1956).

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**REFERENCES**


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<th>Site</th>
<th>Province and locality</th>
<th>Latitude/Longitude</th>
<th>Altitude (m)</th>
<th>Main shrubs and trees</th>
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<td>770</td>
<td>Euphorbia sp. pl., Phoenix dactylifera</td>
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<tr>
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<td>Tiznit: Mestit, near Sidi Iffi.</td>
<td>29°15’N 10°06’W</td>
<td>400</td>
<td>Euphorbia sp. pl.</td>
</tr>
<tr>
<td>3</td>
<td>Tiznit: Sebt-Bou-Namane</td>
<td>29°28’N 9°50’W</td>
<td>530</td>
<td>Euphorbia sp. pl., Argania spinosa</td>
</tr>
<tr>
<td>4</td>
<td>Tiznit: Ait Bâamrân</td>
<td>29°26’N 9°53’W</td>
<td>350</td>
<td>Euphorbia sp. pl., Argania spinosa</td>
</tr>
<tr>
<td>5</td>
<td>Tiznit: 10 km S. of Tiznit</td>
<td>29°34’N 9°43’W</td>
<td>390</td>
<td>Ziziphus lotus</td>
</tr>
<tr>
<td>6</td>
<td>Tiznit: Tleta-idâ-Goughmar</td>
<td>29°31’N 9°20’W</td>
<td>860</td>
<td>Euphorbia sp. pl.</td>
</tr>
<tr>
<td>7</td>
<td>Tiznit: Col-du-Kerdous</td>
<td>29°36’N 9°20’W</td>
<td>1200</td>
<td>Argania spinosa and Euphorbia sp. pl.</td>
</tr>
<tr>
<td>8</td>
<td>Tiznit: Near Anezi</td>
<td>29°40’N 9°19’W</td>
<td>510</td>
<td>Argania spinosa, Euphorbia sp. pl.</td>
</tr>
<tr>
<td>9</td>
<td>Tiznit: 28 km N.W. Anezi, Addar</td>
<td>29°45’N 9°15’W</td>
<td>500</td>
<td>Dracaena draco, Argania spinosa Chamaeops humilis</td>
</tr>
<tr>
<td>10</td>
<td>Tiznit: Aouzert</td>
<td>29°38’N 9°14’W</td>
<td>950</td>
<td>Prunus dulcis</td>
</tr>
<tr>
<td>11</td>
<td>Tiznit: Tizi-n’Tagounit</td>
<td>29°47’N 9°05’W</td>
<td>1600</td>
<td>Quercus rotundifolia</td>
</tr>
<tr>
<td>12</td>
<td>Tiznit: Jebel Leskt</td>
<td>29°48’N 9°01’W</td>
<td>1850</td>
<td>Quercus rotundifolia</td>
</tr>
<tr>
<td>13</td>
<td>Tata: Had-Tahala</td>
<td>29°36’N 9°08’W</td>
<td>1000</td>
<td>Maytenus senegalensis</td>
</tr>
<tr>
<td>14</td>
<td>Tata: near Tafraout</td>
<td>29°44’N 8°54’W</td>
<td>1200</td>
<td>Argania spinosa</td>
</tr>
<tr>
<td>15</td>
<td>Tata: Tizi Mil</td>
<td>29°43’N 8°50’W</td>
<td>1650</td>
<td>Subshrubs</td>
</tr>
<tr>
<td>16</td>
<td>Tata: Tissgui Ida-Ou-Baloul</td>
<td>29°43’N 8°29’W</td>
<td>975</td>
<td>Subshrubs</td>
</tr>
<tr>
<td>17</td>
<td>Tata: Targannt</td>
<td>29°53’N 7°38’W</td>
<td>860</td>
<td>Phoenix dactylifera</td>
</tr>
<tr>
<td>18</td>
<td>Tata: 15 km N. of Akka-Irhèn</td>
<td>30°03’N 7°37’W</td>
<td>950</td>
<td>Nerium oleander, Retama sp.</td>
</tr>
<tr>
<td>19</td>
<td>Tata: Tisnassemene</td>
<td>30°02’N 7°48’W</td>
<td>1200</td>
<td>Nerium oleander, Retama sp.</td>
</tr>
<tr>
<td>20</td>
<td>Taroudannt: Near Igherm</td>
<td>30°03’N 8°27’W</td>
<td>1675</td>
<td>Subshrubs</td>
</tr>
<tr>
<td>21</td>
<td>Taroudannt: Igherm</td>
<td>30°04’N 8°27’W</td>
<td>1800</td>
<td>Subshrubs</td>
</tr>
<tr>
<td>22</td>
<td>Taroudannt: Agadir-Mellou</td>
<td>30°15’N 7°48’W</td>
<td>1700</td>
<td>Tamarix sp., Populus sp., Nerium oleander</td>
</tr>
<tr>
<td>23</td>
<td>Taroudannt: N. of Tamjercht</td>
<td>30°26’N 7°50’W</td>
<td>1540</td>
<td>Subshrubs</td>
</tr>
<tr>
<td>24</td>
<td>Ouazarzate: mountain S. of Amid, 19 km E. of Bou Azzer</td>
<td>30°32’N 6°39’W</td>
<td>1400</td>
<td>–</td>
</tr>
<tr>
<td>25</td>
<td>Ouazarzate: N side of Jebel Ightem, 25 km E. of Bou Azzer</td>
<td>30°31’N 6°40’W</td>
<td>1600</td>
<td>–</td>
</tr>
<tr>
<td>26</td>
<td>Ouazarzate: Jebel Sarhro, E. of Tasettit</td>
<td>31°22’N 05°33’W</td>
<td>1260</td>
<td>Subshrubs</td>
</tr>
<tr>
<td>27</td>
<td>Ouazarzate: Jebel Sarho, Taourirt n-Irhèl</td>
<td>31°19’N 05°36’W</td>
<td>1800</td>
<td>Subshrubs</td>
</tr>
<tr>
<td>28</td>
<td>Ouazarzate: Jebel Sarho, Khettart-n-Ikeddarn</td>
<td>31°17’N 05°35’W</td>
<td>1750</td>
<td>Artemisia shrubs</td>
</tr>
<tr>
<td>29</td>
<td>Ouazarzate: Erfoud-Tinejad road, 47 km before Tinejad</td>
<td>31°31’N 04°36’W</td>
<td>900</td>
<td>Subshrubs</td>
</tr>
</tbody>
</table>


