

*Campylopus introflexus* (Hedw.) Brid (syn.: *Dicranum introflexum* Hedw.)

Newly located taxon in Morocco

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### **Abstract**

*Campylopus introflexus* has been mentioned in some documents of the bryological flora of Morocco but its location has never been mentioned. The objective of this work is to clarify this location and describe the species. Surveys carried out in the Middle and High Atlas, the Rif, the Rabat region and the Benslimane region have shown that *Campylopus introflexus* is confined to the Mamora forest. It was harvested there from the decaying wood and from the trunk of *Quercus suber*.

### **Introduction**

*Campylopus introflexus* is a moss in the Family Leucobryaceae. It was previously classified in the family Dicranaceae (Augier, 1966). It has already been reported in Morocco but without any details on its location (Jelenc, 1955a, cited by Ros et al., 1999). Also Ros et al. in 2013 described its presence as dubious given that it was cited only once in a report based on collections published before 1962.

Thus, the objective of this work is to specify the location of *Campylopus introflexus* and to describe it.

### **Material and methods**

The Mamora forest is located in northwestern Morocco, along the Atlantic Ocean, between the longitudes 6° and 6°45' west and the latitudes 34° and 34°20' north (Fig. 1). It is part of a rectangle 60 km long, from west to east and 30 km wide, from north to south (Aafi, 2007)

it covered more than 130,000 ha at the beginning of the twentieth century (Emberger, 1939; Benabid, 2000). Today, it covers less than 60,000 ha (Benabid, 2000). It is the largest contiguous suberaie in the world. It is subdivided into 5 cantons.

The exploration we conducted in spring 2015 concerned cantons A, B and C. Cantons E and D have been discarded because they are, for the most part, private enclaves. The sampling adopted is of the random stratified type. Among the 245 plots of the 3 cantons invested, a random draw made it possible to designate 50 plots that we consider as stations given the homogeneity of their conditions (Table 1). The proportional random stratified drawing is carried out on Excel thanks to the alea function by taking the cantons as strata. Random points are generated at the rate of one point per plot drawn.

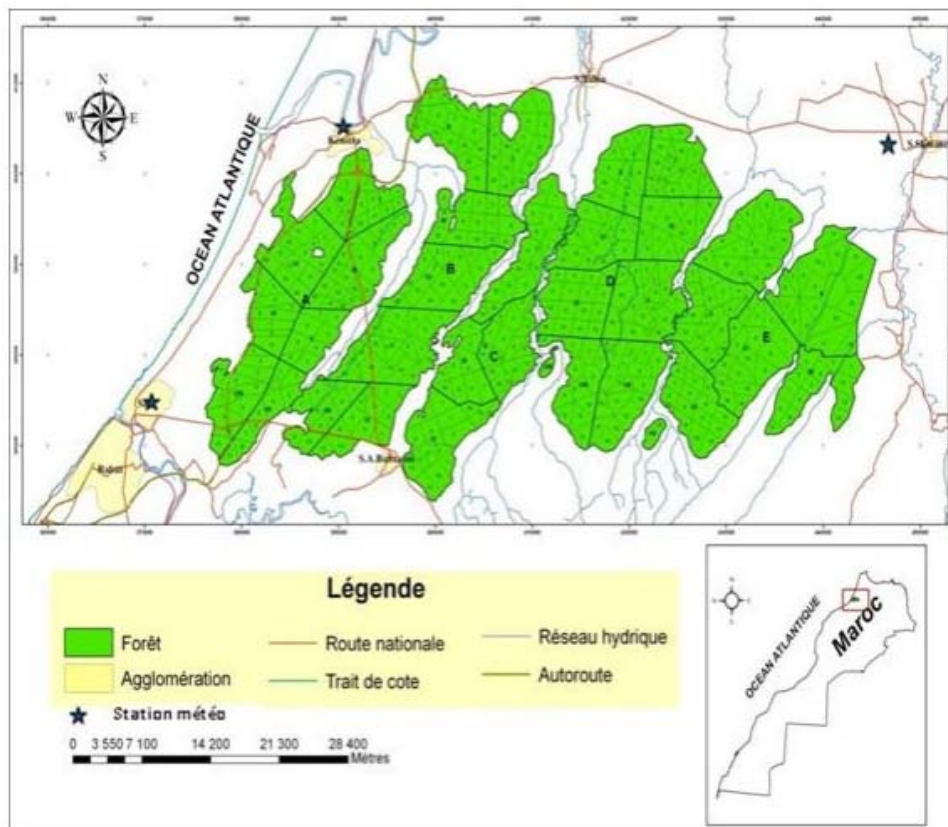


Figure 1 : Geographical location map of Mamora (FAO and HCEFLCD, 2015)

The collected samples were identified in the laboratory, using the keys of determination: Augier (1966), Pierrot (1974), Boulay (1884), Smith (1990), and Casas et al (2006). The herbarium was deposited at the Laboratory of Plant, Animal and Agro-Industry Productions.

Identification was done by observation of all macroscopic and microscopic characteristics of each of the samples by referring to the characters described in the determination keys.

### **Index of Ecological Significance (IES) of *Campylopus introflexus* in cantons A, B and C.**

The relative frequency was estimated using the Index of Ecological Significance (IES) (Lara & Mazimpaka, 1998; Albertos et al., 2001), whose mathematical expression is as follows:  $IES = F(1 + C)$

F is the relative frequency;  $F = 100 * x / n$ , where x is the number of samples containing the species and n is the total number of samples; C: average coverage;  $C = \sum ci / x$ , where ci represents the coverage class assigned to the species in each sample.

In each of the stations and to each species sampled, an index is assigned that corresponds to the coverage class. This index will allow the calculation of the IES (Index of Ecological Significance). The Index/Coverage Class correspondence scale is as follows:

<b>Index</b>	0,5	1	2	3	4	5
<b>Class</b>	<1%	1% à 5%	6% à 25%	26% à 50%	51% à 75%	> 75%

In the index (IES), coverage and frequency, which are the 2 abundance parameters, are combined to best reflect any change in species abundance (Albertos et al., 2001). IES values are combined with frequency classes as follows: very rare (IES<25), rare (26–50), moderately abundant (51-100), abundant (101-200) and dominant (> 200).

## **Results and discussion**

Based on the work done on the bryophytes of Morocco, we found that *Campylopus introflexus* was reported but without any details about the locality. The exploration of 50 stations across the three cantons (A, B and C) of the Mamora suberaie in the spring of 2015 made it possible to locate *Campylopus introflexus* in 7 stations (Table 1 and Figure 2). The species has been observed on *Quercus suber* cork, as well as on decaying wood in the following plots: AVIII 8, BIII 6, BIII 7, CIII 10, CIV1, CIV10 and CIV12 (Table 1).

*Campylopus introflexus* was located in a single plot located in the southern part of Canton A, two parcels in the north of Canton B and in 4 parcels in the southern half of Canton C.

Table 1: Stations sampled with their GPS points (stations with an asterisk are those containing *Campylopus introflexus*).

<b>Station</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Station</b>	<b>Latitude</b>	<b>Longitude</b>
AI6	34,21179	-6,56935	<b>BIII 6 *</b>	34,18364	-6,40039
AI10	34,19706	-6,56980	<b>BIII 7 *</b>	34,18575	-6,42521
AII3	34,21212	-6,58481	BIV1	34,16837	-6,40794
AIII14	34,13427	-6,59386	BIV13	34,13673	-6,45787
AIII15	34,13596	-6,60867	BV1	34,11746	-6,48762
AIII18	34,12814	-6,61549	BV11	34,09336	-6,55672
AIV1	34,18105	-6,59856	BV16	34,07512	-6,56065
AIV6	34,21117	-6,64944	BV17	34,08451	-6,57716
AIV10	34,18130	-6,64699	BVI 7	34,01784	-6,54336
AV 5	34,08729	-6,60922	BVI8	34,03171	-6,55026
AVI 4	34,12979	-6,64247	BVII0	34,02636	-6,57599
AVII 5	34,03741	-6,68268	BVII2	34,01785	-6,59932
AVII 7	34,02509	-6,68686	BVII1	34,06401	-6,55562
AVII 8	34,01464	-6,70177	BVII10	34,02230	-6,60474
AVIII 1	34,08443	-6,66395	CI7	34,17577	-6,36384
<b>AVIII 8 *</b>	34,00945	-6,70021	CI8	34,17176	-6,36784
AVIII 10	34,02198	-6,70747	CI11	34,15096	-6,39115
AVIII11	34,01498	-6,72032	CI12	34,14136	-6,39848
BI 5	34,27765	-6,39273	CII 11	34,09625	-6,43060
BI 6	34,24875	-6,37521	CII 12	34,08574	-6,37483
BII 1	34,29982	-6,48255	<b>CIII 10 *</b>	34,04918	-6,46373
BII3	34,27936	-6,46001	<b>CIV1 *</b>	34,04434	-6,45833
BII5	34,28936	-6,49337	CIV9	34,01136	-6,49220
BIII1	34,26132	-6,47240	<b>CIV10 *</b>	33,97892	-6,48047
BIII3	34,27058	-6,49932	<b>CIV12 *</b>	33,99498	-6,50746

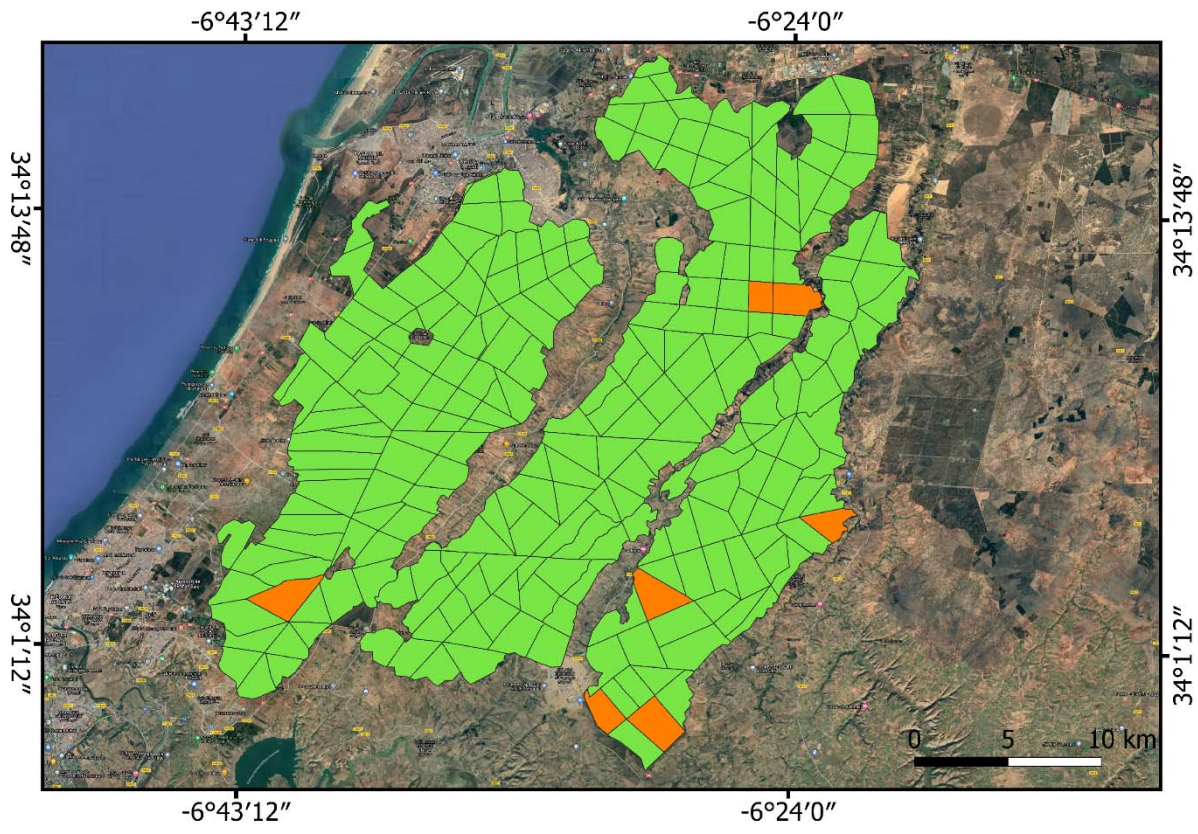


Figure 2: Map showing *Campylopus introflexus* location stations in orange

The calculation of the IES of *Campylopus introflexus* gives values well below 25 (Table 2). It is therefore a very rare species in the area. That said, the plant spreads relatively better in Canton C. Observation of the variation of the IES may suggest that the spread of *Campylopus introflexus* follows a continental gradient. It would develop best in semi-arid bioclimates. This can be reinforced by Canton A where the station containing the species is located in the south probably fleeing the wetter climates of the northern part of the Mamora.

Table 2: IES (Ecological Significance Index) of *Campylopus introflexus* in cantons A, B and C of the Mamora suberaie.

Ecological Significance Index (IES)			
	Canton A	Canton B	Canton C
<i>Campylopus introflexus</i>	6	8	20



## **Ecology of *Campylopus introflexus***

*Campylopus introflexus* has a high ecological tolerance and its preferred environments vary according to biogeographical sectors (Dumas, 2011). It has been reported in flat-bottomed basins on siliceous rocks lit in the moors, flats according to Augier, (1966) and in the moors and coastal sands according to Pierrot (1982). According to Smith (2004), it is common and sometimes locally abundant in the wettest parts of the British Isles most often on bare peat and on sandy or gravelly soil in peatlands. According to the same author, *Campylopus introflexus* is found on burnt moors, rotten wood or tree trunks, rarely on rocks and tiles. It grows on decaying pine wood and peaty soils according to Casas et al, (2006). On decaying wood as well as at the base of *Quercus suber* according to El harech et al. (2020).

## **Range of *Campylopus introflexus***

According to Ros et al.2013, *Campylopus introflexus* has been reported in the following countries: the Açores Islands, the Balearic Islands, Spain, France, Italy, Madeira, Portugal, the Canary Islands, Corsica, Sardinia, Tunisia, Turkia, Algeria and Morocco. In Morocco, only ancient works have cited it without specifying its location (Jelenc, 1955). The present work makes it possible to fill this gap and to give some locations of the species.

## **Description**

*Campylopus introflexus* is a golden acrocarp moss (Figure 3: a), up to 4 cm tall. It has erect leaves (Figure 3: d), oblong, subulated, about 3 to 4 millimeters long, ending in a toothed hyaline tip (Figure 3: e). The median cells of the blade are short, rhomboidal, irregular, thick-walled. The basal cells are hyaline, extending upwards from the margins. The wing cells are reddish to brown in the old leaves (Figure 3: f). The plant rarely fruited according to Augier (1966).

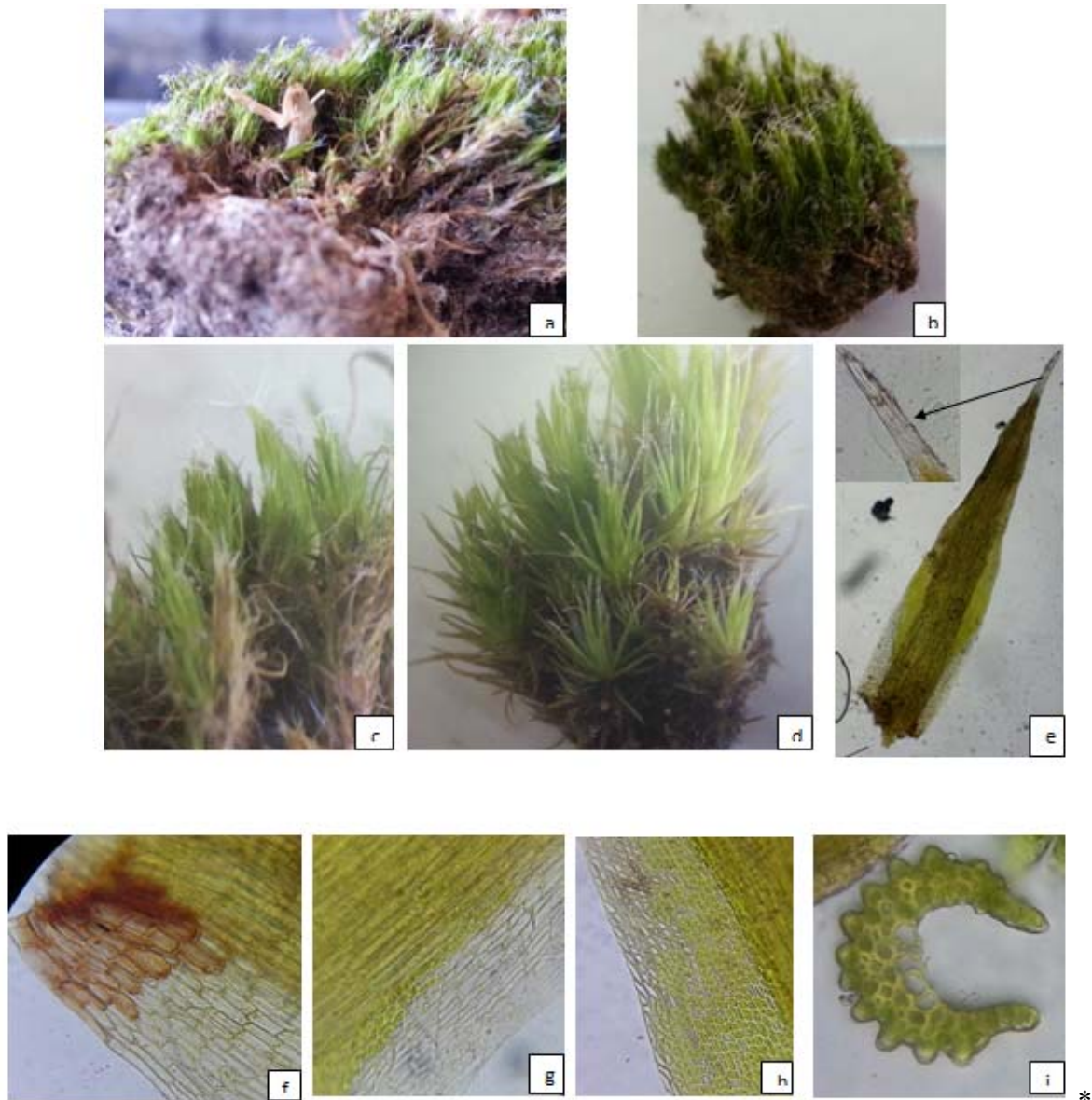


Figure 3: *Campylopus introflexus*: a and b) plant in situ. (c) tuft in the dry state under LB, G×20. (d) tuft hydrated under LB, G×20. (e) OM of a sheet ×40. f, g and h) OM respectively of apical cells; median and basal leaves ×400. (i) OM of a cross-section at the top of the sheet ×400.

### **Conclusion :**

The present work has the merit of specifying the location of *Campylopus introflexus* in Morocco. Species that was previously considered to be of dubious presence. Of the 50 stations sampled, 7 contain the plant but with a low recovery rate. The IES makes it possible to classify the species as very rare in the area even if it has a high ecological tolerance.

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