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Some remarkable bryophytes of the Causse Méjean (Lozère, France)

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Abstract – The discovery of several species known to be rare or very rare in France made it possible to clarify their distribution and ecological affinities at the national level, as well as on the regional scale of the Massif Central. Eight species are concerned: *Encalypta longicollis* Bruch, *Hypnum sauteri* Schimp., *Orthotrichum hispanicum* F. Lara, Garilleti & Mazimpaka, *Orthotrichum scanicum* Grönv., *Orthotrichum shawii* Wilson ex Schimp., *Orthotrichum stellatum* Brid., *Seligeria donniana* (Sm.) Müll.Hal. and *Seligeria recurvata* (Hedw.) Bruch., Schimp & W. Gümbel, which were recorded for the first or the second time only on mainland France or in the Massif Central.

France / Causse Méjean / Massif Central / bryophytes / *Encalypta* / *Hypnum* / *Orthotrichum* / *Seligeria*

Résumé – La découverte sur le Causse Méjean de plusieurs espèces rares ou très rares en France métropolitaine permet de faire le point sur leur répartition et de mieux cadrer leur écologie sur le territoire national ou à l'échelle du Massif Central. Huit espèces sont concernées appartenant aux genres *Encalypta*, *Hypnum, Orthotrichum*, et *Seligeria* pour lesquelles il s'agit de la première ou de la seconde mention soit pour le territoire national métropolitain soit pour le Massif Central *s.t.*.

France / Causse Méjean / Massif Central / bryophytes / *Encalypta* / *Hypnum* / *Orthotrichum* / *Seligeria*

INTRODUCTION

Interesting discoveries were recorded concerning the bryophyte flora of the Causse Méjean (France, Massif Central) and these are the subject of this publication. Prospecting was carried out on this vast calcareous unit, on those natural biotopes best preserved. The wooded slopes show a high diversity of aspects with many natural types of beech and oak woods.

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GEOGRAPHIC CONTEXT

The Causse Méjean is part to the unit of the Grands Causses in Southern Massif Central. It is located in a complex called "Causses Majeurs" between the Causse de Sauveterre (550 km^2, altitude 800-900 m), the Causse Noir and the Causse Begon (200 km^2, medium altitude 850 m), and the two lower Causses of Saint Affrique and Causse rouge (650-740 m). Perfectly isolated between three valleys (Tarnon, Tarn and Jonte) it is a high plateau (350 km^2) of Jurassic dolomiticous limestone. The highest point is the Gargo (1247 m) and whereas the Western slope towers only 800 m above the gorges of the Tarn, the plateau is 400 to 500 m above the deep gorges traced to Tarnon, Tarn and Jonte valleys.

The Causses are subject to four main climatic influences: Atlantic in the western area, mountainous and subalpine on the northern and northeastern sides, and Mediterranean towards the south. Due both to high altitudes (over 1000 m on average) and to its position in the North-East of the Causses complex, the Causse Méjean area is mainly subject to mountainous, subalpine and atlantic influences. The Mediterranean influence is limited to its southwestern part. Over one hundred days of frost per year, and only 700-800 mm of annual rainfall are quite common. This strongly reduces the oceanic influence. Northern and northeastern winds are common both in summer and in winter, which still accentuates the dryness of the Causse.

Taking into account these rigorous conditions, the Méjean plateau is primarily occupied by calcicolous graminaceous vegetal formations or "devèzes" (communities with *Stipa pennata*) punctuated with pubescent oak coppices (*Quercus pubescens*) and common box facies (*Buxus sempervirens*). It should be noted that the Salzmann's pine (*Pinus nigra* subsp. *clusiana*) is present on the dolomitic left bank cliffs of the Tarn and from the Roc des Hourtous to the Cirque des Baumes (Causse de Sauveterre). However, one cannot be certain of its spontaneous origin at these locations (Bernard & Fabre, 1983).

The high lawn-grass formations are for the most part the result of deforestation. Primary formations are limited to cliff tops and to the top of rocks where they grow at the higher edge of the Tarn and Jonte Gorges. On the slopes, despite the presence of secondary pine woods, the deciduous forest is far better preserved. It accounts for approximately 25% of the total surface of the Causse.

Pubescent oak groves (*Buxo sempervirentis-Quercetum pubescentis*) are mainly present on the south facing slope, and meso xerophilous beech woods (*Buxo sempervirentis-Fagetum sylvaticae*) on the north facing slope (ubac) or on the eastern front of the Causse Méjean. The forested sites with *Pinus sylvestris* in the most exposed stations are linked to a facies of *Buxo sempervirentis-Quercetum pubescentis,* the dynamic formation with bearberry (*Arctostaphyllos uva ursi*) representing preforest vegetal formation.

THE BRYOPHYTES SPECIES

Most of the bryophytes are found in areas well studied by researchers because of their rarity and scarcity on mainland France, or because of their particular distribution throughout the Massif Central. These species belong to various ecological groups: epilithic and humo-epilithic (*Seligeria* ssp., *Hypnum sauteri*), humo-terricolous (*Encalypta longicollis*) and corticolous (*Orthotrichum* ssp.). The most original and rare species are further commented and mapped.

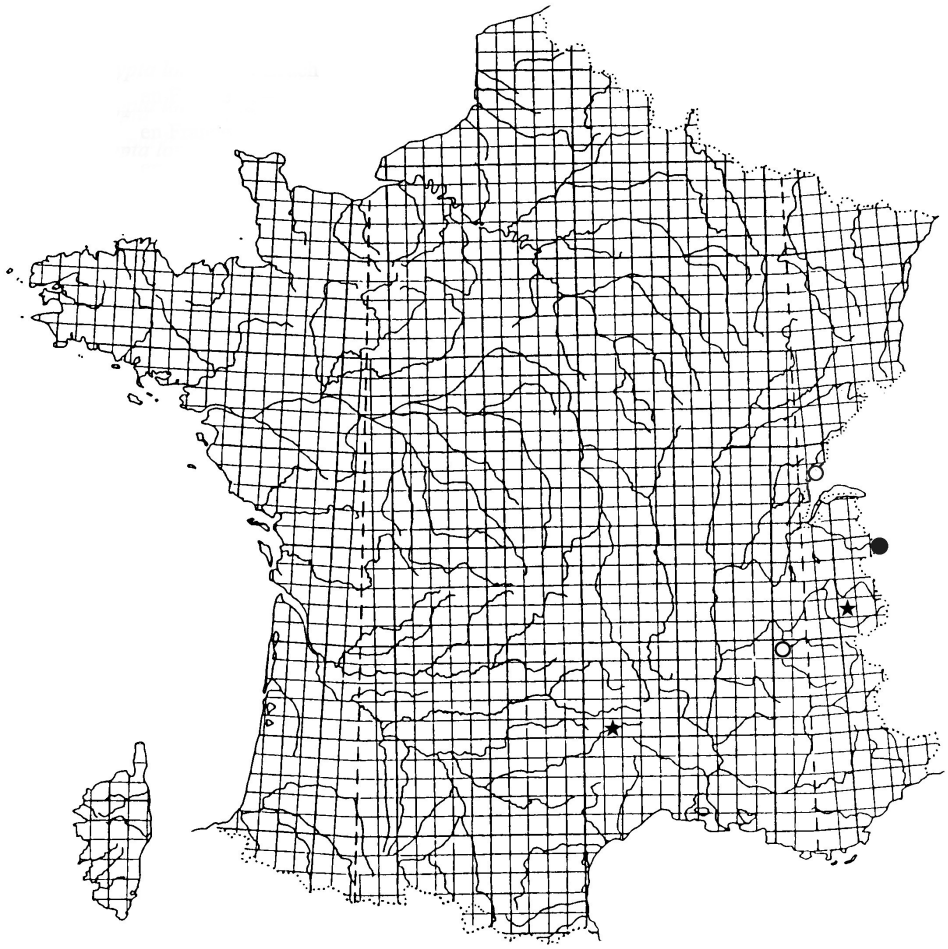

Fig. 1. *Encalypta longicollis* Bruch. in France. Meshing UTM 20 × 20 km. ○ observed before 1980 ● observed after 1980 ★ news observations.

* New species from the Massif Central are sown with an asterisk (*)

****Encalypta longicollis* Bruch.** (Fig. 1)

New reports from France:

Lozère: Montbrun, higher slope of the Gorges du Tarn, along the driving path of Chadenède to Montbrun, on limestone flagstones with horizontal microscopic cracks under clear pine forest with boxwood. Altitude: 905 m. UTM 10X10: EK 30. 30 June 2004. Herb. P. Boudier n°7284B and D, 7286 and 7288; Herb. J. Bardat n°CM15A2.

Savoie: Les Avanchers-Valmorel, Roche Blanche, vertical humiferous gypsum wall. Altitude: 2300 m. UTM 10X10: LR 03. 28 July 2005. Herb. P. Boudier n°7590.

Previous reports from France:

Isère: Villard-de-Lans, La Petite-Moucherolle. Altitude: ± 2000 m. UTM 10X10: GK 08. *In* Ravaud (1867, 1878).

Jura: Longevilles-Mont-d'Or, le Mont-d'Or. UTM 10X10: KS 97. *In* Meylan (1905), also included by Hillier (1954).
Haute-Savoie: Vallorcine, crête du Béchat. Altitude: 2180 m. UTM 10X10: LR 49. *In* Bardat & Boudier (1996).

Encalypta longicollis was discovered in the northern part of the Causse at an altitude of approximately 905 m in the higher areas of the slopes dominating the Tarn. This site is characterised by open limestone flagstones with horizontal microscopic cracks under clear pine forest with common box. The species accompanying *Encalypta longicollis* (Table 1), are primarily made up of a terrohumicolous species group of limestone soils with a mixture of post-pioneer species (*Jungermannia atrovirens, Leiocolea collaris, Distichium capillaceum, Trichostomum brachydontium*) and pleurocarpous species (*Ctenidium molluscum, Orthothecium intricatum*) marking a progressive change towards forest systems. *Encalypta longicollis* belongs to the communities of long-lived post-pioneer species on calcareous substrate, generally rich in basics salts (cations) of the alliance of *Ctenidion mollusci* Stefureac 1941.

The earliest mention of this species is reported by Ravaud (1867) from the Petite-Moucherolle in Vercors. Since then, Ravaud (1878) noted that he could not find it again. Meylan (1905) reported this species at the Mont-d'Or in the Jura. Meylan (1905) regarded this species as widespread throughout the "Swiss" Jura but extremely rare in all other European mountains. But two years later, Meylan (1907) announced that he had not found the species in the Bernois and Soleurois Jura (Switzerland) which could be a confirmation of its relative scarcity, even within the Jurassic chain. The species was more recently reported from Haute-Savoie (Bardat & Boudier, 1996).

The sites in the French Alps range between 2000 and 2300 m altitude, those in the Jura average 1400m. According to Amann (1912), it is a mesophitic, sciaphilous, humicolous and calciphilous species, observed on the humus found in rock crevices on steep walls, facing north or west, and within an altitudinal range between 1370 and 2500 m. Dierßen (2001) regards it as an arctico-alpine species of the temperate circumpolar zone.

******Hypnum sauteri* **Schimp.** (Fig. 2)
New report from France:
Lozère: La Malène, Roc des Hourtous, outcrop of limestone rocks under woods made of *Pinus sylvestris* and *Sorbus aria*. Altitude: 870 m. 28 June 2004. UTM 10X10: EK 20. Herb. P. Boudier n°7227-C, 7230-A, 7231; Herb. J. Bardat CM7-41, CM7-44 and CM7-45.
Previous report from France:
Savoie: Termignon, Sufflet forest. UTM 10X10: LR 21. *In* Sébille (1914); Herb. Bizot n°8333 (PC). 24 August 1912. Leg. Sébille.

This very rare small Hypnaceae, the most discrete of the *Hypnum* genus, was discovered in one of the most floristically famous places of Causse Méjean, the Roc des Hourtous. *Hypnum sauteri* forms very fertile monospecific populations, in the undergrowth, on naked rock, close to the ground and often in contact with *Lophozia alpestris, Jungermannia atrovirens* and *Hygrohypnum luridum.* This species requires a humid and quite shaded atmosphere on limestone, with low humus content, and it is very sensitive to other competitive species. Amann (1912) regarded it as a mesophytic, sciaphilous, and calcicolous epilithic species. It can be included in the communities of long-living post-pioneer species occurring on limestone substrates generally rich in bases (slopes or rocks) with regard to the alliance of *Ctenidion mollusci* Stefureac 1941.

From a chorological point of view, Ando (1973) regarded *Hypnum sauteri* as a strict European taxon (North of Norway, Jura and Alps). Amman (1912)

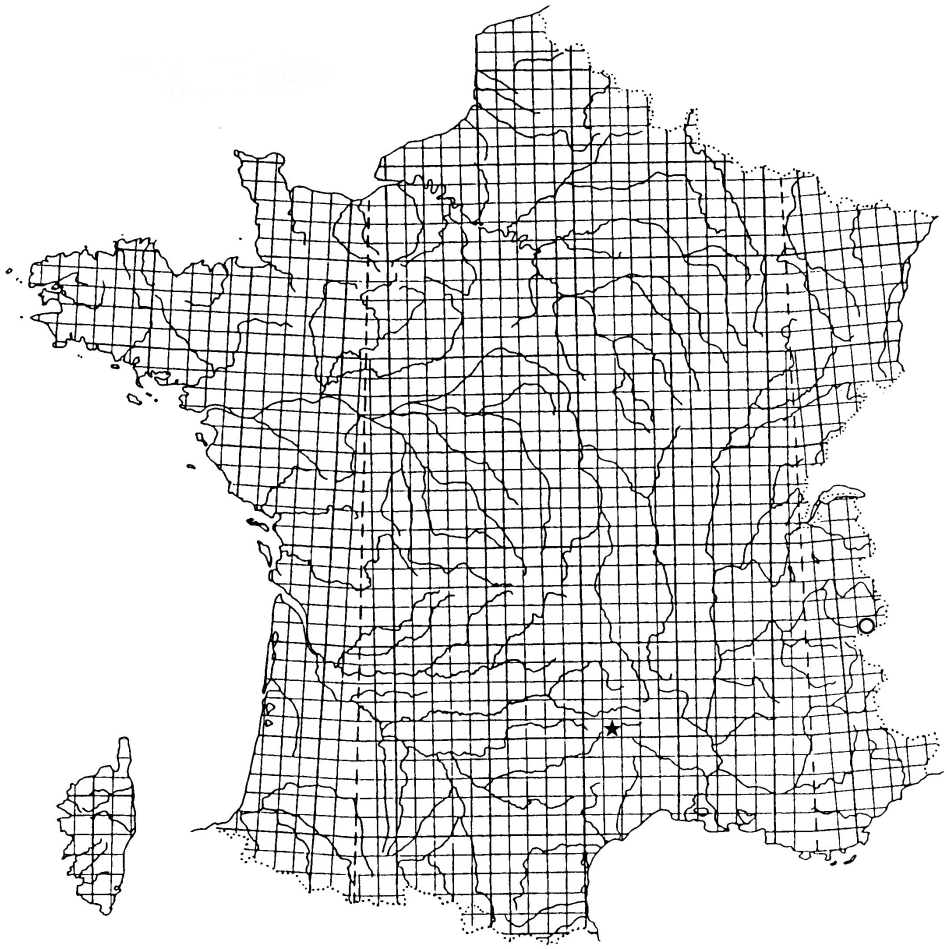

Fig. 2. *Hypnum sauteri* Schimp. in France. Meshing UTM 20 × 20 km. ○ observed before 1980 ★ new observation.

defined it as boreo-alpine mesothermophytic species observed in Europe within a broad altitudinal range (between 460 and 2030 m). For France, its presence is attested with certainty from only one site in Savoie, in the forest of Sufflet (Sébille, 1914), and this is confirmed by an *exciccata* of the Bizot herbarium (PC, leg. Sébille, 1912).

Genus *Orthotrichum*

While prospecting on the Causse Méjean, we identified 17 *Orthotrichum* species. Among these species, four deserve a particular comment ●:

Orthotrichum affine Brid. (incl. *Orthotrichum fastigiatum* Bruch ex Brid.)

Orthotrichum anomalum Hedw.

Orthotrichum cupulatum Brid.
Orthotrichum diaphanum Brid.
• *Orthotrichum hispanicum* F.Lara, Garilleti & Mazimpaka
Orthotrichum lyellii Hook. & Taylor
Orthotrichum obtusifolium Brid.
Orthotrichum pallens Bruch ex Brid.
Orthotrichum pumilum Sw.
Orthotrichum rupestre Schleich. *ex* Schwägr.
• *Orthotrichum scanicum* Grönv.
Orthotrichum schimperi Hammar
• *Orthotrichum shawii* Wilson ex Schimp.
Orthotrichum speciosum Nees var. *speciosum*
• *Orthotrichum stellatum* Brid.
Orthotrichum stramineum Hornsch. ex Brid.
Orthotrichum striatum Hedw.

***Orthotrichum hispanicum F.Lara, Garilleti & Mazimpaka** (Fig. 3)
New report from France:
Lozère: Vébron, Cirque du Rio Cabala, Woodforest with Common Box, on a dead small box branch. Altitude: 985 m. UTM 10X10: EJ 49. 29 June 2004. Herb. P. Boudier n°7281-A.
Previous reports from France:
Alpes-Maritimes: two locations, one in the Tinée valley and one in the Var valley (Hébrard, 2003)

Orthotrichum hispanicum was found on an east facing slope with mesophilous woods, at an altitude slightly under 1000 m. It is fixed on a dead boxwood branch. This identification was confirmed by V. Mazimpaka (Madrid). This woodland is established on a rock slope, and made up of older trees of only medium height (12-15m).

Orthotrichum hispanicum, described recently from Spain (Lara *& al.*, 2000), is known also from Greece (Lara *& al.*, 2003) and from France by samples collected in the Alpes-Maritimes (Hébrard, 2003). The species is new from the Massif Central.

The conditions in which this moss was found are the same as those described by these authors: it is a species from open woods of the mountain storey, growing especially on shrubs, particularly on boxwood, under a Mediterraneo-continental climate with sub Mediterranean not subject to oceanic influences. Botanists should pay more attention to the Cirque de Rio Cabala which is subject to original ecological conditions within the Causse Méjean, because of its sheltered situation and its southeastern general orientation.

***Orthotrichum scanicum* Grönv.** (Fig. 4)
New report from Massif Central:
Lozère: Fraissinet-de-Fourques, to the north of the Col du Perjuret. Altitude: 1075 m. UTM 10X10: EJ 49. 29 June 2004. Herb. P. Boudier n°7283-D; Herb. J. Bardat n°CM 14.
Previous reports from Massif Central:
Previously known stations according to Héribaud (1899): Puy-de-Dôme: Mont-Dore: UTM 10X10: DL 84; wood near to Pierre-sur-Haute: UTM 10X10: EL 65.
Cantal: Malbo. Altitude: 1030 m. UTM 10X10: DK 78. 31 July 2004. Herb. P. Boudier n°7380 (Boudier, 2004).

Orthotrichum scanicum was observed only on one site. It is roughly an alignment of ashes (*Fraxinus excelsior*) at the edge of a small road, at an altitude of approximately 1100 m, on the southeastern side of the Causse. For the Massif Central, available data show that it is a rather rare species occurring at 1000 m

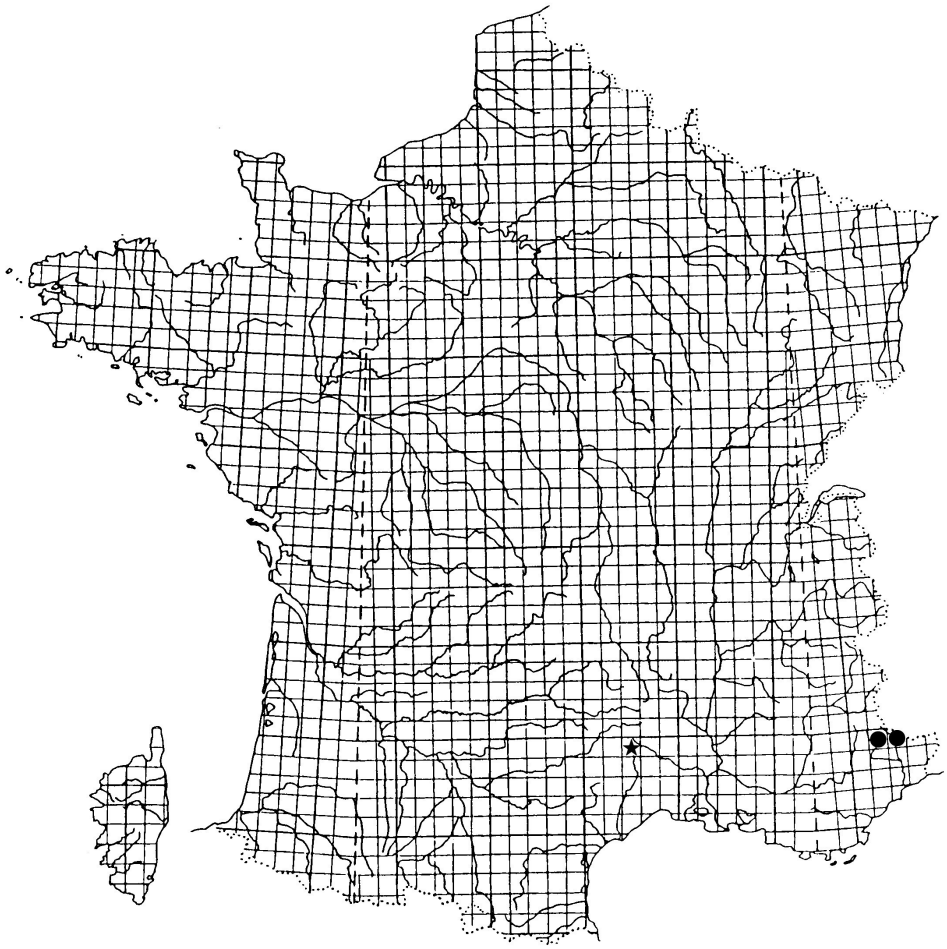

Fig. 3. *Orthotrichum hispanicum* F.Lara, Garilleti & Mazimpaka. in France. Meshing UTM 20 × 20 km. ● observed after 1980 ★ new observation.

and higher. Boudier (2004) published a recent discovery in the Cantal, also on ashes, but in a forest environment.

Amann (1912) regarded this species as a xerophilous, corticolous, calcifuge and mesothermic boreal plant with an average and subalpine range. The species is frequently found on the branches of young trees (fir trees, willows...). But Dierßen (2001) describes it as an aerophilous species and as a mountain, hemi-boreal, eurasiatic, acidiclin, xeroclin, sciaphilous to photophilous, thermophilous species, living on leafy shrubby trees, seldom on rocks.

The characteristics described by this author are more specific and better fit the ecology of the species. According to him, this species characterized the *Orthotrichetum pallentis* Ochsner 1928 (class of *Frullanio dilatatae-Leucodontetea*

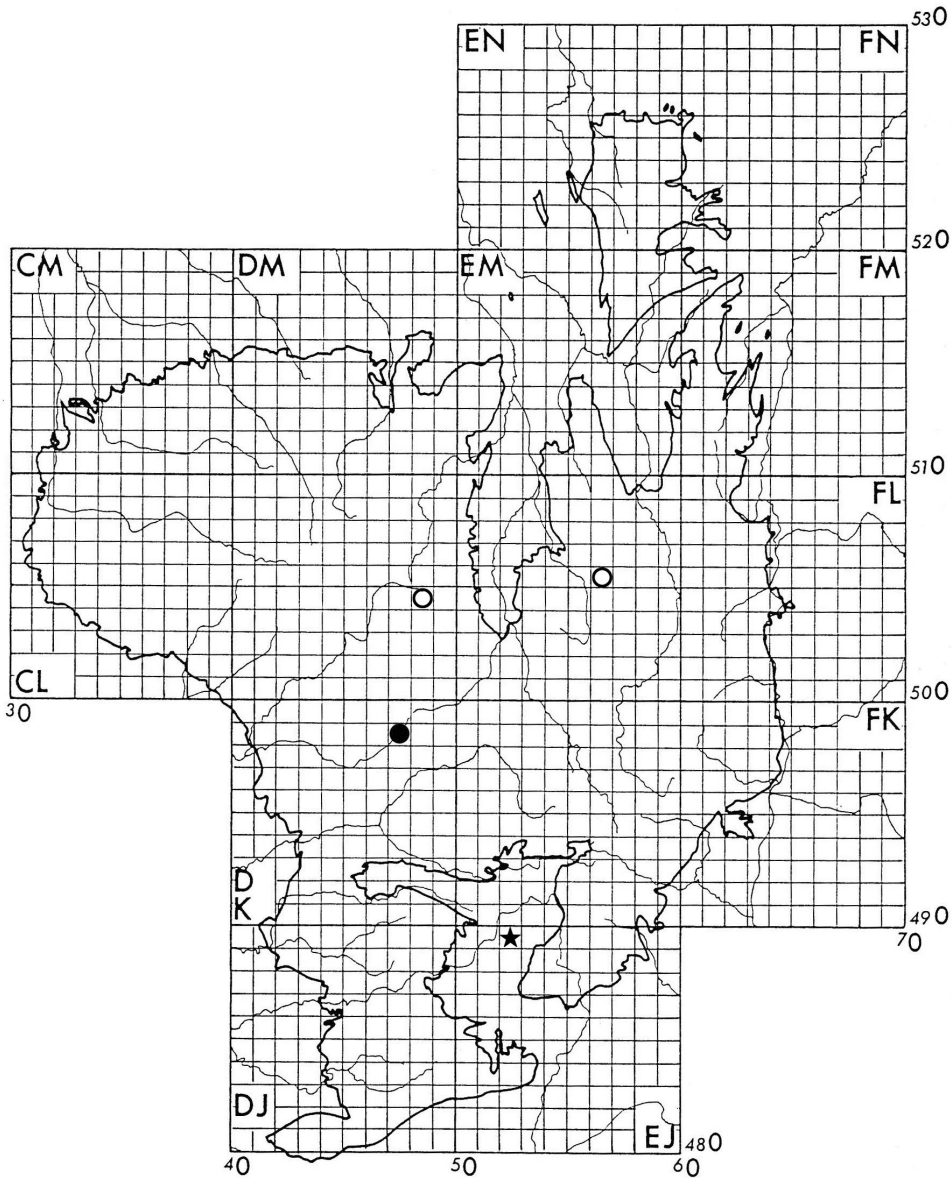

Fig. 4. *Orthotrichum scanicum* Grönv. in the Massif Central. Meshing UTM 10 × 10 km. ○ observed before 1980 ● observed after 1980 ★ news observations.

sciuroidis Mohan 1978 em. Marstaller 1985). He considered that the optimum for this species is in timbers of the type *Sambuco racemosae-Salicion capreae* Tüxen & Neumann *in* Tüxen 1950 and *Salicion albae* Soó 1930, less frequently in *Quercion roboris* Malcuit 1929.

We have to specify that ashes have a clearly neutocline bark, whereas *O. scanicum* is considered in the literature (Amann, 1912; Dierßen, 2001) as an acidicline calcifuge plant. In fact, it appears highly tolerant with respect to the support.

Its discovery in the Massif Central, in two far apart locations, is due to the fact that this species has been undoubtedly ignored. More thorough prospecting could lead to the reconsideration of a greater number of sites.

***Orthotrichum shawii* Wilson ex Schimp.**

New report from Massif Central:

Lozère: Vébron, Cirque of Rio Cabala, in a wood, on a branch of a pubescent oak. Altitude: 985 m. UTM 10X10: EJ 49. 29 June 2004. Herb. P. Boudier n°7273-A.

Though scientists debated at length on the taxon's status, *Orthotrichum shawii* was rehabilitated as a species by Mazimpaka *& al.* (2000). The species was found on the same site as *O. hispanicum*.

In France, Pierrot (1978) described this moss as extremely rare (RRR). It is an European species, well known here and there in the southern half of France. It was found in the Départements of Puy-de-Dôme (Mazimpaka *& al.,* 2000), Drôme (Dismier, 1922), of Ardèche (Dismier, 1925), Hérault (Bardat & Boudier, 1994), and in Corsica (Philibert, 1882), and we do not claim this list to be exhaustive. The recent discovery in Lozère is a new data for this Département.

Most of the French sites are located in mountain forests (Drôme, Ardèche, Corsica, Lozère), under conditions which appear to be the optimum for the species in the Mediterranean mountain environment (Mazimpaka *& al.*, 2000). However, *O. shawii* was also collected in more thermophilous conditions as is the case for the site found in Hérault at an altitude of 230 m, in the Gorges d'Héric, in a late-Mediterranean environment, and associated with bryophytes: *Orthotrichum philibertii* Vent., *Syntrichia papillosa* (Wilson) Jur., *Habrodon perpusillus* (De Not.) Lindb. and *Frullania dilatata* (L.) Dumort. (Bardat & Boudier, 1994).

The Mediterranean-oceanic status suggested by Mazimpaka *& al.* (2000) probably needs to be re-examined. Taking into account its current distribution which is characterised by relatively northern dry conditions, the species is rather like a late-Mediterranean plant.

***Orthotrichum stellatum* Brid.** (Fig. 5)

New reports from Massif Central:

Lozère: Mas-Saint-Chély, near Carnac, D 986 and D 43 crossroad, on *Fraxinus excelsior.* Altitude: 900 m. UTM 10 × 10: EK 20. 26 June 2004. Herb. P. Boudier n°7153-A. – Gatuzières, on a roadside (D 996) on *Fraxinus excelsior.* Altitude: 875 m. UTM 10 × 10: EJ 39. 29 June 2004. Herb. P. Boudier n°7257-G. – Fraissinet-de-Fourques, road from the Col du Perjuret to l'Hom, on *Fraxinus excelsior* trunks. Altitude: 1075 m. UTM 10 × 10: EJ 49. 29 June 2004. Herb. P. Boudier n°7283-G.

Previous reports from Massif Central:

Puy-de-Dôme: Mont-Dore, Puy de l'Angle. UTM 10X10: DL 84. *In* Héribaud (1899).

Aveyron: Sainte-Eulalie-de-Cernon, D 77 and D 277 crossroad. Altitude: 650 m. UTM 10 × 10: EJ 08. *In* Pierrot *& al.* (1983).

Gard: Gorges de la Virenque. Altitude: 700-725 m. UTM 10 × 10: EJ 26. *In* Pierrot *& al.* (1983).

Lozère: Meyrueis. UTM 10 × 10: EJ 29. *In* De Zuttere (1993).

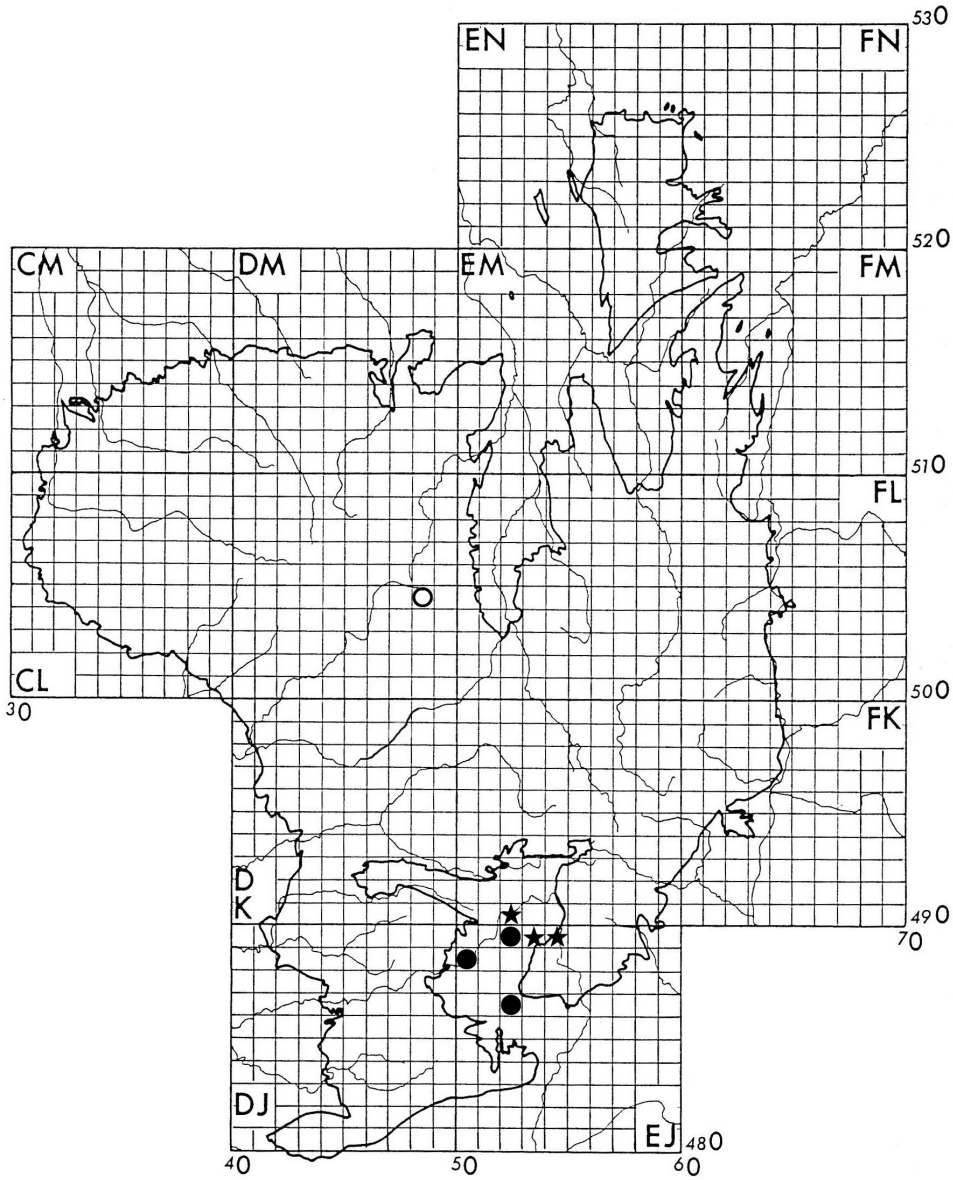

Fig. 5. *Orthotrichum stellatum* Brid. in the Massif Central. Meshing UTM 10 × 10 km. ○ observed before 1980 ● observed after 1980 ★ news observations.

Orthotrichum stellatum was collected (with three recoveries) on ashes aligned alongside the road. Pierrot (1978) described this species as extremely rare (RRR) in France. However, it was found several times in the Causses Majeurs area. Pierrot *& al.* (1983) mentioned it in two localities, on the Larzac (Aveyron), and in the Gorges de la Virenque (Gard), and De Zuttere (1993) at Meyrueis (Lozère). All recent data are from the Massif Central (Fig. 5), and these are very probably the only recent mentions for France.

Orthotrichum stellatum belongs to the aerophilous species group. Amann (1912) qualified it as a xerophilous, corticolous but rarely epilitic, calcifuge, or hygrothermic species. But Dierßen (2001) described this species as subneutrophilous, mesophilous, sciaphilous to photophilous, thermophilous and sensitive to air pollution. This characterisation by Dierßen seems to fit better with our observations.

This species belongs to the alliance *Ulotenion crispae* (Barkman 1958) Lecointe 1975.

Genus *Seligeria*

Four species were collected: *Seligeria pusilla, S. trifaria* which are taxa usually found on the Causses, but also *Seligeria donniana* and *S. recurvata* which are rare species at the scale of the Massif Central.

***Seligeria donniana* (Sm.) Müll. Hal.** (Fig. 6)

New reports from Massif Central:

Gard: Vébron, Galy, Nimes-le-Vieux (western part), shaded ruin-like dolomitic rocks, 27 June 2004. Altitude: 1090 m. UTM 10X10: EJ 39. Herb. P. Boudier n°7179; Herb. J. Bardat n° CM5-24D.

Lozère: Florac, higher part of the east side of the Gorges du Tarnon, in a wood with *Buxus sempervirens* and *Quercus robur* with an undergrowth made up with *Corylus avellana* with *Lilium martagon, Lathyrus niger, Daphne laureola* and *Geranium nodosum.* 1 July 2004. Altitude: 1000 m. UTM 10X10: EK 40. Herb. J Bardat n° CM20-F2.

This species was found twice in Nimes-le-Vieux and at the top of gorges dominating the Tarnon River. These two stations are located on two 10 × 10 UTM squares, but the species was already known in square EK 40 (cf. Sapaly, 1996).

Seligeria donniana is present from the lowland storey, in particular in the Paris basin (Dismier, 1910; Allorge, 1917; Doignon, 1955; Boudier, 1986) to the alpine level, in the Alps between 500 and 2230 m (Amann, 1912) with better conditions in the mountains. According to Dierßen (2001) *Seligeria donniana* is a mountain circumpolar, subneutrophilous, mesohygrophilous, sciaphilous and cryophilous-mesotherm species.

This species always occupies micro-habitats thus strongly limiting population development. For the Massif Central, the lack of limestone can partially explain its scarcity, with the only known sites located exclusively on the Causses Majeurs.

According to the bryosociological classification (Bardat & Hauguel, 2002), this species belongs to the alliance *Seligerion calcareae* Marstaller 1986, which includes the communities of small pioneers lucifugous species on limestone rocks low in cations. It defines a particular association, the *Seligerietum donnianae* Marstaller 1985. This low specific community is a pioneer on very shaded and fresh wet (but not oozing) limestone walls.

***Seligeria recurvata* (Hedw.) Bruch, Schimp. & W. Gümbel** (Fig. 7)

New report from Massif-Central:

Lozère: Florac, higher part of the side of the Gorges du Tarnon, in a forest with *Buxus sempervirens* and *Quercus robur* with undergrowth made up of *Corylus avellana* with *Lilium martagon, Lathyrus niger, Daphne laureola* and *Geranium nodosum.* 1 July 2004. Altitude: 1000 m. UTM 10 × 10: EK 40. Herb. P. Boudier n°7324; Herb. J. Bardat n° CM20-F2.

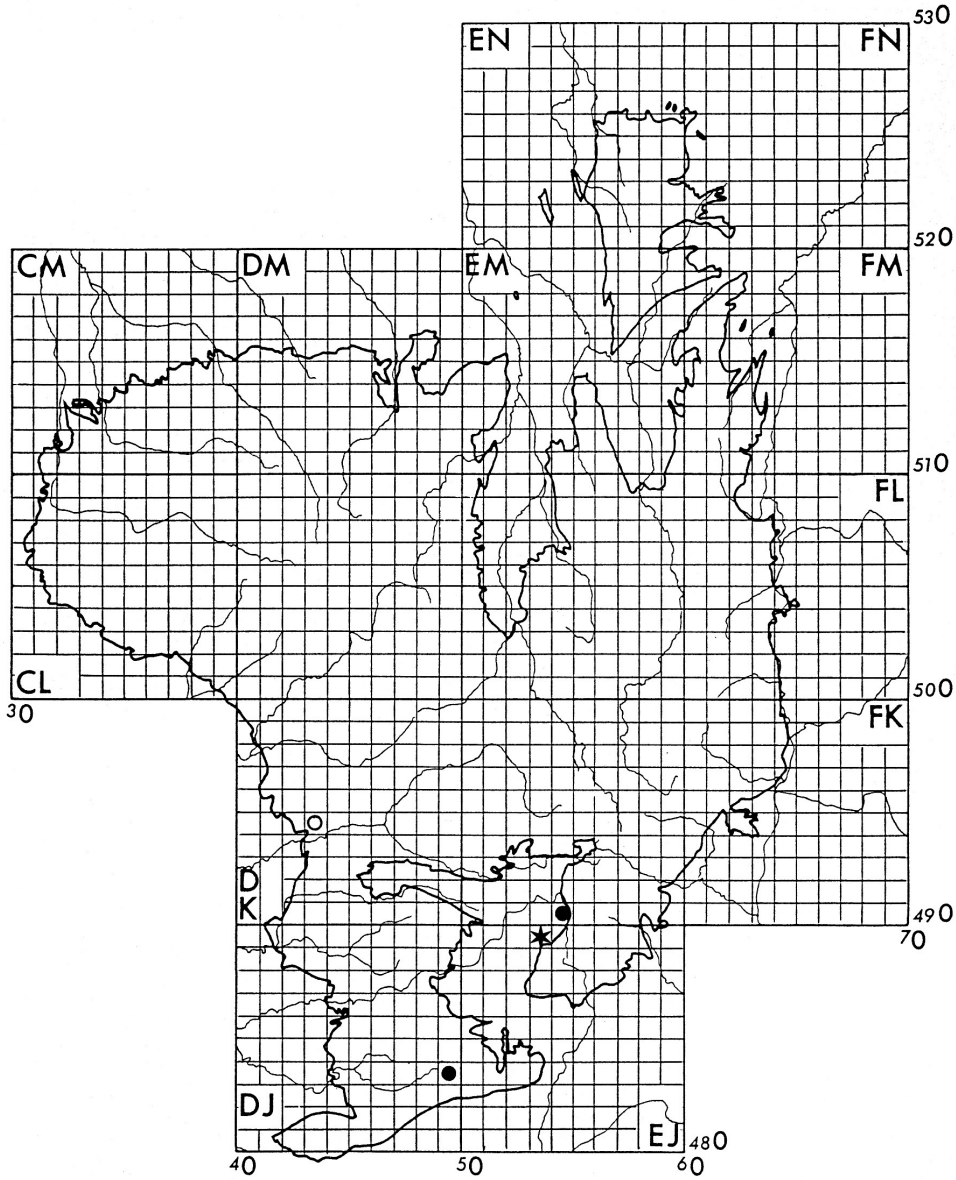

Fig. 6. *Seligeria donniana* (Sm.) Müll. Hal. in the Massif Central. Meshing UTM 10 × 10 km (according to an unpublished manuscript by Jean Sapaly).
○ observed before 1980 ● observed after 1980 ★ new observation

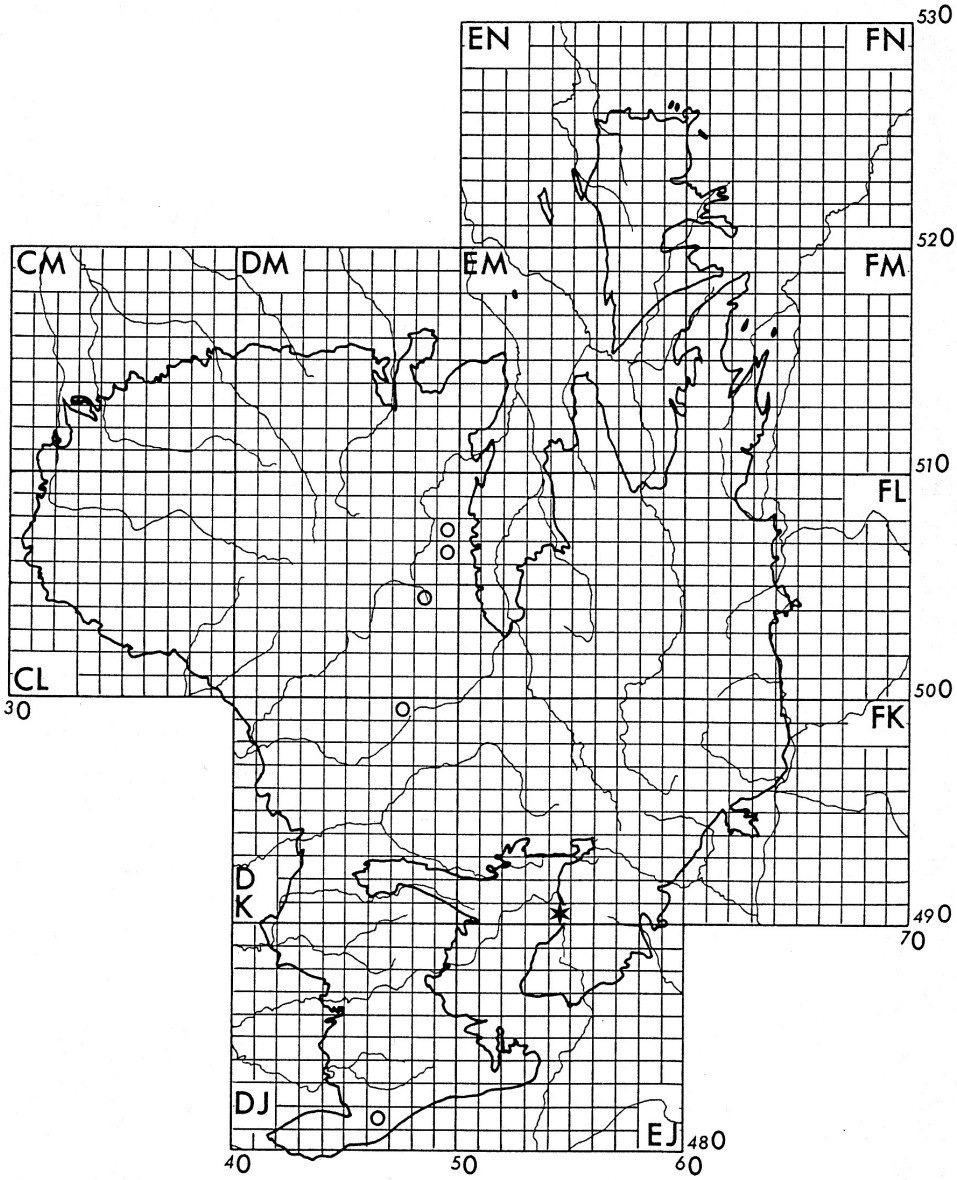

Fig. 7. *Seligeria recurvata* (Hedw.) Bruch, Schimp. & W.Gümbel. in the Massif Central. Meshing UTM 10 × 10 km (according to an unpublished manuscript by Jean Sapaly).
○ observed before 1980 ★ new observation

The map established by Jean Sapaly (1996) for the Massif Central (data from Héribaud (1899)) shows the presence of *Seligeria recurvata* in several locations in Auvergne, but these old data (more than one century old), were not recently confirmed.

This *Seligeria* is less associated with the calcareous substrate than other species occurring in France. Héribaud (1899) has observed it on volcanic rock (trachyte, domite) but it prefers a sandy limestone substrate. It grows generally on rocks or cracks on sandstone, near water. In this case, the site is fresh, in the undergrowth (in the forest), facing north. The substrate is consistent with sandy limestone plateau, restricted to soils retaining humidity.

The populations are monospecific, but can temporarily be included in an association of *Seligerio recurvatae-Fissidentetum pusilli* Duda 1951 where *Seligeria recurvata* is in particular associated with *Fissidens gracilifolius* Brugg. Nann. & Nyholm (= *Fissidens pusillus* Wils.) and *Lophocolea minor.*

CONCLUSION

This note introduces a restricted choice of remarkable species, but it draws attention to how interesting these woodlands can be, with north facing slopes where two alpine species are located (arctico-alpine: *Encalypta longicollis,* and boreo-alpine: *Hypnum sauteri*). The presence of these two species at an altitude of approximately 900 m, definitely lower than those previously known, and in a geographical environment very remote from the Alps (over 300 km away, to the west) suggests that populations were established during colder periods and held on because of a particular microclimate.

Moreover, it is necessary to point out the great richness of the genus *Orthotrichum* in species (17 taxa). This richness is probably the result of several factors: absence of air pollution of agricultural or industrial origin associated with very separate sites (isolated trees or in alignment on the plateau), and contrasted climatic conditions. One notes also the great diversity of the supports colonized by these species.

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