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Revue scientifique pour la biodiversité du Massif central

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Thébaud *et al.* / BIOM 2 (2021) : 62-109

BIOM/https://doi.org/10.52497/biom.v2i1.283 https://revues.bu.uca.fr/index.php/BIOM

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Contribution to the survey of the heathlands of the french Massif central (habitats 4030 and 4060): analysis of phytosociological data

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Submit 5 january 2021
Accepted 27 april 2021
Edit 1 june 2021

Abstract

Based on a sample of 990 relevés of heathlands from the French Massif central, taken from the bibliography and from recent surveys in the field, the authors carry out a global analyses in MTC, CCA and DCA, then focus partial analyses on 675 relevés concerning montane and subalpine belt. The results of this revision lead to the characterization of 16 plant associations, including 5 new ones and 47 sub-units. The south and east of the Massif central, Cévennes, Vivarais, Margeride, until now less well known, bring the largest batch of phytosociological novelties. These plant communities belong to 2 phytosociological classes (*Loiseleurio procumbentis-Vaccinietea microphylli* and *Calluno vulgaris-Ulicetea minoris*) and 3 alliances including a new one, *Genisto pilosae-Empetrion hermaphroditi all. nov.* and *Genisto pilosae-Vaccinion* Braun-Blanq. 1926. The nomenclature and syntaxonomy of this last alliance are discussed and modified and a new suballiance is created inside it (*Vaccinienion myrtillo-uliginosi suball. nov.*). The studied communities differ mainly according to the climatic disparity, the altitudinal gradient, the geological substrate and the topography. They can be stable or be included in dynamic successions leading to wooded stages. The characterization of these communities contributes to the knowledge of the biogeographic and bioclimatic compartmentalization of the Massif central; it reflects differences linked to the importance of summer rainfall, between northwestern volcanic mountains under oceanic influence, internal massifs with a subcontinental character and southern border under mediterranean influence. Likewise an upper subalpine belt is confirmed in the few mountains which exceed 1600 m. The hierarchy of discriminating ecological variables for these communities, the description of their station conditions and their dynamic characterization within sylvo-pastoral spaces, provide elements for the management and conservation of the corresponding habitats of European interest, especially number 4030 and 4060.

Keywords
Low montain range
Dwarf-heath
Syntaxa
Digital analyzis

Résumé

À partir d'un échantillonnage initial de 990 relevés de landes du Massif central français, issu de la bibliographie et de recherches récentes sur le terrain, les auteurs réalisent une analyse globale puis des analyses partielles en MTC, CCA et DCA sur 675 relevés concernant les étages montagnard moyen et subalpin. Les résultats de cette révision conduisent à la caractérisation de seize associations végétales dont cinq nouvelles et quarante-sept sous-unités. Le sud et l'est du Massif central, Cévennes, Vivarais, Margeride, jusqu'ici moins bien connus, apportent le plus grand lot de nouveautés phytosociologiques. Ces communautés appartiennent à 2 classes phytosociologiques (*Loiseleurio procumbentis-Vaccinietea microphylli* et *Calluno vulgaris-Ulicetea minoris*) et 3 alliances dont le *Genisto pilosae-Empetrion hermaphroditi all. nov.* et le *Genisto pilosae-Vaccinion* Braun-Blanq. 1926. La nomenclature et la syntaxonomie de cette dernière alliance sont discutées et modifiées et une sous-alliance nouvelle y est créée (*Vaccinienion myrtillo-uliginosi suball. nov.*). Les communautés étudiées se différencient principalement en fonction de la disparité climatique du Massif, le gradient altitudinal, le substrat géologique et la topographie. Elles peuvent constituer des végétations stables ou entrent dans des successions dynamiques conduisant à des stades boisés. Leur caractérisation contribue à la connaissance de la compartimentation biogéographique et bioclimatique du Massif central, en rapport notamment avec les différences liées à la pluviométrie estivale, entre montagnes volcaniques nord-occidentales sous influence océanique, massifs internes au caractère subcontinental et bordure méridionale sous influence méditerranéenne. De même les végétations étudiées confirment un étage subalpin supérieur dans les quelques massifs qui dépassent 1600 m. La hiérarchisation des variables écologiques discriminantes pour ces végétations, la description de leurs conditions stationnelles et leur caractérisation dynamique au sein des espaces sylvo-pastoraux, donnent des éléments pour la gestion et la conservation des habitats d'intérêt européens correspondants, en particulier 4030 and 4060.

Mots-clés
Moyenne montagne
Landes basses
Syntaxons
Analyses numériques

Introduction

In the French Massif central, the heathland vegetation shows a great extension and is very diverse (Schaminée *et al.* 1993; Thébaud *et al.* 2014). It has a great heritage interest, particularly as European interest habitats (European Directive «habitats»: n° 4030 and 4060) mentioned and described in the habitat books (Bensettiti *et al.* 2001) and are abundantly represented in many protected sites and Natura 2000 areas. They also occupy a decisive position at the heart of extensive grazing systems (Loiseau & Merle 1981; Michalet *et al.* 1989; Etlicher *et al.* 1993). Conservative management of these habitats and the corresponding plant communities requires a deepening of knowledge through their phytosociological characterization and their ecogeographic contextualization. These aspects still present major gaps in the Massif central and our study aims to help fill them within the framework of a general syntaxonomic revision including the groupings already described by previous authors. The data being insufficient concerning the low altitude regions we decided to concentrate on the upper vegetation, from the middle montane belt to subalpine. To do this, we analyzed 990 relevés from the Massif central, from previous publications or unpublished, or produced by us in the field on this occasion. We have specially carried out surveys on major massifs which until now were not sufficiently documented: Margeride, monts du Cantal, mont Lozère, mont Aigoual. Thus, our results should make possible to confirm or not communities already individualized by previous authors, to possibly characterize new ones, to highlight the main discriminating variables for them as well as their contribution to a bio-ecogeographical compartmentalisation of the territory.

Another collaborative article about the same subject but on the whole French territory is underway within the framework of the "Prodrome des végétations de France" (PVF2, Boullet *et al.* to be published). It concerns the phytosociological declination up to the level of the plant association of subatlantic to continental heathlands from plain to montane belt (*Vaccinio myrtilli-Genistetalia pilosae* Rivas Mart. 1979). The results, presented here about the Massif central, will be included.

Biogeography

The Massif central represents the largest mountainous area in France: it occupies an area of approximately 80.000 km^2, corresponding to one seventh of the metropolitan area, including 30.000 km^2 above 1000 m (Ozenda 1985). It is made up of a multitude of sub-regions and small massifs, each with a strong differentiation, a consequence of its geological, climatic, altitudinal and agro-sylvo-pastoral diversity (Fig. 1). It is the most atlantic massif, the most extensive and the highest of the European low mountains ranges of the Hercynian Arc, together located north-west of the Alps (Fig. 2). Its maximum altitude is 1886 m at puy de Sancy in Auvergne. Its latitude is between 47.43° north and 43.30° south, its longitude between 4.77° east and 0.6° west, that is to say more than 4° of difference. Most of it is in the Eurosiberian biogeographic region, Alpine-Caucasian sub-region, Pyrenean-Cévénole province, Arverno-Cévénole sub-province (Rivas-Martínez 2007). The southern fringe belongs to the Mediterranean region. Thébaud & Roux (2018) proposed for the highest areas of the Massif central a delimitation into eight main biogeographic subdivisions based on the chorology of taxa, altitude, type of geological substrate and climatic types taken from thermal and rainfall diagrams (Fig. 3 and 4). We are aware this is a limited approach: indeed the Massif central is known as a «crossroads of influences» and the different biogeographical areas delimited in figure 3 are subject to climatic influences which collide. It would also be necessary to better express in our territorialization and in the factors of climatic influence selected, the water continentality and the Mediterranean aridity, using, for example, the Gams index as in Pache *et al.* (1996) and Michalet *et al.* (2021) which would make possible to provide more details in the correlation between types of vegetation and bioclimates. Unfortunately, in the context of this study, we were unable to produce a more relevant bioclimatic pattern.

Human influence and ecology

In the Massif central, as in the whole of the European Holarctic region, there are several physiognomic types of heaths. They are mainly structured by chamaephytic or nanochamephytic plants of the *Ericaceae* or *Fabaceae* families with among the most common, *Calluna vulgaris*, *Erica cinerea*, *E. tetralix*, *Genista pilosa*, *G. anglica*, *G. sagittalis*, *Ulex minor*, *Vaccinium myrtillus*, *V. uliginosum* s. *microphyllum* and s. *uliginosum*, *V. vitis-idaea*. Others are rarer or more circumscribed such as *Genista germanica*, *Cytisus decumbens*, *Empetrum nigrum* s. *nigrum* and s. *hermaphroditum*, *Erica vagans*, *Arctostaphylos uva-ursi*. There are also broomy heaths and forest mantles with *Erica scoparia*, *Ulex europaeus*, *Cytisus scoparius* and *C. oromediterraneus*. Some, in stations with strong ecological constraints, such as in rocky environments or in the subalpine belt, can constitute more or less stable vegetation, not or only slightly colonized by phanerophytes, considered to be climax; this is the case in monts Dore (Coquillard 1993; Coquillard *et al.* 1994; Michalet & Philippe 1996), monts du Forez (Thébaud 2004). But many, in the montane belt, fall into plant successions, where they succeed herbaceous formations and lead to forest stages; for example in the chaîne des Puys (Prevosto & Coquillard 2001; Roux 2017), Aubrac (Doche 1986), Haut-Lanquedoc (Baudière 1970). Their maintenance is then linked to extensive grazing practices, such as guarding, mowing of heather, post-winter burning, and low loads of livestock. These less intense practices lead to physiognomic and quantitative changes in these heaths in the form of more or less fleeting herbaceous facies, but do not fundamentally modify the floristic composition of the vegetation (Thébaud 1988). The latter is the result of several variables, chorological, ecological, dynamic and anthropogenic, and we will endeavor to take this into account in the interpretations proposed below, by addressing these causalities for each individualized plant community.

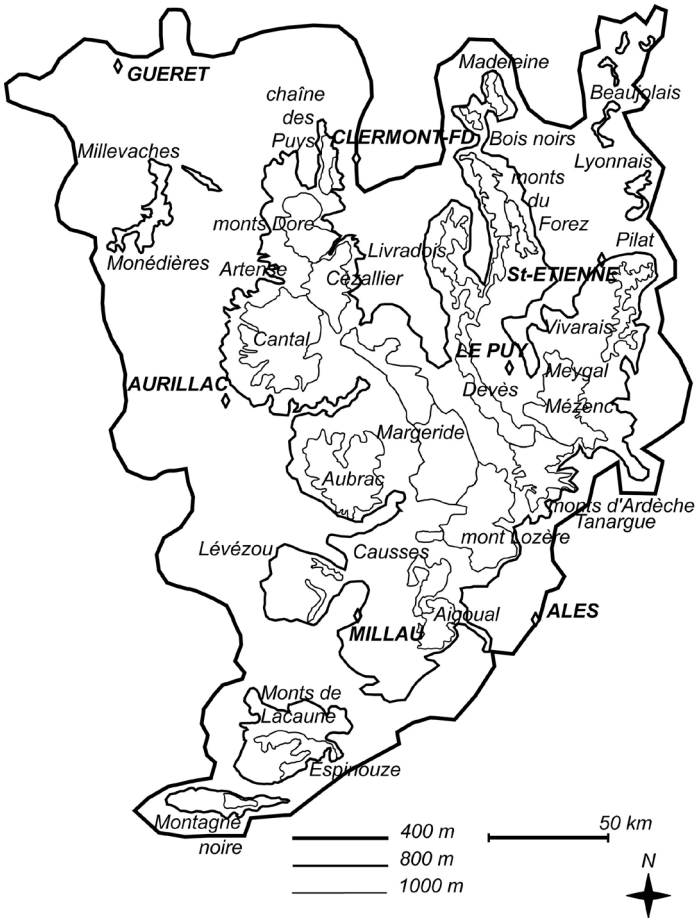


Figure 1 - Location of the mountainous regions of the French Massif central.

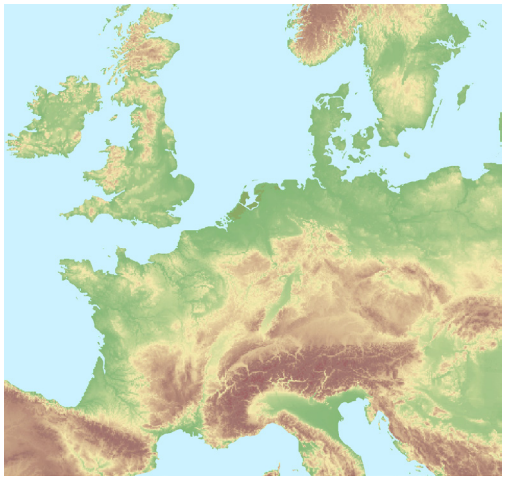


Figure 2 - The French Massif central in the European mountain area.

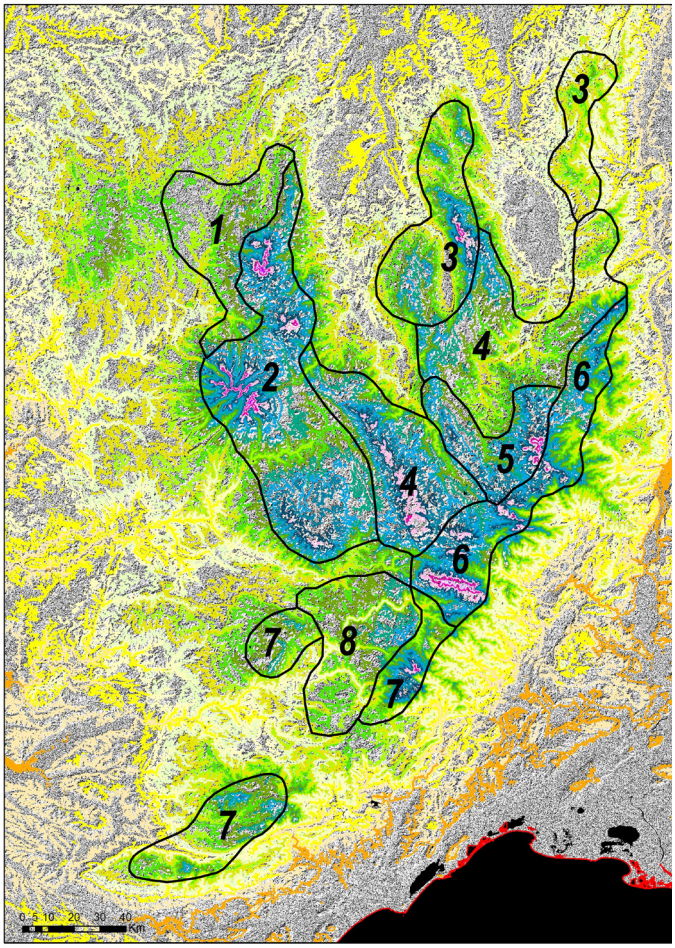
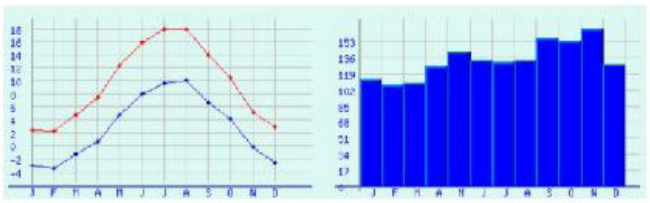
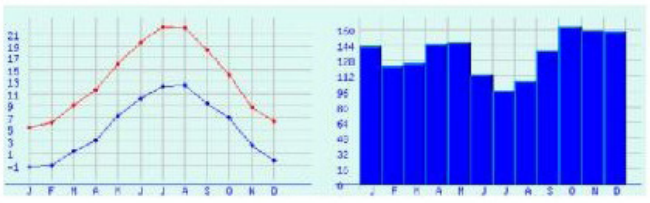


Figure 3 - Biogeographical sketch of the mountains of the French Massif central (Thébaud & Roux 2018); in blue and pink are shown the areas of higher altitudes (source Earth Explorer). 1- zone of oceanic influence on crystalline substrate; 2- zone of oceanic influence on volcanic substrate; 3- zones of attenuated oceanic influence on crystalline substrate; 4- subcontinental internal zone on crystalline substrate; 5- subcontinental internal zone on volcanic substrate; 6- zone of attenuated Mediterranean influence, on crystalline substrate; 7- zone of accentuated Mediterranean influence on crystalline substrate; 8- zone of Mediterranean influence on limestone substrate.

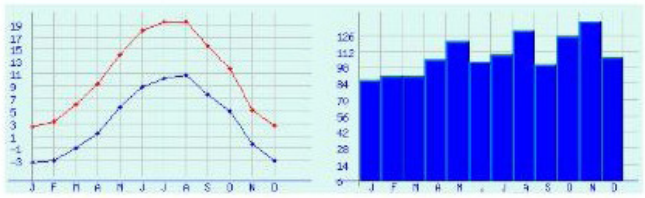
Chastreix (**2**; 1385m; T 6.1°; P1600mm; Pe 398mm)



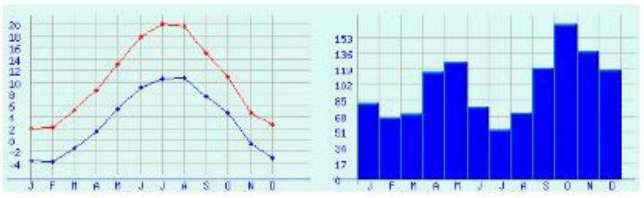
Salers (**2**; 945 m; T 9.3°; P 1617 mm; Pe 316mm)



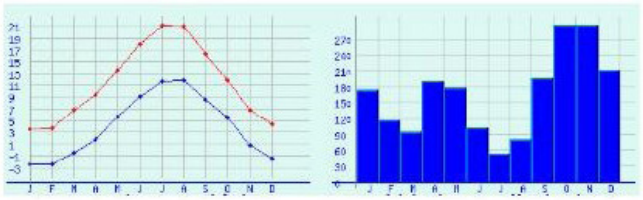
Col de la Loge (**3**; 1261m; T 7°; P 1305mm ; Pe 342mm)



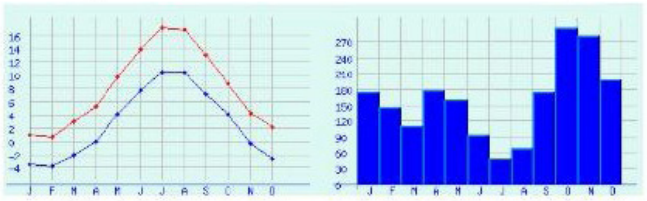
Le Bleymard (**6** ; 1418m; T 6.7°; P 1210mm; Pe 204mm)



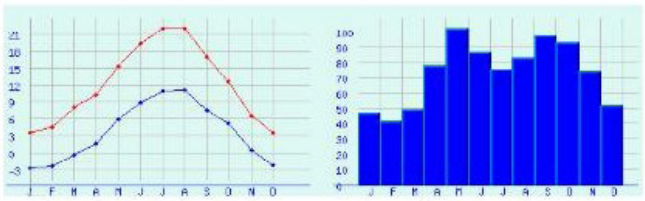
Loubaresse (**6** ; 1220 m; T 7.7°; P 1990 mm; Pe 234mm)



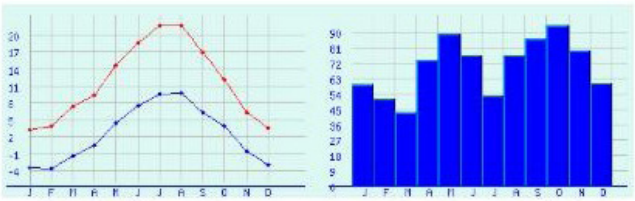
Mont Aigoual (**7** ; 1567 m; T 5.3°; P 1931; Pe 209mm)



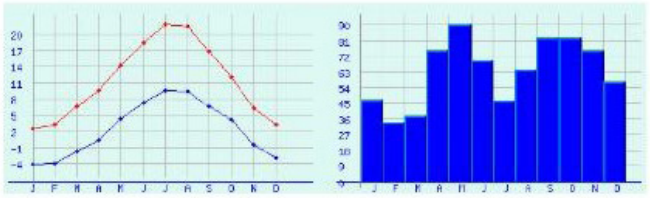
Fix-St-Geneys (**4**; 1102 m; T 7.9°; P 880 mm; Pe 245mm)



Grandrieu (**4**; 1220 m; T 7.1°; P 841 mm; Pe 205mm)



St-Paul-de-Tartas (**5** ; 1146 m; T 7°; P 762 mm; Pe 180mm)



Les Estables (**5**; 1486 m ; T 6.1° ; P 1198 mm ; Pe 249mm)

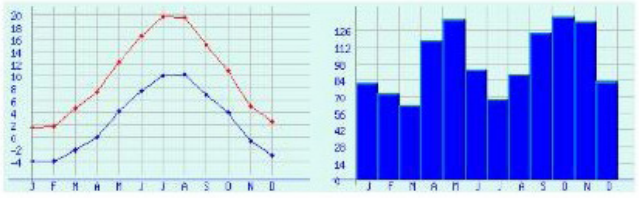


Figure 4 - Thermal and rainfall diagrams of montane localities in the Massif central according to Thébaud & Roux (2018, modified), over the period 1981-2010 (sources Météo-France, Météociel site). Next to each station, are given in order: the biogeographic zone number (see Fig. 3), altitude, average annual temperature T, sum of average monthly rainfall, P; sum of average summer rainfall, Pe (June, July, August); these data do not take into account the altitudinal differences between localities. These data and the rainfall patterns (histogram of average monthly rainfall in blue) reflect three main climate trends:

- low contrast rainfall patterns at high P and Pe (300 <Pe <400 mm), Atlantic type: Chastreix (monts Dore); Salers (Cantal); col de la Loge (Forez);
- rainfall patterns with autumnal maximum and summer minimum (Pe <250 mm), Mediterranean type. These localities also have the highest P values, due to very rainy winters: Le Bleymard (Cévennes-mont Lozère); Loubaresse (mountains of Ardèche); mont Aigoual (southern Cévennes);
- contrasting rainfall patterns between winters and spring / summer, with winter minimum and low P values, continental type; Pe also exhibits low values (<250 mm). For the last 3 stations, we see in the histogram a pronounced summer hollowing out, which reflects the dual influence, continental and Mediterranean: Fix-St-Geneys (Sud-Livradois); Grandrieu (Sud-Margeride); St-Paul de Tartas (Sud-Velay); Les Estables (Velay-Mézenc).

Material and method

Dataset and sampling

We limit ourselves here to the study of short heathlands, dominated by chamaephytes, representing more than 50 % of the cover of the herbaceous layer. The broomy scrubs, and forest mantle with nano-phanerophytes have not been analyzed nor the peaty moors, formed on histosol or organomineral soil (*Oxycocco-Sphagnetea*).

990 relevés were used here, all carried out according to the method of Braun-Blanquet (1932) or similar. Their surface, slightly variable according to the authors, is between 10 and 50 m^2; the minimum area retained for this type of acid moor, tested in the Massif central, is generally between 10 and 20 m^2 (Thébaud 1988). Some older relevés of a larger area (Quézel & Rioux 1954; Braun 1915...), in particular type relevés, have been kept. The characterization of the plant associations used here meets the criteria of floristic, physiognomic, synecological and chorological homogeneity (Géhu & Rivas-Martinez 1981; Géhu 2006; Willner 2006); they correspond to an original and repetitive floristic combination (Guinochet 1973) including diagnostic species, with a significant fidelity (Chytrý *et al.* 2002).

The records have different origins. 165 recent relevés were carried out during this study by G. Thébaud or C. Roux from the UniVegE laboratory at the University of Clermont-Ferrand. Others are from previous phytosociological publications; others, unpublished, were communicated to us by F. Billy for Auvergne, or by A.-M. Mollet from Delpech & Mollet for Haute-Ardèche, of which we have the field notebooks. Some others by J. Schaminée & S. Hennekens (*in* Thébaud 1988). Other relevés are given to us by the Conservatoire d'espaces naturels Languedoc-Roussillon (Barret & Klesczewski 2006) and by the Conservatoire botanique national du Massif central (Choisnet & Mulot 2008). The numbers of relevés by geographic region appear in Table 1. Details of the sources for the 675 higher altitude relevés are given below in the descriptive part.

Data storage and analyses

Relevés were entered in the TURBOVEG database (Hennekens & Shaminée 2001), in a version adapted to French standards. They were exported into the JUICE software (Tichý 2002) to be processed in tabular form and by digital analyses. They were analyzed by hierarchical ascending classification (Modified twinspan classification, Roleček *et al.* 2009), in presence-absence, using total inertia as an index of dissimilarity.

We thus obtained a clustering of the data, constitutive basis for the characterization of the different plant associations, subassociations and variants. These analyses were supplemented by ordination analyses on MVSP software (Kovach 2010, version 3.22), detrended correspondence analyses type (DCA; Hill & Gauch 1980) and canonical correspondence analyses (CCA; Ter Braak 1986) which allowed to improve the positioning of certain relevés and to highlight the relationships and correspondences between ecological variables, taxa and plant associations. The CCA was carried out using as quantitative values those of the indices of bio-indicator taxa (Ellenberg *et al.* 1992 or failing that Julve 1997); this method, which has the advantage of clearly visualizing the correspondence in the form of vectorized arrows between ecological variables and readings by amplifying the differences, however has the disadvantage of creating redundancy because the values of Ellenberg are dependent on the species. Quantitative data climatic, geographic or edaphic, independent of the species, would have been preferable but, in the context of this study, we unfortunately came up against the limits of our sampling for which a lot of data is lacking concerning the bibliographical relevés.

The selection of characteristic or differential species of plant associations was carried out by combining data from the bibliography and the results of analyses by calculating a fidelity index, the coefficient Phi (Chytrý *et al.* 2002) making it possible to determine so-called «diagnostic» species showing a certain level of fidelity to a given set of relevés. These values are given in brackets next to the taxa in the description of the floristic composition of the plant associations. The global analysis of the French heathlands, in progress as part of the PVF2 (Boullet *et al.*), helped us to compare and distinguish the different plant associations thanks to a larger sample spanning the national territory. The final results are expressed in a synoptic table (n° 2) and full tables, showing the individual associations based on single relevés (n° 4 to 11).

Syntaxonomy and nomenclature

The nomenclature of the syntaxa respects the international code of phytosociological nomenclature (ICPN 4th ed. Theurillat *et al.* 2020). The higher hierarchical units mainly refer to the "prodrome des végétations de France", PVF1, first version, up to the alliance level (Bardat *et al.* 2004) and PFV2 (French Society of Phytosociology 2021) and to the European classification (Mucina *et al.* 2016), the latter specially for the vegetation of *Juncetea trifidi* Hadač *in* Klika & Hadač 1944 and *Loiseleurio-Vaccinietea* Eggler *ex* Schubert 1960.

Table 1 - Distribution of the number of relevés by region (in blue the highest regions where the middle montane belt is extended; in green the lower regions where this belt is absent or not extended; upper lign: altitude; lower lign: number of relevés).

Mountains	Chaîne des Puys	Combraille Artense	Montagne limousine	Haut-Languedoc	Limagnes, haut-Allier et bordures	Livradois-Forez Bois Noirs	Boutière Pilat	Vivarais Mézenc Tanargues Ardèche	Mont Lozère Bougès	Vallées cévenoles	Aigoual	Margeride	Aubrac	monts du Cantal	Cézallier	monts Dore	non classés autres
Alt. max. m	1465	1066	977	1259	<1000	1640	1430	1747	1699	< 1400	1565	1551	1469	1856	1551	1886	
num. rel. (total: 990)	**116**	4	55	70	14	104	4	125	51	67	7	22	19	101	4	203	24

The taxonomic nomenclature adopted for vascular plants is TAXREF v. 5.0 (National Museum of Natural History). Plant samples, collected during our surveys, specially concerning difficult genera, were deposited in the University of Clermont-Ferrand Herbarium (CLF).

For digital processing, to avoid bias due to different levels of identification according to the authors, we had to group together taxa in the genera *Festuca*, *Thymus*, *Alchemilla*, *Hieracium*, *Vaccinium* and *Empetrum*. *Vaccinium uliginosum* subsp. *microphyllum* is widespread in the subalpine heathlands of the Massif central (Tison & de Foucault 2014), and subsp. *uliginosum* also exists in more humid areas. *Empetrum nigrum* subsp. *hermaphroditum* and subsp. *nigrum* have also been confirmed, the first in subalpine heaths, the second in peatlands. *Festuca* samples from our recent relevés have been verified by R. Portal; *F. nigrescens* subsp. *microphylla* and subsp. *nigrescens*, *F. rubra* subsp. *rubra* and subsp. *fallax*, for the *rubra* group and *F. billyi*, *F. arvernensis* subsp. *costei*, *F. ovina* subsp. *guestfalica*, *F. filiformis*, *F. lemanii* and *Festuca airoides* are the most common taxa, the last collected in our study area in 2018, was confirmed as well as its diploidy by Boeuf *et al.* (2021). Bryophytes in our surveys were determined by R. Skrzypczak.

The definitions relating to the dynamics of vegetation, series, curtaseries, permaseries, climatophilous, edaphophilous, etc. are those corresponding to the vegetation series concept given in Bioret *et al.* (2019). However, we believe it useful to broaden the set of definitions given by these authors: we can indeed distinguish between "climatoxerophilous" series, marked by a deficit of precipitation during the growing season (Mediterranean climate, etc.), the "climatohygrophilous" series, showing an excess of precipitation during the growing season (atlantic climate…) and the "edaphochionophilous" permaseries, typical of long snow-covered areas in the subalpine and alpine belts.

The layering phytogeographic model for mountain vegetation adopted here is that of Ozenda (1985, 2002), defined as an «alpine system» generalized to adjacent mountains including the low mountain ranges of the Hercynian arc and the Massif central. For the upper zones of temperate Europe, it designates, from bottom to top, a lower montane belt (or submontane), a middle montane belt and an upper montane belt (delimited by the upper beech timberline), and for subalpine belt, a lower subalpine, a middle subalpine and an upper subalpine. In the Massif central, subalpine belt is not, however, sufficiently developed to express these last three sub-belts. It only develops two sub-belts, called here for convenience, «lower subalpine» and «upper subalpine» but not really corresponding to their equivalents of the Alps.

Results

The different stages of analyses have led us to distinguish 17 plant communities and 47 sub-units, for the montane and subalpine heathlands of the Massif central, 16 of which have the rank of plant association grouped together in three phytosociological alliances. They are presented in detail as follows.

Results of classification analyses

A preliminary global MTC classification focused on 990 relevés from all regions and all altitudes; the results appear in supplement 1. It allowed us to rule out 295 relevés corresponding to the most thermophilous formations, which did not fall within our priorities, because for this low altitude vegetations our data were not complete. In particular, we lack relevés of Morvan (Robbe 1993) and Limousin (Botineau *et al.* 1986).

After this selection, 695 relevés of higher altitude heathlands were then subjected to a second MTC, in presence-absence (Fig. 5). Among the 30 individualized clusters we observe a first differentiation into 3 main sets.

Group A (clusters 1 to 6): group of cryophilous, oligotrophilous communities from the subalpine belt; these are relevés of the monts Dore, monts du Cantal, Mézenc et Cévennes (mont Lozère and mont Aigoual). Two sub-groups stand out: A1 (clusters 1 to 3), corresponding to the more xerophilous heathlands of the Cévennes summits and the monts du Cantal, and A2 (clusters 4 to 6), bringing together the communities more chionophilous and mesophilous of the monts Dore and monts du Cantal.

Group B (clusters 7 to 21): group of thermoxerophilous and montane communities. It breaks down into 3 sub-groups: B1 (clusters 7 to 10), dry, acidiphilous and oligotrophilous heathlands, paucispecific, from the lower mountain level to the middle mountain level, present in crystalline mountains of the north of Massif central, and also on acidic volcanic rocks, in chaîne des Puys and Ardèche; B2 (clusters 11 to 16): mesophilous, acidiphilous, oligotrophilous and paucispecific heaths, from the middle montane belt to the upper montane belt, located more in the central and southern part of the Massif central; B3 (cluster 17 to 21), containing neutro-acidiphilous communities, mainly present on more basic substrates.

Group C (Clusters 22 to 30): group of mesophilous communities of upper montane belt and lower subalpine belt formed by communities close to the upper forest edge. They mainly come from the north of the Massif central, volcanic Auvergne, monts du Forez, as far as mont Mézenc. A C1 sub-group (clusters 22 to 24), very well individualized, corresponds to mesotrophilous heaths rich in taxa, of monts Dore and monts du Cantal; C2, corresponds to a more impoverished sub-group.

This clustering analyses forms the basis for the differentiation of plant associations and their sub-units, with which they are mapped (Fig. 5).

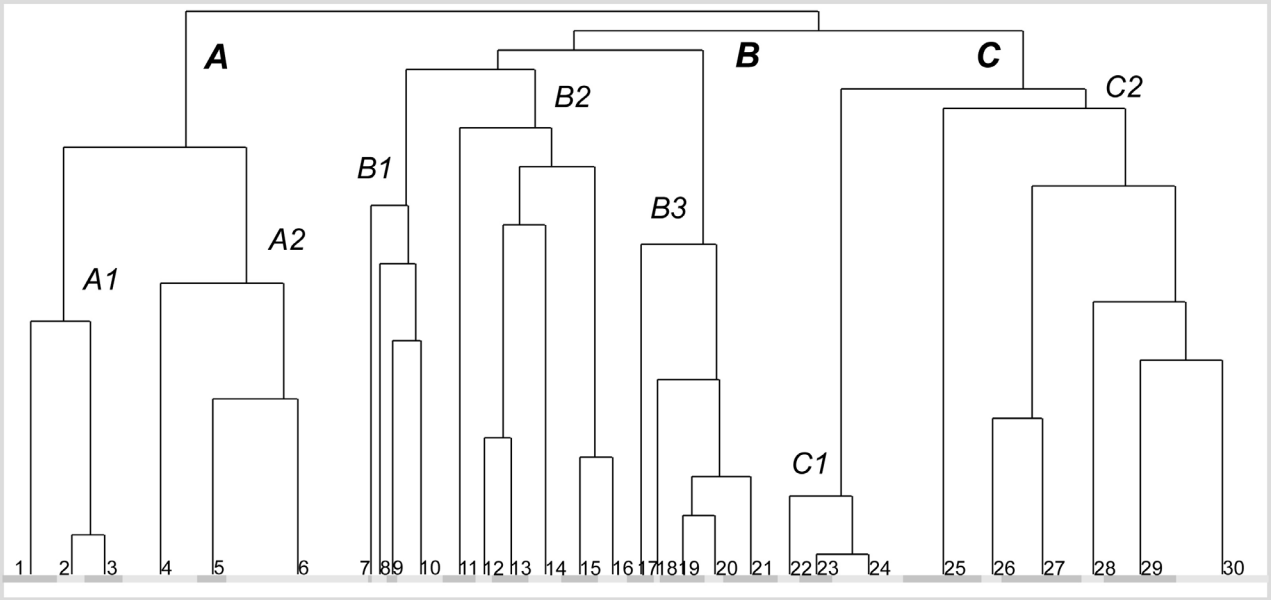


Figure 5 - Dendrogram resulting from the MTC, relating to 695 surveys of middle montane and subalpine heathlands and 319 species (Presence-absence analysis; 30 clusters requested: species present less than 2 times subtracted from the analysis ; dissimilarity index = «total inertia»). The correspondence between the clusters and the individualized plant associations is as follows. **Group A**: **A1** *Phyteumo hemisphaerici-Callunetum vulgaris* (1); *Pulsatillo vernalis-Cytisetum decumbentis* (2); *Biscutello arvernensis-Arctostaphyletum uvae-ursi* (3); **A2** *Racomitrio lanuginosi-Empetretum nigri* (4); *Vaccinietum myrtillo-uliginosi*, *Jasione laevis-Callunetum vulgaris* and *Carici vaginatae-Callunetum vulgaris* (5, 6); **Group B**: **B1** *Teucrio scorodoniae-Callunetum vulgaris* ; **B2** *Pulsatillo vernalis-Cytisetum scabietosum pp* (11), *Vaccinio vitis idaeae-Genistetum pilosae* (12 to 15); **B3** *Galio saxatilis-Vaccinietum myrtilli* (17 to 21). **Group C**: **C1** *Euphorbio hybernae-Vaccinietum myrtilli* (22 to 24); **C2** *Centaureo pectinatae-Juniperetum nanae* (25); *Patzkeo paniculatae-Vaccinietum myrtilli* (26, 27 *pp*); *vaccinietosum uliginosi* subassociation of *Allio victorialis-Vaccinietum myrtilli* (27 *pp*); *Vaccinio myrtilli-Genistetum pilosae* (clusters 28 to 30 *pp*); *Alchemillo saxatilis-Vaccinietum uliginosi* (27 *pp*, 29 *pp*) *Allio victorialis-Vaccinietum myrtilli*, other subassociations (30 *pp*); *Euphorbia hyberna- Calluna vulgaris* community (30 *pp*). Clusters 11, 16 and 18 correspond to intermediate situations.

Results of ordination analyses; correspondence between communities and ecological variables

Several DCA and CCA were carried out in order to specify the groups obtained by MTC and to put in correspondence relevés with plant associations and with ecological variables. They also made it possible to reject 20 relevés that were too different and caused a distortion. A first analysis focused on the totality of the remaining 675 relevés. Then various partial analyses were made on the subsets.

Global analyses were carried out in DCA (Fig. 6a) and in CCA (Fig. 6b); the different individualized plant associations are attached to 3 alliances, delimited in Fig. 6a. The differentiation of these last three does not result directly from our statistical results on the Massif central but from a larger national sample (Boullet *et al*. forthcoming) analyzed as part of the PVF2. Alliance 1: *Genisto pilosae-Empetrion hermaphroditi all. nov.*, cryophilous alliance from the upper subalpine belt of Massif central, belonging to the alpine class *Loiseleurio procumbentis-Vaccinietea microphylli*; Alliance 2: *Genisto pilosae-Vaccinion* Braun-Blanq. 1926, alliance of the montane and subalpine levels of the middle subatlantic mountains, itself divided into three sub-alliances. *Carici piluliferae-Vaccinienion* Schaminée *et al.* 1993, mesophilic sub-alliance, montane to lower subalpine, mainly in crystalline mountain, *Vaccinienion myrtillo-uliginosi suball. nov.*, mesophilic, upper subalpine and cryophilic sub-alliance of volcanic mountains and *Eu-Genisto pilosae-Vaccinienion* Schaminée *et al.* 1993, xerophilic sub-alliance, upper montane to subalpine. Alliance 3: *Diantho hyssopifolii-Vaccinion myrtilli* Boullet *et al. ad interim*, a south-western thermoxerophilic montane alliance present mainly in the Massif central and the Pyrénées (Boullet *et al.* submitted).

On axis 1, the vegetation is differentiated according to a temperature gradient: the most thermophilous communities, 15 and 16, (*Galio saxatilis-Vaccinietum* and *Teucrio scorodoniae-Callunetum*) opposed to the most cryophilous, 1 and 2 (*Carici vaginatae-Callunetum* and *Racomitrio lanuginosi-Empetretum*). Axis 2 corresponds mainly to a nutrient gradient with a mesotrophilous community, 4 (*Euphorbio hybernae-Vaccinietum*), opposing the more oligotrophilous, 13 (*Phyteumo hemisphaerici-Callunetum*). The moisture gradient also plays a role, but more limited. Among the driest communities are 13 and 14 (*Vaccinio vitis-idaeae-Genistetum*), 15 and 16; among the wettest, 2, 3 (*Vaccinietum myrtillo-uliginosi*) and 4. The acid-base reaction is less discriminating.

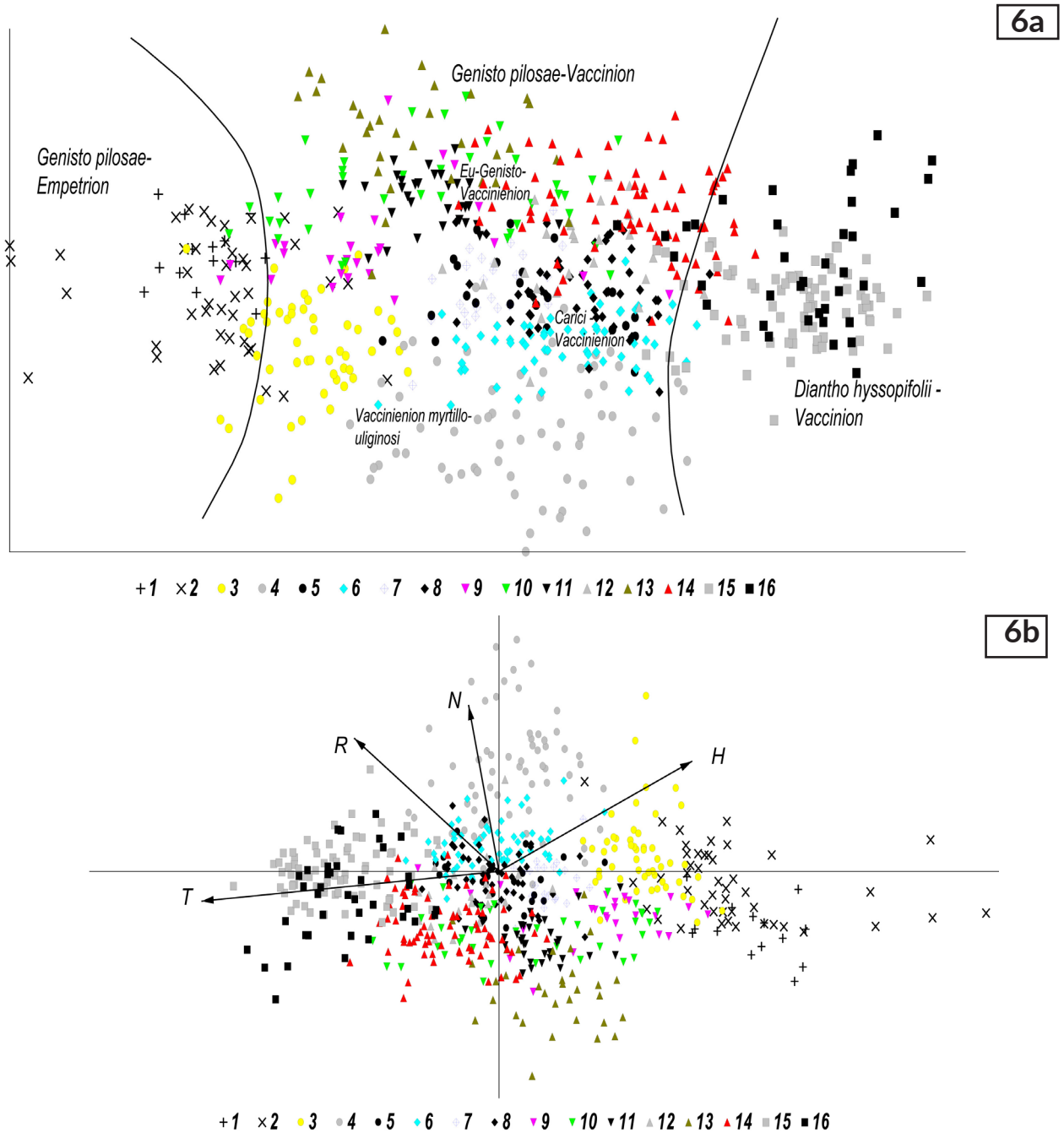


Figure 6 - Global ordination analyses carried out on 675 surveys and 315 taxa, in presence-absence, presenting the projection on the factorial plane of the points-relevés according to the first two axes. **6a**: DCA (eigenvalues of axes 1 and 2 respectively 0.398 and 0.344): Figure 6a delimits the 3 alliances on each side of the two main lines and the three sub-alliances globally positioned within the *Genisto-Vaccinion*. **6b**: CCA (eigenvalues of axes 1 and 2 respectively 0.334 and 0.267) presenting the main ecological variables, in the form of vector arrows, temperature (T), acid-base reaction (R), nutrients (N), soil moisture (H). The records are grouped by plant associations according to the numbers: 1, *Carici vaginatae-Callunetum*; 2, *Racomitrio lanuginosi-Empetretum;* 3, *Vaccinietum myrtillo-uliginosi*; 4, *Euphorbio hybernae-Vaccinietum*; 5, *Patzkeo paniculatae-Vaccinietum*; 6, *Allio victorialis-Vaccinietum*; 7, *Alchemillo saxatilis-Vaccinietum*; 8, *Vaccinio myrtilli-Genistetum*; 9, *Jasione laevis-Callunetum*; 10, *Pulsatillo vernalis-Cytisetum*; 11, *Biscutello arvernensis-Arctostaphyletum*; 12, *Centaureo pectinatae-Juniperetum*; 13, *Phyteumo hemisphaerici-Callunetum*; 14, *Vaccinio vitis idaeae-Genistetum*; 15, *Galio saxatilis-Vaccinietum*; 16, *Teucrio scorodoniae-Callunetum.*

Several partial DCA and CCA analyses were then carried out on more limited sets of readings to refine the results and their visibility. An initial analysis concerned the most cryophilic and high-altitude groups, 1 to 5, corresponding to the alliance of *Genisto pilosae-Empetrion* and those of the suballiance *Vaccinienion myrtillo-uliginosi*. A second analysis was done on the records of xerophilic and thermophilic communities, 9 to 16, of the *Diantho hyssopifolii-Vaccinion* alliance and the *Eu-Genisto pilosae-Vaccinienion* suballiance. Finally a third, 6 to 8, was carried out, on the records of the suballiance of *Carici piluliferae-Vaccinienion*. The results are shown in figures 7, 8 and 9.

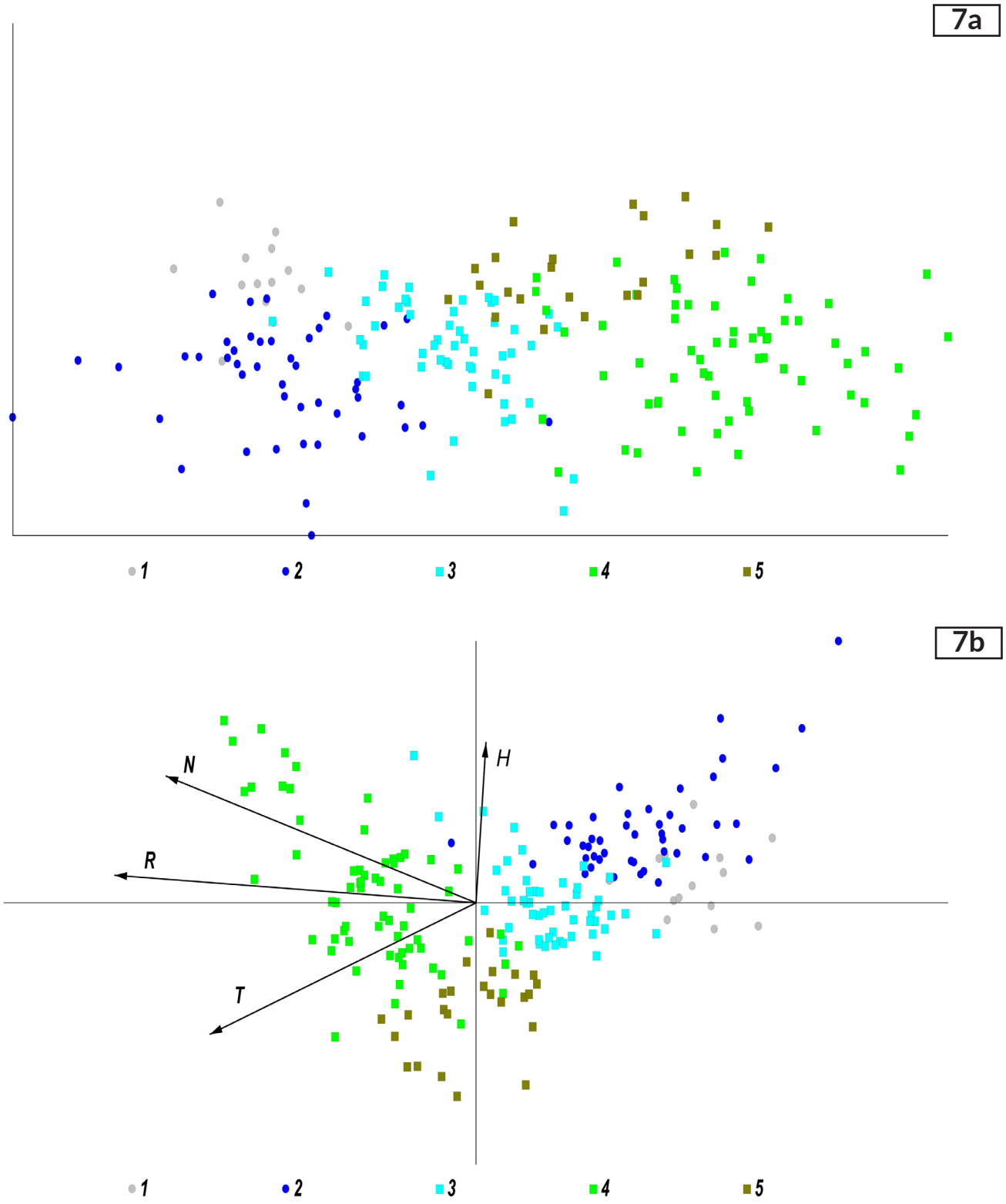


Figure 7- Partial ordination analyses of cryophylous subalpine communities 1 to 5 of *Genisto pilosae-Empetrion* and *Vaccinienion myrtillo-uliginosi* from the Massif central, carried out on 200 relevés and 229 taxa, in presence-absence, presenting the projection on the factorial plane of the points-relevés according to the first two axes. **7a**: DCA (eigenvalues of axes 1 and 2 respectively 0.459 and 0.253): **7b**: CCA (eigenvalues of axes 1 and 2 respectively 0.389 and 0.207), presenting the main ecological variables, in the form of vector arrows, temperature (T), acid-base reaction (R), nutrients (N), soil moisture (H). The relevés are grouped by plant associations according to the following numbers: alliance *Genisto pilosae-Empetrion*: 1, *Carici vaginatae-Callunetum*; 2, *Racomitrio lanuginosi-Empetretum*; suballiance *Vaccinienion myrtillo-uliginosi*; 3, *Vaccinietum myrtillo-uliginosi*, 4, *Euphorbio hybernae-Vaccinietum*; 5, *Patzkeo paniculatae-Vaccinietum*.

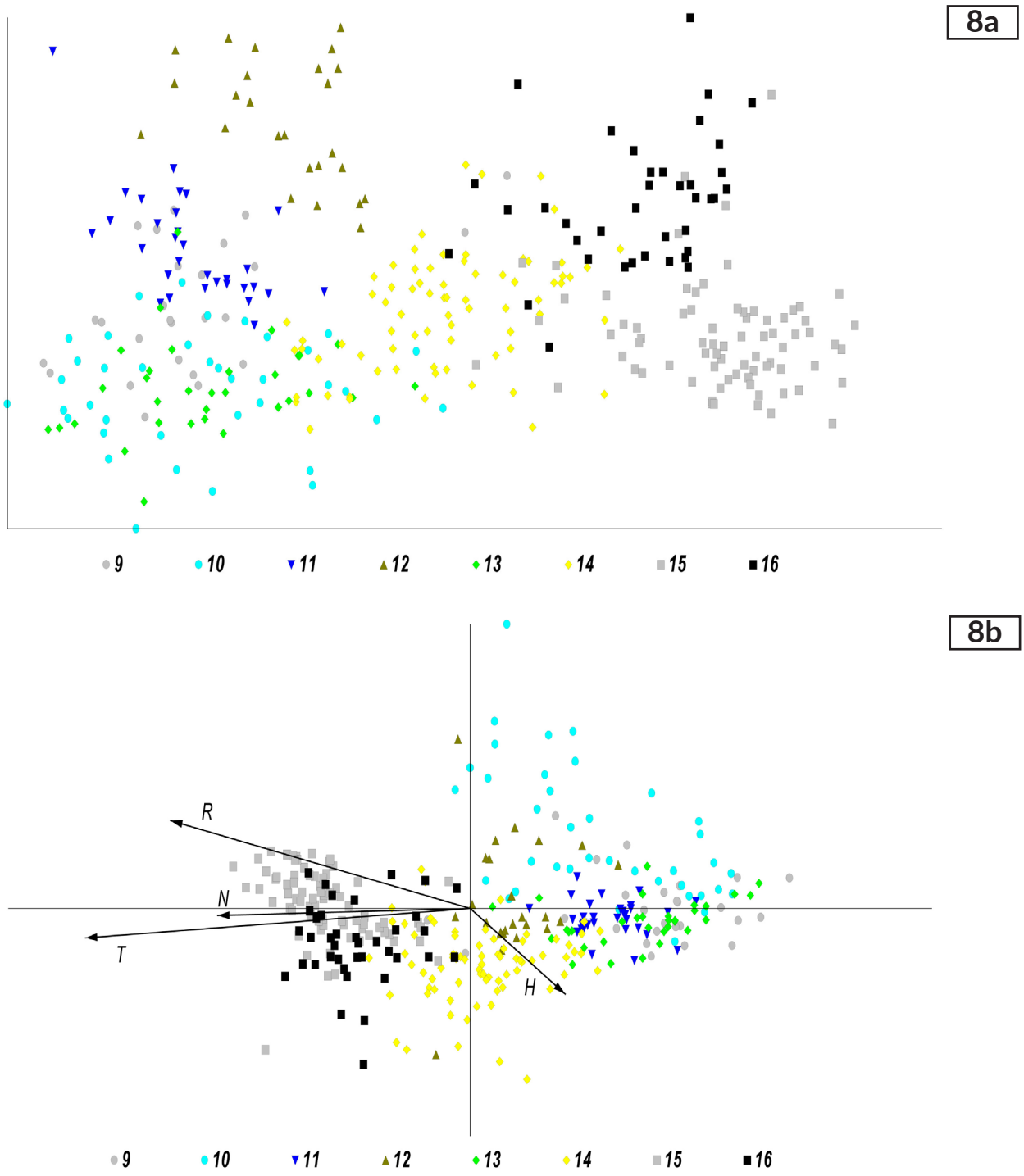


Figure 8 - Partial ordination analyses of xerophilous and/or thermophilous communities 9 to 16 of sub-alliance *Eu-Genisto-pilosae-Vaccinienion* and montanous alliance *Diantho hyssopifolii-Vaccinion* from the Massif central, carried out on 341 relevés and 264 taxa, in presence-absence presenting the projection of the points-relevés along the first two axes. **8a** DCA (eigenvalues respectively 0,439 and 0,306); **8b** CCA (eigenvalues respectively 0,341 and 0,175) ; the main ecological variables are represented by vector arrows, temperature (T), acid-base reaction (R), nutrients (N), soil moisture (H). The relevés are grouped into 8 plant associations according to the following numbers: 9, *Jasione laevis-Callunetum*; 10, *Pulsatillo vernalis-Cytisetum*; 11, *Biscutello arvernensis-Arctostaphyletum*; 12, *Centaureo pectinatae-Juniperetum*; 13, *Phyteumo hemisphaerici-Callunetum*; 14, *Vaccinio vitis-idaeae-Genistetum*; 15, *Galio saxatilis-Vaccinietum*; 16, *Teucrio scorodoniae-Callunetum*.

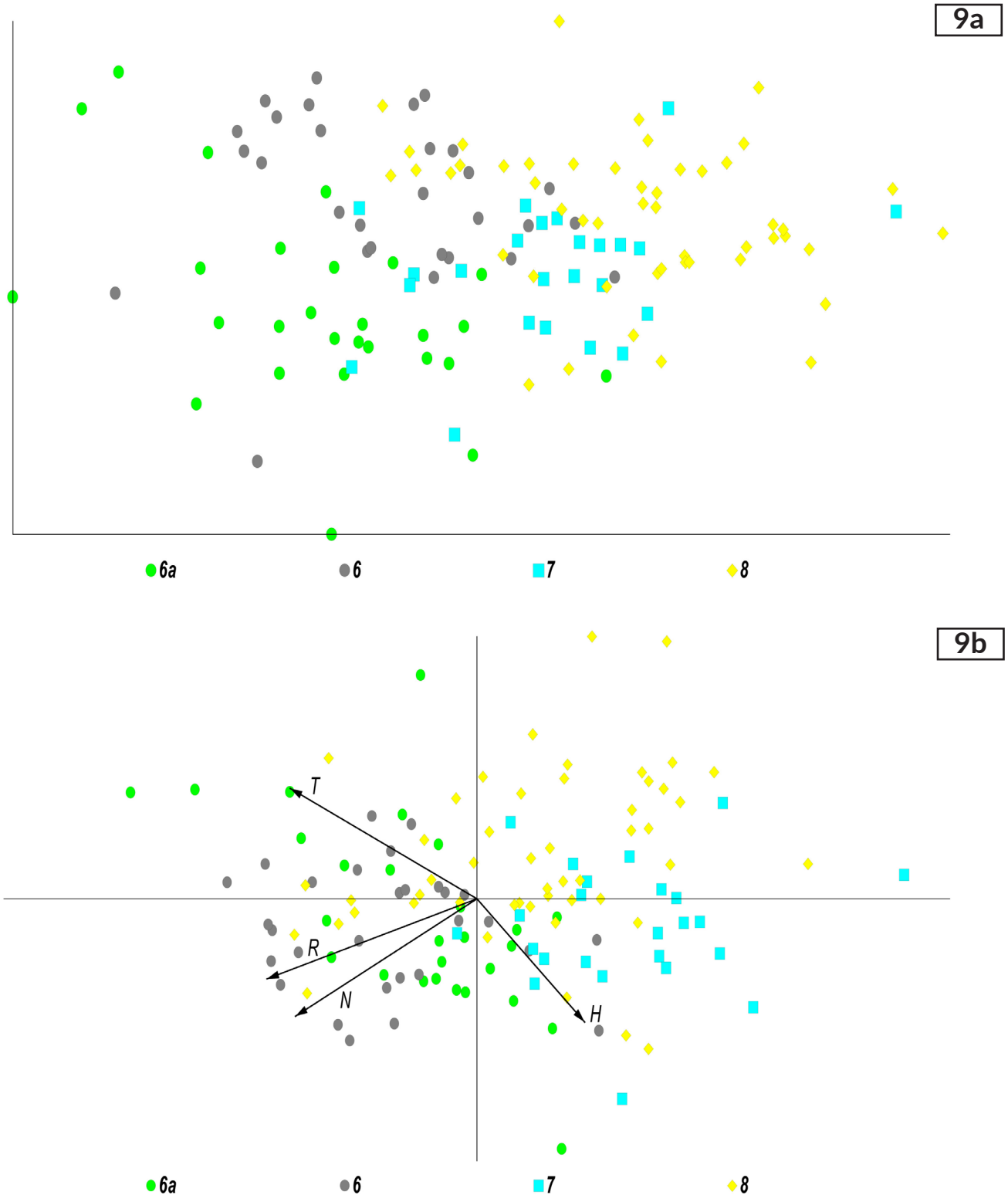


Figure 9 - Partial ordination analyses of mesophilous communities to suballiance of montane to lower subalpine belt *Carici piluliferae-Vaccinienion* of the Massif central, carried out 130 relevés and 154 taxa, in presence-absence, presenting the projection of the points-relevés according to the first two axes. **9a**: DCA (eigenvalues respectively 0,225 and 0,191); **9b**: DCA (eigenvalues respectively 0.157 and 0.102) the main ecological variables are represented by vector arrows, temperature (T), acid-base reaction (R), nutrients (N), soil moisture (H). The relevés are grouped into 3 plant associations according to the following numbers: 6a, *Allio victorialis-Vaccinietum vaccinietosum uliginosi*; 6, *Allio victorialis-Vaccinietum* others sub-associations; 7, *Alchemillo saxatilis-Vaccinietum*; 8, *Vaccinio myrtilli-Genistetum*.

The partial analyses of the relevés of cryophilic communities 1 to 5, carried out in DCA and CCA (Fig. 7a and 7b) shows that they are discriminated on axis 1 by multiple factors, mainly nutrients and acid-base reaction which appear correlated, and temperature. The more cryophilic communities of *Genisto pilosae-Empetrion*, 1 and 2 (*Carici vaginatae-Callunetum* and *Racomitrio lanuginosi-Empetretum*) are opposed to the other three of the *Vaccinienion myrtillo-uliginosi* sub-alliance. Community 4 (*Euphorbio hybernae-Vaccinietum*) appears to be the most eutrophilous and neutroclinophilous. Axis 2 reflects a water gradient, with 5 (*Patzkeo paniculatae-Vaccinietum*) as the driest heathland of well-exposed slopes.

The partial analyses of the relevés of xerophilous and/or thermophilous communities 9 to 16, carried out in DCA and CCA (Fig. 8) shows that they are discriminated on axis 1 by multiple factors, mainly temperature, with the acid-base reaction and nutriments. Within these communities stands out a thermophilic set, 15 and 16 (*Galio saxatilis-Vaccinietum* and *Teucrio scorodoniae-Callunetum*) opposing a cryophilic set, 9, 10, 11 and 13 (*Jasione laevis-Callunetum*, *Pulsatillo vernalis-Cytisetum*, *Biscutello arvernensis-Arctostaphyletum* and *Phyteumo hemisphaerici-Callunetum*). Community 15 is the most neutrophilous. Axis 2 does not show a clear differentiation according to humidity which, here, is not a discriminating factor but which is however weakly correlated to the axis.

The partial analyses within communities 6 to 8 (*Carici piluliferae-Vaccinienion*), carried out in DCA and CCA (Fig. 9; the DCA), concludes with fairly poorly discriminated vegetations, with large overlapping areas. The CCA shows that on axis 1 the readings are discriminated according to several variables. Communities 6 and 6a (*Allio victorialis-Vaccinietum*) appear to be more eutrophilous and neutrophilous (due to their more chionophilic stationary situation). *Alchemillo saxatilis-Vaccinietum*, 7, is the most cryophilous (given its top and windy location).

Comparison of communities by analyses of ecological indices

The 17 characterized communities are compared using their average values of the Ellenberg indices according to the five main ecological variables (Fig. 10).

The temperature curve shows a large difference (1.69) and the low values globally reflect communities in cold mountain climates. The index opposes the most cryophilic communities, 1 (*Carici vaginatae-Callunetum*), 2 (*Racomitrio lanuginosi-Empetretum*) and 3 (*Vaccinietum myrtillo-uliginosi*) to the most thermophilic, 14 (*Vaccinio vitis idaeae-Genistetum*), 15 (*Galio saxatilis-Vaccinietum*), 16 (*Teucrio scorodoniae-Callunetum*) and 17 (*Euphorbia hybernae* and *Calluna* community).

The humidity curve shows a smaller gap (0.84) and overall mesophilous communities. However, there is a clear opposition between mesophilous communities in an atlantic climate, 1 to 9, corresponding to those of *Genisto pilosae-Empetrion*, *Vaccinienion myrtillo-uliginosi* and *Carici piluliferae-Vaccinienion* located exclusively in the north of the Massif central and dry communities, i.e. edaphoxerophilous, or climatoxerophilous, from 10 to 17, corresponding to those of *Eu-Genisto pilosae-Vaccinienion* and *Diantho hyssopifolii-Vaccinion*.

The curve of the acid-base reaction reflects communities on globally acidic soils but showing a significant difference (1.85); 4 (*Euphorbio hybernae-Vaccinietum*) and 15 (*Galio saxatilis-Vaccinietum*), acidiclinophilic to neutroclinophilic communities, are distinguished from the others which remain frankly acidiphilic, in particular 13 (*Phyteumo hemisphaerici-Callunetum*) and 1 (*Carici vaginatae-Callunetum*) which present the lowest values.

The nutrients curve presents globally low values reflecting globally oligotrophilous communities. But important gaps exist (1.45): in particular 4 (*Euphorbio hybernae-Vaccinietum*), 6 (*Allio victorialis-Vaccinietum*) and 15 (*Galio saxatilis-Vaccinietum*) have higher values, with a more oligomesotrophic character. Here again 1 (*Carici vaginatae-Callunetum)* and 13 (*Phyteumo hemisphaerici-Callunetum*) stand out as the most oligotrophilous.

All these communities are heliophilic as shown by the light curve with strong index values, and there is a small gap (0.91). However communities 4 (*Euphorbio hybernae-Vaccinietum*), 6 (*Allio victorialis-Vaccinietum*), 8 (*Vaccinio myrtilli-Genistetum*), 12 (*Centaureo pectinatae-Juniperetum*), 17 (*Euphorbia hyberna-Calluna* community) at lower values, reflect more shaded, due to their topographic conditions or their forest dynamics in the montane belt.

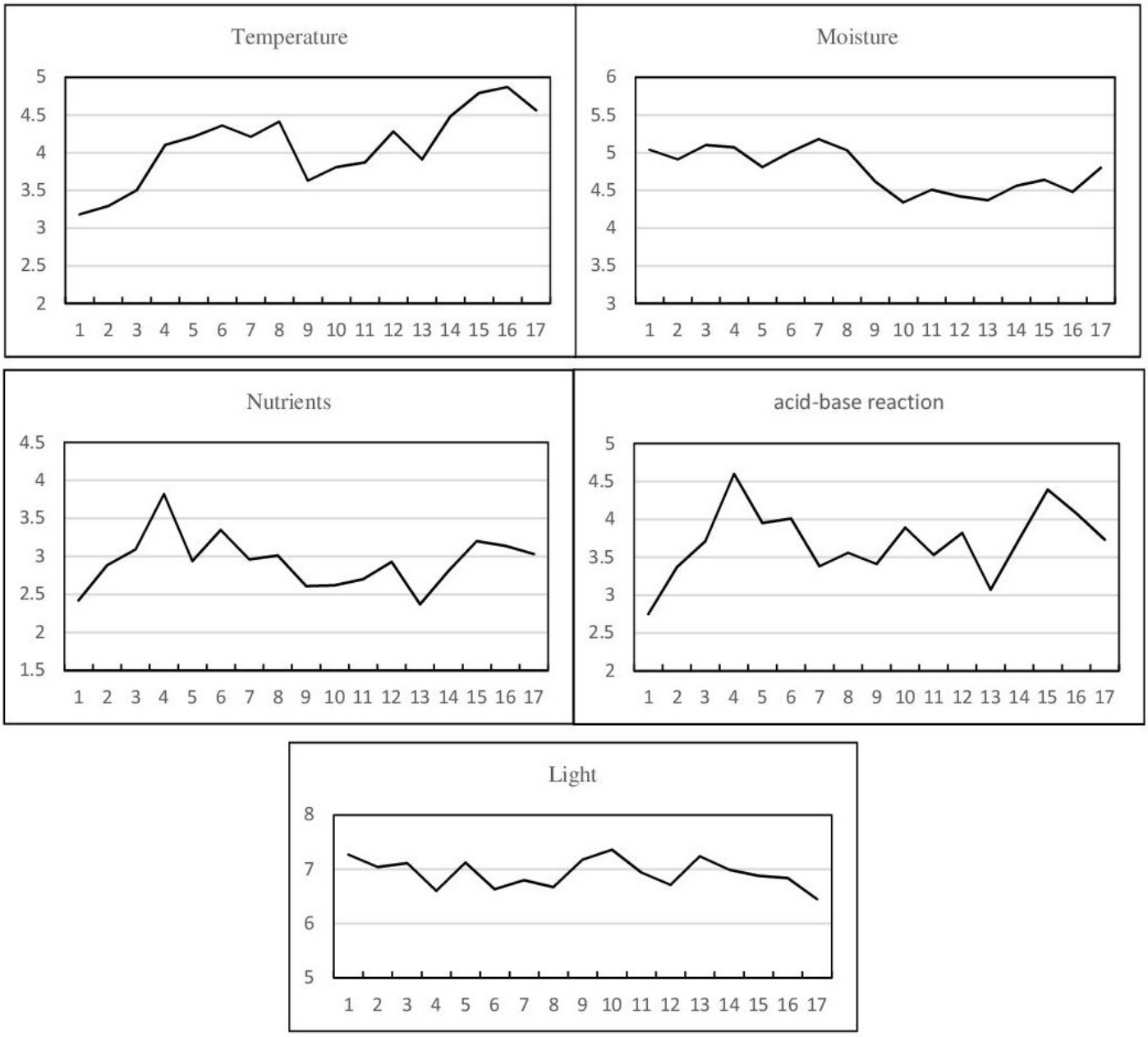


Figure 10 - The average values of the ecological index (Ellenberg *et al.* 1992) calculated for each of the 17 communities. The values are weighted by the frequency of the taxon in the community. **1,** *Carici vaginatae-Callunetum*; **2**, *Racomitrio lanuginosi-Empetretum*; **3**, *Vaccinietum myrtillo-uliginosi*; **4**, *Euphorbio hybernae-Vaccinietum*; **5**, *Patzkeo paniculatae-Vaccinietum*; **6**, *Allio victorialis-Vaccinietum*; **7**, *Alchemillo saxatilis-Vaccinietum*; **8**, *Vaccinio myrtilli-Genistetum*; **9**, *Jasione laevis-Callunetum*;**10**, *Pulsatillo vernalis-Cytisetum*; **11**, *Biscutello arvernensis-Arctostaphyletum*; **12**, *Centaureo pectinatae-Juniperetum*; **13**, *Phyteumo hemisphaerici-Callunetum*; **14**, *Vaccinio vitis idaeae-Genistetum*; **15**, *Galio saxatilis-Vaccinietum*; **16**, *Teucrio scorodoniae-Callunetum*; **17**, *Euphorbia hyberna–Calluna* community.

Presentation and characterization of communities

The seventeen plant communities described below are presented according to their membership in 3 alliances and three suballiances which do not all result directly from our statistical results on the Massif central but from a larger national sample (Boullet *et al.* forthcoming) analyzed as part of the PVF2. The floristic composition of these communities is given in synoptic table n° 2. Figures 11a and 11b show their distribution in the Massif central. A complete table of all relevés is given in supplement 2. Phytosociological tables 4 to 11, give details of the relevés for new associations or subassociations. For others, the reader will refer to the work of the original authors cited in the bibliography. Photographs corresponding to precise statements are given for each community.

Table 2 - General synoptic table of montane and subalpine heathlands of the French Massif central.

CLASSES		*Loiseulerio - Vaccinietea*	*Calluno - Ulicetea minoris*
ALLIANCES		A1 *Genisto - Empetrion*	A2 *Genisto pilosae-Vaccinion*	A3 *Diantho hyssopifolii-Vaccinion*
SUBALLIANCES			A21 *Vaccinienion myrtillo-uliginosi*	A22 *Carici piluliferae-Vaccinienion*	A23 *Eu-Genisto pilosae-Vaccinienion*	A31 *Diantho hyssopifolii-Vaccinienion*
num. association		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
num. subassociations		1 2	1 2 3 4	1 2 3 4	1 2 3	1 2	1 2 3 4	1 2	1 2 3	1 2	1 2	1 2 3	1 2	1 1 1	1 2 3	1 2 3 4	1 2 1		
variants														1 2 3			1 2		col
num. rel. (total 647)		5 9	6 23 10 6	9 19 18 6	23 24 18	12 12	29 17 10 5	16 8	13 20 17	14 12	21 17	13 6 4	14 9	5 6 21	22 21 13	27 11 11 22	16 9 10	8	
Salix bicolor Willd.	d2	. .	. . II V	I . . .	I . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. I . .	. . .	.	5
Carex vaginata Tausch	c1	II IV	. . . .	I . . .	. . I	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Huperzia selago (L.) Bernh. *ex* Schrank & Mart.	*C1* cA1	III III	II V . .	. . . .	. I .	. .	. . . .	. .	. I .	II .	. .	. . 1	. .	. . .	. . .	. . . .	. . .	.	8
Empetrum nigrum L. (incl. s. *hermaphroditum*)	*C1* cA1 c2	II I	IV IV V V	. I . .	. . .	. .	. . . .	. .	. . .	. I	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	9
Cerastium alpinum L.	*C1* dA1 c2	. .	I I III III	I . I .	. . .	. .	. . . .	. .	. . .	. I	I I	. . .	. .	. . .	. . .	. . . .	. . .	.	9
Luzula desvauxii Kunth	d2	. I	III I IV II	III . I V	III II .	. .	I . . .	I .	. . .	. I	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	14
Avenula versicolor (Vill.) Laínz	*C1* dA21 c3	II II	III IV IV III	IV IV V IV	I . I	I I	. . . .	. .	. . .	. III	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	16
Pulsatilla alpina s. alba Zamelis	cA1 d3	V V	V I IV V	III II IV III	I . .	. I	I . . .	. .	. . .	II V	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	16
Mutellina adonidifolia (J.Gay) Gutermann	c3	III IV	IV I III .	IV IV IV V	II . I	I .	I . . .	. .	. . .	. II	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	15
Agrostis rupestris All. (et *marysae-tortii*)	*C1*	I V	III II I .	IV I II .	. . .	. I	. . . .	. .	. . .	II II	IV .	II .	. .	I . I	. . I	. . . .	. . .	.	16
Trifolium alpinum L. **I**	c12	I V	I I I .	V III II .	I I I	II I	I . II I	III II	. . .	I I	III II	. . .	. .	. II III	I . I	. . . .	. . .	.	26
Euphrasia minima Jacq. *ex* DC.	*C1*	. III	I I I .	III II I I	. . .	. I	. . . .	. .	. . .	. III	I I	. . .	. .	. . .	. . .	. . . .	. . .	.	12
Pulsatilla alpina s. apiifolia (Scop.) Nyman	*C1* dA21	. .	. I I I	II III . .	II I II	I I	I . . .	. .	. . .	. I	III II	. . .	. .	. . .	. . .	. . . .	. . .	.	14
Melampyrum sylvaticum L.	cA21	II .	. II III II	I II III V	II I I	I I	I . . .	I .	. . .	I .	. . 2	. . .	. .	. . .	. . .	I . . .	. . .	III	19
Phyteuma spicatum L.		. .	. . II III	. I II III	III II I	I .	. . I .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	I	11
Knautia basaltica Chass. & Szab.	cA21	. .	. . I .	. II I I	III . I	I .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I . . .	. . .	.	8
Trollius europaeus L.	dA21	. .	. . . .	. III II II	III II I	. .	. . I .	. .	. . .	. I	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	8
Geum montanum L.	dA21	. .	. . . .	II I II I	II I I	. .	. . . .	. .	. I .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	8
Campanula scheuchzeri s. lanceolata (Lapeyr.) Tison	dA21	I .	. . . .	III IV II .	IV III IV	IV I	I III I .	I .	I . I	I II	I I	. . .	. .	. . .	. I .	I . . .	. . .	IV	22
Potentilla aurea L.	d3	. .	. . I .	IV IV II II	II I I	II I	I I . III	I .	I . .	. II	II I	. . .	IV V	. . .	I . .	I . . .	. . .	.	20
Melampyrum pratense L.	dA22	. .	. II . .	II III . .	I II II	I .	II IV II II	II IV	I I III	I .	I .	. . .	. .	I . I	. . .	I . . .	I I I I	.	25
Sorbus aucuparia L.	dA22	. .	. I I I	. II . .	I IV II	I I	II V IV III	III III	II III IV	I .	. .	. . .	. I	II . I	I I I	I I . .	II . I	IV	30
Allium victorialis L.	dA22 c6	. .	. . . .	. I I I	II I I	. .	I II III IV	II I	II I I	. .	. .	. . 1	I .	. . .	. . .	. . . .	. . .	.	17
Convallaria majalis L. **II**	dA22	. .	. . . .	. . . .	I I .	I .	. III I II	. .	I I III	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	9
Maianthemum bifolium (L.) F.W.Schmidt	cA22	. .	. . . .	. I . .	I I I	. .	II II I II	I II	I I III	. .	. .	. I .	. .	. . .	I I I	I I . .	I . .	II	21
Anemone nemorosa L.	cA2A22	. .	. . . .	. I I .	I II II	. I	III III III IV	III IV	II II III	I I	I .	I V 1	. .	. . I	I I I	I I . I	. . .	I	29
Calamagrostis arundinacea (L.) Roth	dA31	. .	. I I .	. I . I	IV IV IV	III I	II III III II	I .	II II V	II .	. I	I . .	IV V	. . .	I I .	I I . .	II . I	.	28
Festuca paniculata (L.) Schinz & Thell. *s. paniculata*	c5 dA2	. .	. I . .	I II II .	IV II II	IV II	I I I .	I .	. I I	I .	I III	I . 1	V II	I . I	I . .	I . . .	. . .	.	28
Solidago virgaurea L.		. .	I II III I	II II II II	IV V IV	V I	IV III I .	. .	I I III	I I	II .	. . .	IV I	. . .	I I I	I II . .	I . .	II	32
Phyteuma hemisphaericum L.	C1 c13	V V	IV IV III III	IV III III .	. I II	I II	. . . .	. I	. . .	III V	IV II	V V 1	I .	III IV III	. . .	I . . .	. . .	.	26
Festuca airoides Lam.	*C1* c13 cA23	. I	IV III II .	I I . .	. . .	. I	. . . .	. .	. . .	II I	IV III	I II 1	II .	IV V V	II IV IV	. . . .	. . .	.	21
Juniperus communis s. nana (Hook.) Syme	*C1* dA23 c12	. I	. I . .	. I . .	I I I	I .	I . . .	. .	III . I	IV I	I II	V V 4	V V	II I I	I . .	I . . .	. . .	.	26
Luzula spicata (L.) DC.	*C1* d13 dA23	. .	. I I .	. I . .	. . I	. .	. . . .	. .	. . .	I III	IV I	. . .	. .	III IV II	I I I	. . . .	. . .	.	15
Antennaria dioica (L.) Gaertn.	*C2* dA23	. .	. . . .	I I . .	. . .	. I	I . . .	. I	. I .	. .	II III	IV I .	. .	II III V	I I II	. I II II	II . .	.	20
Cotoneaster integerrimus Medik./ *tomentosus* Lindl.	dA23	. .	. . . .	. . . .	. I .	I .	. I . .	. .	. . .	II .	. I	. 1	IV II	. . .	I . .	. . . I	. . II	.	12
Arctostaphylos uva-ursi (L.) Spreng.	dA23 c4 c5	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. III	IV V 4	IV V	. . .	. . .	. . . .	. . .	.	6
Pulsatilla vernalis (L.) Mill. **III**	*C1* c10 11	. .	. . . .	I . . .	. . .	. .	. . . .	. .	. . .	III II	V IV	. .	. .	. I .	. . .	. . . .	. . .	.	6
Biscutella laevigata coll. (incl. *arvernensis* Jord.)	dA2 c11	II .	. I . I	I II I .	. I .	I .	. . . .	. .	. . .	I I	II I	V I .	. .	. . .	. . .	. . . .	. . .	.	14
Pedicularis comosa L.	c10	. .	. I I .	. II . .	I . .	. .	. . . .	. .	. . .	I .	III II	. . .	. .	. . .	. . .	. . . .	. . .	.	7
Festuca arvernensis Auquier, Kerguélen & Markgr.-Dann.	d10	. .	. . . .	. . . .	I . .	. .	. . . .	I I	. . .	I .	II III	. . .	. .	I . .	. . .	I . . .	. . .	.	8
Silene ciliata Pourr.	*C1* c10	. .	. I . .	I . . .	. . .	. .	. . . .	. .	. . .	. .	II I	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Androsace halleri L.	*C1* d10	. .	. I I .	. I . .	. . .	. .	. . . .	. .	. . .	. .	II I	. . .	. .	. . .	. . .	. . . .	. . .	.	5
Euphrasia micrantha Rchb.		. .	. . . .	. . . .	. . .	I .	. . . .	. .	. . .	. .	I II	. . .	. .	. III I	. . .	. . . .	. . .	.	5
Juncus trifidus L.	*C1* c13	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	V I I	. . .	. . . .	. . .	.	3
Hieracium schmidtii Tausch	d13	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	I .	IV V III	I I II	. . . .	. . .	.	7
Plantago holosteum Scop.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	I I I	I I I	. . . .	. . .	.	6
Sesamoides pygmaea (Scheele) Kuntze	c13	I .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	I .	. .	. . .	. .	. V .	. . .	. . . .	. . .	.	3
Centaurea pectinata L.	c12	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	III IV	. . .	. . .	. . . .	. . .	.	2
Sorbus mougeotii Soy.-Will. & Godr.	d12	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	III III	. . .	. . .	. . . .	. . .	.	2
Centaurea nigra L.		. .	. . . .	. . . .	I II II	IV .	I I I .	. .	. . I	. .	I II	. . .	. .	. . .	. . I	II . . II	. . .	I	14
Lathyrus linifolius v. montanus (Bernh.) Bëssler		. .	. . . .	. . I .	IV I II	I II	I II I .	. I	. . I	. .	. .	. . .	I II	. . .	I I I	II III V V	. . .	.	20
Hypericum maculatum Crantz		. .	. . . .	. I . .	III III IV	I .	I III III V	. .	. . .	. .	. .	. . .	I .	. . .	. . .	II III II V	. . .	I	15
Poa chaixii Vill. **I V**		. .	. . . .	II II II III	IV III IV	I .	III III I II	. .	. I I	. .	I I	. . .	I .	. . .	I . II	II IV III III	. . .	.	23
Dianthus seguieri s. pseudocollinus (P.Fourn.) Jauzein		. .	. . . .	. III . I	II II IV	IV III	IV I . .	. .	I . I	I .	I I	. . .	II .	. . .	I I III	II III II I	I . .	II	24
Stachys officinalis (L.) Trévis.		. .	. . . .	. . . .	I I II	III .	. IV . .	. .	. I .	. .	. I	. . .	. .	. . .	. . .	III III IV IV	I . I	II	14
Achillea millefolium L.		. .	. . . .	. . . .	I I II	II .	I . . .	. .	. . .	. .	. II	. . .	. .	. . .	I . III	III III IV IV	I I I	.	15
Galium verum L.	dA3	. .	. . . .	. . . .	I I II	I .	. . . .	. .	. . .	. .	. .	. . .	. I	. . .	III I I	V IV V V	. . I	IV	14
Galium pumilum Murray	dA3	. .	. . II II	. . . .	I II II	. I	I . . .	. .	. . .	I .	. .	. . .	. .	. . .	I I I	II I II III	I II .	.	17
Genista sagittalis L.	cA3	. .	. . . .	. . . .	. . I	I .	I I . .	. .	. . .	. .	. I	. . .	. .	. . .	I I I	III . II III	. II .	I	13
Pimpinella saxifraga L.	d15	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. I	I .	. . .	. .	. . .	. . .	I II I II	. . .	.	6
Avenula pratensis (L.) Dumort. **V**	dA3 d15	. .	. . . .	. . . .	. . I	. .	. . . .	. .	. . .	I .	. .	. . .	. .	. . .	. . .	I IV IV IV	I . .	.	7
Centaurea jacea L.	d15	. .	. . . .	. . . .	. . .	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I III III II	I . .	.	6
Helianthemum nummularium (L.) Mill.	cA3 c15	. .	. . . .	. . . .	. . I	. .	. . . .	. .	. . .	. .	. I	. . .	. .	. . .	. . .	I II IV II	I . .	I	8
Corylus avellana L.	dA31	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. I	. . .	. . .	I III I I	V . I	I	8
Brachypodium pinnatum coll. (incl. *rupestre*)	dA3	. .	. . . .	. . . I	I . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	III II V III	III II I	.	9
Thymus pulegioides L.	cA3	. .	. . I .	. . . .	I . .	. I	. . . .	. .	. . .	. .	I III	II . .	. I	I . .	I I .	II II V III	I III .	.	17
Hieracium pilosella		. .	. . . .	. . . .	. . .	I I	I I . .	. .	. I .	. .	I III	. . .	. .	. . .	I I I II	I I IV I	I III I	.	18
Viola canina L.		. .	. . . .	. . . .	. . .	. .	I . . .	. .	. . I	. .	. I	. . .	. .	. . I	I I I	II IV III III	III I I	.	14
Luzula campestris (L.) DC. **VI**		. .	. . . .	. . . .	. . .	I .	I I . .	I .	I I .	. .	I .	. . .	. .	I . I	II III II	I . . II IV	I II I	.	20
Pinus sylvestris L.		. .	. . . .	. . . .	. . .	. .	. I I .	I II	II III I	I .	. .	. 1	I .	. IV I	I III I	I I . I	IV IV .	.	20
Vaccinium vitis-idaea L.	c14	. .	. . . .	. . I .	. . .	. .	. . . .	I I	. I I	. .	I .	. . .	. .	. II II	II III II	. . . .	. . .	.	12
Cytisus oromediterraneus Rivas Mart. & *al.*		. .	. . . .	. . . .	. I .	I .	I I . .	. .	. I .	I .	I I	. . .	I IV	. I I	V I I	. I . .	. II .	II	19
Genista anglica L.	d14 d17	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	II II I	I . . .	. . .	III	6
Juniperus communis s. communis L.		. .	. . . .	. . . .	. . .	. .	I . . I	. .	I . I	I .	. .	. . .	. .	. . I	II II I	I . . .	. IV I	I	13
Cytisus scoparius (L.) Link **VIb**	d16	. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	I . .	I . .	II . . .	III III I	I	6
Teucrium scorodonia L.	c16	. .	. . . .	. I . .	. . .	. .	. I . .	. .	. . .	. .	. .	. . .	. II	. . .	. . .	. I . .	III IV III	.	7
Jacobaea adonidifolia (Loisel.) Mérat	d5	. .	. . . I	I I II	IV I	I .	. . . .	. .	. I .	. .	I II	. . .	I II	. . .	II . II	I II . I	II II I	I	21
Silene vulgaris (Moench) Garcke	d4	. .	. . . .	. . . .	III II II	I .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	I . . .	. . . .	I I .	.	9
Crepis conyzifolia (Gouan) A.Kern.	c5	. .	. . . .	. . . .	I I I	III .	. . . .	. .	. . .	. .	I I	. . .	. .	. . .	I I II	I . . .	. . .	.	10
Senecio doronicum (L.) L.	d4	. .	. . . .	. I . .	IV I II	I .	I . . .	. .	. . .	. .	I I	. . .	. .	. . .	. . .	. . . .	. . .	.	8
Laserpitium latifolium L. **VIIa**		. .	. . . .	. . . .	II II I	. .	. . . .	. .	. . .	I .	. I	. . .	. I	. . .	. . .	. I . .	. . .	.	7
Hieracium prenanthoides Vill.		. .	. . . .	. I I .	II II I	. .	I . I .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I . . I	I . .	.	11
Adenostyles alliariae (Gouan) A.Kern.		. .	. . . I	. . I IV	I II I	. .	. I . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	7
Luzula sylvatica (Huds.) Gaudin	d4	I .	. . I .	. . I I	IV III I	I .	II . . .	. .	I . .	I I	I .	. . .	. .	I . .	. . .	I I . I	. . .	.	17
Sanguisorba officinalis L.		. .	. . . .	. . I .	III II I	II I	II I III .	. .	. I .	. .	. .	. I .	. .	. . .	. . .	. . . .	. . .	.	11
Geranium sylvaticum L.	d4	. .	. . I .	I . . II	IV IV II	. I	. . I .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	8
Euphorbia hyberna L.	c4 c17	. .	. . . .	. I . .	II III I	I .	. . . .	. .	. I .	. .	. .	. . .	. .	. . .	. . .	I . . .	. . .	IV	8
Lilium martagon L. **VIIb**	d4 d12	. .	. . . .	. . . .	III IV I	I .	I I I .	. .	. . .	I .	. I	. . .	IV III	. . .	I . I	. . . .	. . .	I	14
Senecio cacaliaster Lam.		. .	. . . .	. . . .	I III I	. .	I . . .	. .	I . I	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	6
Lactuca plumieri Gren. & Godr.		. .	. . . .	. . . .	I III I	I .	. . I .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	5
Doronicum austriacum Jacq.		. .	. . . I	. . . .	. III I	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Athyrium filix-femina (L.) Roth		. .	. . . .	. . . .	. III I	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Ranunculus aconitifolius L.		. .	. . . .	. . . .	I III .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	2
Deschampsia flexuosa (L.) Trin.		V IV	V IV V V	V V V V	V IV V	V V	V IV V IV	V IV	V V V	V V	V III	V V 4	V IV	IV I IV	IV V V	V V V V	V IV V	V	47
Vaccinium myrtillus L.	*C2*	V V	I V V IV	V V V V	V V V	V V	V IV V IV	V IV	V V V	V V	III III	IV V 4	V IV	V II IV	V V V	V II V V	III . V	V	46
Calluna vulgaris (L.) Hull	*C2* c9 c13	V V	. V IV II	III V IV II	II II V	V V	V V IV V	V V	V V V	V V	V V	V V 4	V V	V V V	V V IV	V V V V	V V IV	V	46
Festuca rubra coll. **VIII**		. II	I I I I	IV IV V V	IV IV IV	III III	V V IV V	V III	II IV III	II II	I I	V II 2	I .	I . II	II III II	III III III III	II I I	IV	44
Genista pilosa L.	*C2* cA1A2	IV .	. II I III	II I . .	I . III	V V	III V IV IV	III IV	IV V V	IV V	V V	V V 3	V IV	IV III IV	V IV IV	IV V IV V	V IV V	V	43
Vaccinium uliginosum L. (incl. s. *microphyllum*)	cA2	V IV	V V V V	IV V V V	IV III V	III V	V I III III	V V	IV II I	IV IV	IV III	III III 3	IV .	III II III	I . I	I II . I	. . .	.	40
Scorzoneroides pyrenaica (Gouan) Holub *s. pyrenaica*		V V	III IV IV .	V IV V IV	II I III	III III	IV III III III	V IV	II III III	III V	IV I	I V .	. .	I . II	I II I	I IV III II	II . I	.	40
Gentiana lutea L.	*C2* cA2	I IV	. I I .	IV V V II	V V IV	V IV	IV V V IV	V IV	IV III IV	IV IV	III III	III V 2	IV III	I . .	. . I	II III I II	I . . II	V	40
Alchemilla alpina coll.		I .	I IV II .	III II I I	II II II	I III	I II I .	III II	. . .	III II	IV III	I II 1	II .	IV II V	III II IV	I I I II	I I I .	.	39
Galium saxatile L.	*C2*	. .	. I I III	IV I I I	I II III	III I	IV IV II V	V II	III IV V	I .	I I	. . .	II .	I . I	II III III	II IV I II	I I II	I	38
Anthoxanthum odoratum L.		. .	. . III .	IV III V V	IV I I	I I	III III II III	I I	I I I	I I	I I	. . .	I .	I I I	I I III	II III III III	II II I	II	38
Nardus stricta L.		. II	. . . .	II II I .	III II	I III I	IV IV II III	IV III	III . I	I I	III IV	III IV .	II I	. . III	I II IV	II I I I	I I . .	III	37
Carex caryophyllea Latourr.		V II	. I . .	III II III I	II I II	I IV	II I . II	I I	. I .	III IV	III III	III IV 2	. .	IV . V	I III V	I I IV II	I I . .	.	36
Meum athamanticum Jacq.	dA2	. .	. I . .	II IV II I	IV III IV	V III	IV V IV IV	IV III	I IV III	II II	I II	IV V 1	IV I	. . I	I I III	II I . .	. . I	IV	36
Carex pilulifera L.	dA22	. I	. . . .	. I I .	. I I	I I	I III II I	III III	III III III	II I	I I	I II 1	II .	. . I	I II I	I I . I	I II I	I	35
Agrostis capillaris L.		. .	. . . .	II I III II	IV IV IV	III II	. II I II	III II	. II I	I I	II I	I II 1	. .	. . I	I II II	IV V V IV	III I .	V	34
Persicaria bistorta (L.) Samp.		II I	I III IV I	III V V IV	IV IV IV	II III	IV IV IV III	V I	I III II	. III	III .	. I .	. .	. . I	I I III	I . . .	. . .	.	32
Luzula multiflora (Ehrh.) Lej.		II II	. I I .	III V IV III	I II III	III III	III I I .	III II	II I I	. IV	II .	. . 1	I .	I . I	I I .	. . . I	I . .	.	31

num. association		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
num. subassociations		1 2	1 2 3 4	1 2 3 4	1 2 3	1 2	1 2 3 4	1 2	1 2 3	1 2	1 2	1 2 3	1 2	1 1 1	1 2 3	1 2 3 4	1 2 1		
variants														1 2 3			1 2		col
num. rel. (total 647)		5 9	6 23 10 6	9 19 18 6	23 24 18	12 12	29 17 10 5	16 8	13 20 17	14 12	21 17	13 6 4	14 9	5 6 21	22 21 13	27 11 11 22	16 9 10	8	
Arnica montana L.	*C2* cA2	. .	. . . .	II IV III .	III IV IV	IV IV	IV III III .	I III	III IV III	I III	II I	IV V 1	II .	I . II	. II IV	I . . .	. . I	V	31
Potentilla erecta (L.) Rausch.	*C2*	. .	. . . .	I II I .	III III IV	V III	V V V V	IV III	V V V	I .	I III	. IV .	II .	. . .	. II I	V V IV IV	I . II	V	31
Festuca billyi Kerguélen & Plonka (et *lemanii* Bastard)		V II	. I II I	. II III .	I I III	III II	III . . .	I .	. . .	I V	I I	. . .	. .	I II II	II I II	I IV III IV	I . I	.	30
Serratula tinctoria L. *incl. s. monticola* (Boreau) Berher		. .	. . . .	. II . .	IV III IV	V III	II V III II	I I	I I III	I I	I II	II III .	II .	. . I	I I III	I III II II	. . .	.	30
Viola lutea Huds. *s. lutea*		. .	. . . I	I II I .	II I III	III II	II III I II	I I	. I .	II II	I II	II II .	. .	. . .	. . I	II IV IV V	I . I	.	29
Campanula rotundifolia L.		. .	. . I .	. . . .	I I I	. IV	I . I .	I I	. . .	II .	II III	II I 1	III III	. . I	I I III	III III V IV	IV II II	.	28
Lotus corniculatus L.		. .	. . II .	II I II I	II I I	I II	I I I .	I .	. . .	. II	III III	. . .	I .	. . II	I . I	I I II II	. I .	.	26
Jasione laevis Lam.	c7	I .	. . . .	I I I .	I . II	III II	I I . .	. I	. . .	. III	II II	. . .	. .	. II I	. I II	I II II I	I . I	.	24
Leucanthemum vulgare coll.		. .	. I II I	. . I .	II II I	II I	I I I .	. I	I . .	I .	I III	II I .	I .	. . .	. . II	. . . I	. . .	.	23
Hieracium praecox Sch.Bip.		. .	. I II .	. . . .	. . I	I II	. . . .	I I	I I .	I .	II II	I I 3	II .	. . I	I II II	. . . .	I III II	.	23
Sorbus aria (L.) Crantz	dA31	. .	. . . .	I III II	I .	I III II	I . .	. .	I I III	I .	. . .	. . .	. .	. . .	II I .	I IV I I	III II III	IV	22
Succisa pratensis Moench		. .	. . . .	I I II	I II	I I I .	. . .	. .	. I I	. .	I I	. III .	I .	. . I	. I I	I I I I	. . .	.	21
Hieracium murorum L.		. .	. I II .	. . . .	. I I	I II	. . I .	I I	I . .	I I	. .	III . .	III I	. . .	. I I	. II . .	IV . .	I	20
Thesium alpinum L.		. .	. . . .	. I . .	I I II	II I	. I I .	I I	. I .	. .	I II	I . .	I .	. . .	. I .	I . I I	. . I	.	20
Linaria repens (L.) Mill.		. .	. . . .	. . . .	I II III	I I	I II . .	. .	I . .	. .	. I	. . .	. .	. II .	I . I	II I I .	I II II	II	19
Hieracium umbellatum incl. *s. monticola* (Jord.) Nyman	c8	. .	. . . .	. . . .	I . .	. I	I II I I	I I	II III II	. .	. .	. . .	. .	. . .	I I .	I III II I	. . I	.	18
Rubus idaeus L.		. .	. . . .	. . . .	. III I	. I	I II II .	. .	II I II	I .	. .	. . .	III I	. . .	I . .	III III . .	II . I	I	18
Hieracium species autres		. .	. I . .	. . . .	. I I	I I	I . . .	. .	. I .	I .	I II	I II .	. .	. . .	. I .	. I . I	I . .	I	17
Dianthus hyssopifolius L. *s. hyssopifolius*	cA3	. .	. . . .	. . . .	. . I	. .	I II I .	. .	. I I	I .	. III	. . .	. .	I . .	I . I	I . . II	II . I	.	16
Rumex acetosa L.		. .	. . . .	. . . .	II I I	I .	I II . I	I .	. . II	. .	. .	. . .	. .	. . .	. I I	I II I II	I . .	.	16
Epikeros pyrenaeus (L.) Raf.		. I	. . . .	II IV I .	. I II	I .	I . I .	III .	I I .	. .	I I	. . .	. .	. . I	. . .	. . . .	. . .	.	15
Veronica officinalis L.		. .	. . . .	. . . .	. I .	I .	I I I .	. .	. I .	. .	. .	. . .	. .	I . .	I I I	II I II I	I . .	.	15
Rhinanthus minor L.		. .	. . I .	I I II I	II . I	. I	I . . .	. I	. . .	. I	. I	. . .	. .	. . .	. I .	I . I .	. . .	.	14
Rosa pendulina L.	d4	. .	. . . .	. . . I	I III .	. .	. I . .	. I	I . .	. .	. I	I . 2	IV IV	I . .	I . .	. . . .	. . .	.	13
Stellaria holostea L.		. .	. . . .	. . . .	. I I	. .	I II I II	. I	. . I	. .	. .	. . .	. .	. . .	I I I	I I . .	. . .	.	13
Molinia caerulea (L.) Moench	d8	. .	. . . .	. . . .	I I .	. .	. . I .	I I	V II I	. .	. .	I . 1	. .	. . .	. I .	. . . .	. . I	.	12
Picea abies (L.) H.Karst.		. .	. I . .	. . . .	. . I	. .	. I . .	. .	I . .	. .	. .	. . 1	. .	. . .	. I .	I III I .	II I I	.	12
Valeriana tripteris L.		I .	. I II I	I . . .	. I .	. .	. . I .	. .	. . .	. .	. I	. . .	I .	I . .	I . .	. . . .	. . .	.	11
Carex umbrosa Host		. I	. I . .	. II . .	. . I	I I	I . . .	. .	. . .	. I	I .	. II 1	. .	. . .	. . .	. . . .	. . .	.	11
Narcissus pseudonarcissus L.	d8	. .	. . . .	. . I .	I I .	I .	I . I .	I .	II II II	. .	. .	. . .	. .	. . .	. . .	I . . .	. . .	.	11
Ranunculus tuberosus Lapeyr.	d15	. .	. . . .	. . I II	I . I	. .	. . . .	. .	. . .	. .	II II	. . .	. .	. . .	. . .	I II IV IV	. . .	.	11
Polygonatum verticillatum (L.) All.		. .	. . . .	. . . .	. IV .	. .	III III .	. .	. I II	. .	. .	. . .	I I	I . .	. . .	. . . .	. . .	II	11
Hieracium lachenalii sensu auct. plur.		. .	. . . .	. . . .	. I I	I .	. II I .	. II	I I I	. .	. I	. . .	. .	. . I	. . .	. . . .	. . .	.	11
Lycopodium clavatum L.	*C2*	. .	. . . .	. I . .	. . .	I .	I I . I	I I	. I I	. .	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	10
Polygala vulgaris L.		. .	. . . .	. . . .	I . .	. .	I . . .	. .	. . .	. .	. .	I . .	I .	. . .	. . I	I I I I	. I .	.	10
Rumex acetosella L.		. .	. . . .	. . . .	. I .	. .	. I . .	. .	. . I	. .	. .	. . .	. .	. . I	I . I	I . . I	. III I	.	10
Fagus sylvatica L.		. .	. . . .	. . . .	. I I	. .	. . . .	. .	. . I	. .	. .	. . .	I .	. . I	I I .	I II . .	II . .	IV	10
Betula pendula Roth		. .	. . . .	. . . .	. I I	. .	. . . .	. .	. I .	. .	. .	. . .	. III	. . .	. . .	I I . .	I II I	I	10
Festuca filiformis Pourr.		. .	. . . .	. . . .	. . .	. .	. I . .	. .	I I .	. .	. .	. . .	. .	. . I	I I .	I . I I	II II .	.	10
Gentiana pneumonanthe L.		. I	. . . .	. I I .	I . I	I .	I . . .	. .	II . .	. II	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	9
Alchemilla vulgaris coll.		. .	. . I .	. . I .	I I I	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I I I II	. . .	.	9
Cerastium arvense L.		. .	. . . .	. . . .	. . .	. I	. . . .	. .	. . .	. .	I I	. . .	. .	. I I	I I I	I . . I	. . .	.	9
Festuca ovina coll. autres sp.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	I .	. .	. . .	. I	. I I	I I .	. . I .	I III I	.	9
Silene nutans L.		. .	. . . .	. . . .	. . I	I .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I I . I	I II I	.	9
Veratrum album L.	d6	. .	. . . .	I . I .	. I I	. .	. I V .	I I	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	8
Galium mollugo s. erectum Syme		. .	. . . .	. . . .	. I .	I I	. . . .	. .	. . .	I .	I I	. . .	. .	. I .	. . .	. . . .	. . .	.	8
Conopodium majus (Gouan) Loret		. .	. . . .	. . . .	. II I	I .	I . . .	. .	. . .	. .	. .	. . .	I .	. . I	. . .	I . . .	. . .	I	8
Betula pubescens coll.		. .	. . . I	. . . .	. II I	. .	I . I .	I .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	I . .	.	7
Avenula pubescens (Huds.) Dumort.		. .	. . . .	. I . .	. . I	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . I	I I I .	. . .	.	7
Astrantia major L.		. .	. . . .	. . . .	II II I	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I III . I	I . .	.	7
Stellaria graminea L.		. .	. . . .	. . . .	. I I	. .	I . . .	. .	. . .	I .	. .	. . .	. .	. . .	. . .	I . I IV	. . .	.	7
Thymus polytrichus A.Kern. *ex* Borbas		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	I .	. 1	I I	. . I	. . I	. . . I	. . .	.	7
Polygala serpyllifolia Hose		. .	. . . .	. . . .	. . .	. .	. . . .	. .	I I .	. .	. .	. . .	. .	. . .	. . .	I I I I	I . .	.	7
Agrostis stolonifera L.		. .	. . . .	. I . .	I . I	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . I	I . .	. . . .	. . .	.	6
Luzula nivea (L.) DC.		. .	. . . .	. . . .	. I I	. .	. . . .	. .	. . .	. .	. .	. . .	. II	. I I	. . .	. . . .	. . .	I	6
Abies alba Mill.		. .	. . . .	. . . .	. . I	. .	. . . .	. .	. I II	. .	. .	. I II	. .	. I .	. . .	. . . .	. . .	.	6
Pinus mugo s. uncinata (Ramond *ex* DC.) Domin		. .	. . . .	. . . .	. . .	. .	. . . .	. .	I . .	. .	. .	. 2 .	. .	I I I	. . .	. . . .	. . .	.	6
Leontodon hispidus L.		. .	. . . .	. . . .	I I .	I .	. . . .	. .	. . .	. .	. I	. . .	. .	. . .	. . .	. . I I	. . .	.	6
Veronica chamaedrys L.		. .	. . . .	. . . .	. I .	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I II I I	. . .	.	6
Ajuga reptans L.		. .	. . . .	. . . .	. I .	. .	. II I I	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I . . I	. . .	.	6
Salix aurita L.		. .	. . . .	. . . .	. . .	. .	. . I .	II .	I I .	. .	. .	. . .	. .	. . I	. . .	I . . .	. . .	.	6
Salix caprea L.		. .	. . . .	. . . .	. I I	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I II . .	II . .	.	6
Danthonia decumbens (L.) DC.		. .	. . . .	. . . .	. . .	I I	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . I	. . IV II	I . .	.	6
Hypochaeris maculata L.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. I .	. .	. .	. . .	. .	I I I	I . .	. I . .	. I .	.	6
Potentilla heptaphylla s. fagineicola (Lamotte) P.Fourn.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. I	. . .	. .	. . I	I I III I	. . . .	. . .	.	6
Ranunculus platanifolius L.		. .	. I . .	. . I I	III . .	. .	. . I .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	5
Plantago alpina L.		. I	. . . .	I . . .	. . .	. .	. . . .	. .	. . .	. I	I .	. . .	. .	. . I	. . .	. . . .	. . .	.	5
Thymus species		. .	. . . .	I . . .	. . .	. .	. . . .	. .	. . .	. .	I .	. . .	. .	. I I	. . I	. . . .	. . .	.	5
Prenanthes purpurea L.		. .	. . . .	. . . .	. II I	. .	. . . .	. .	. . .	. .	. .	. . .	I .	. . .	. . .	. . . .	. . I	I	5
Hieracium laevigatum Willd.		. .	. . . .	. . . .	. I I	I .	I . . .	. .	. I .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	5
Hieracium maculatum Schrank		. .	. . . .	. . . .	. . .	. .	. I I .	. .	I I I	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	5
Cytisus decumbens (Durande) Spach		. .	. . . .	. . . .	. . .	I .	. . . .	. .	. I .	. .	I I	. . .	. .	. . .	. I .	. . . .	. . .	.	5
Galium mollugo L. *s. mollugo*		. .	. . . .	. . . .	. I .	. .	I . . .	. .	. . .	. .	. I	. . .	. .	. . .	. . .	I . . I	. . .	.	5
Koeleria pyramidata (Lam.) P.Beauv.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	I I	. . .	. .	. . .	. . .	. I I I	. . .	.	5
Epilobium angustifolium L.		. .	. . . .	. . . .	. I .	. .	. . . .	. .	. I .	. .	. .	. . .	. .	. . .	. . .	. I . .	. I I	.	5
Cerastium fontanum Baumg.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. I	. . .	. .	I . .	I . .	. . I I	. . .	.	5
Briza media L.		. .	. . . .	. . . .	. . .	I .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I . I II	. . .	II	5
Taraxacum species		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. I I I	I . .	I	5
Digitalis purpurea L.		. .	. . . .	. . . .	. I .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . I	I I I	.	5
Salix lapponum L.		. .	I . I .	I . . I	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Soldanella alpina L.		. .	. . . .	II . I II	I . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Imperatoria ostruthium L.		. .	. . . .	I . . I	I II .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Knautia godetii Reut.		. .	. . . .	. I . .	I I I	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Genista tinctoria L.		. .	. . . .	. . . .	I I I	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Tephroseris helenitis (L.) B.Nord.		. .	. . . .	I I . .	. . .	I .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I . . .	. . .	.	4
Vicia orobus DC.		. .	. . . .	. . . .	I I I	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . I	.	4
Dactylorhiza maculata (L.) Soo		. .	. . . .	. . . .	I . .	. .	. . I .	. .	I I .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Noccaea caerulescens s. virens (Jord.) Kerguélen		. .	. . . .	. II . .	. . .	. .	I . . .	. .	. . .	. .	I I	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Coincya cheiranthos (Vill.) Greuter & Burdet		. .	. . . .	. I . .	. . .	I .	. . . .	. .	. . .	. .	I I	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Helictotrichon sedenense (Clarion *ex* DC.) Holub		. .	. . . .	. . . .	. I .	. .	. . . .	. .	. . .	I .	I I	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Silene rupestris L.		. .	. . . .	. . . .	. . I	. .	. . . .	. .	. . .	I .	I II	. . .	. .	. . .	. . .	. . . .	. . .	.	4
Euphrasia officinalis s. pratensis Schübl. & G.Martens		. .	. . . .	. . . .	I . .	. .	. . . .	. .	. . .	. .	I .	. . .	. .	I . .	. . .	. . . .	. . .	.	4
Luzula sudetica		. .	. . . .	. . . .	. . .	. .	. . I .	I .	. . .	. .	. .	. . .	. .	. . .	. . .	I . . I	. . .	.	4
Crataegus monogyna Jacq.		. .	. . . .	. . . .	. . .	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I I . I	. . .	.	4
Sanguisorba minor Scop.		. .	. . . .	. . . .	. . .	I .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . II I	. . .	I	4
Carlina vulgaris L.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . I	. . .	. . I .	I I .	.	4
Saxifraga bryoides L.		. .	I I I .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Diphasiastrum alpinum (L.) Holub		. II	. I . .	. I . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Rhinanthus pumilus (Sterneck) Soldano		. .	. I . .	. . . .	I . .	. .	. . . .	. .	. . .	. .	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Gnaphalium norvegicum Gunnerus		. .	. . . .	II I I .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Bartsia alpina L.		. .	. . . .	. I . .	I . .	I .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Rumex arifolius All.		. .	. . . .	. . . I	I II .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Cyanus montanus (L.) Hill		. .	. . . .	. . . .	I I .	. .	. . . .	. .	. . .	. .	I .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Vicia sepium L.		. .	. . . .	. . . .	I I .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I . . .	. . .	.	3
Cirsium erisithales (Jacq.) Scop.		. .	. . . .	. . . .	I I .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. I . .	. . .	.	3
Sorbus chamaemespilus		. .	. . . .	. . . I	. . .	. .	I . I .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Gnaphalium sylvaticum (L.) Crantz		. .	. . . .	. . . .	. I .	I .	. I . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Viola riviniana Rchb.		. .	. . . .	. . . .	. I .	. .	. I . .	. I	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Oxalis acetosella L.		. .	. . . .	. . . .	. I .	. .	I . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. I . .	. . .	.	3
Daphne mezereum L.		. .	. . . .	. . . .	. II .	. .	. . I .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	I	3
Myosotis alpestris F.W.Schmidt		. .	. . . .	. . . .	I . .	. I	. . . .	. .	. . .	. .	. I	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Carex nigra (L.) Reichard		. .	. . . .	. . . .	. . .	. .	. . . I	. I	I . .	. .	. .	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Minuartia verna (L.) Hiern		. .	. . . I	. . . .	. . .	. .	. . . .	. .	. . .	. .	I I	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Scabiosa columbaria L.		. .	. . . .	. . . .	I . .	. .	. . . .	. .	. . .	. .	I III	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Gentianella campestris (L.) Börner		. .	. . . .	. . . .	. . .	. .	I . . .	. .	. . .	I .	. I	. . .	. .	. . .	. . .	. . . .	. . .	.	3
Scorzonera humilis L.		. .	. . . .	. . . .	. . .	I .	. . . .	I .	. . .	. .	. .	. . .	. .	. . .	. I .	. . . .	. . .	.	3
Allium lusitanicum Lam.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. I I	. . I	. . . .	. . .	.	3
Potentilla neumanniana Rchb.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . I	I . I .	. . .	.	3
Holcus mollis L.		. .	. . . .	. . . .	. . .	. .	. . . .	. .	. . .	. .	. .	. . .	. .	. . .	. . .	I I . .	. . .	I	3

num. association		1	2				3				4			5		6				7		8			9		10		11			12		13			14			15				16			17	
num. subassociations		1 2	1	2	3	4	1	2	3	4	1	2	3	1	2	1	2	3	4	1	2	1	2	3	1	2	1	2	3	1	2	1	1	1	1	2	3	1	2	3	4	1	2	1		
variants																																1	2	3								1		2		col
num. rel. (total 647)		5 9	6	23	10	6	9	19	18	6	23	24	18	12	12	29	17	10	5	16	8	13	20	17	14	12	21	17	13	6	4	14	9	5	6	21	22	21	13	27	11	11	22	16	9	10	8	
Hypericum perforatum L.		. .	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	.	.	.	.	3
Euphrasia stricta D.Wolff *ex* J.F.Lehm.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	I	.	.	.	.	3
Poa pratensis L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	II	.	.	.	II	3
Prunella grandiflora (L.) Scholler		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	I	.	.	I	3
Lathyrus pratensis L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	.	I	.	.	.	3
Cerastium arvense s. arvense L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	II	I	.	.	.	3
Trifolium pratense L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	I	I	.	.	.	3
Asperula cynanchica L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	I	I	.	.	.	3
Salix x capreola A.Kern. *ex* Andersson		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	I	.	.	.	3
Euphorbia cyparissias L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	I	.	.	I	3
Quercus robur L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	II	.	.	3
Quercus petraea Liebl.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	II	.	II	3
Jasione montana L.		. .	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	.	II	3
Knautia arvernensis (Briq.) Szabó		. .	.	.	.	I	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Saxifraga paniculata Mill.		. .	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Phyteuma gallicum R.Schulz		. .	.	.	.	.	I	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Pedicularis foliosa L.		. .	.	.	.	.	.	.	.	I	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Aconitum napellus L.		. .	.	.	.	.	.	.	.	.	.	II	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Euphorbia stricta L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Gymnocarpium dryopteris (L.) Newman		. .	.	.	.	.	.	.	.	.	.	I	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Pseudorchis albida (L.) Á.Löve & D.Löve		. .	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Arrhenatherum elatius (L.) P.Beauv. *ex* J. & C. Presl		. .	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	2
Dryopteris filix-mas (L.) Schott		. .	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	2
Angelica sylvestris L.		. .	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	2
Galeopsis tetrahit L.		. .	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	2
Ranunculus repens L.		. .	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	2
Festuca heterophylla Lam.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Trichophorum cespitosum (L.) Hartm.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Poa alpina L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Scleranthus perennis L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	2
Plantago lanceolata L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	.	.	2
Potentilla recta (L.) Rausch.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	2
Helianthemum grandiflorum (Scop.) DC.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	I	.	.	2
Rubus fruticosus L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	2
Salix herbacea L.		. .	v	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Lactuca alpina (L.) Benth. & Hook.f.		. .	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Athyrium distentifolium Tausch *ex* Opiz		. .	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Aconitum lycoctonum L.		. .	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Sedum forsterianum Sm.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Pinus cembra L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Aquilegia vulgaris L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Cryptogramma crispa (L.) R.Br.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Tanacetum vulgare L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Polygonatum odoratum (Mill.) Druce		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Rhamnus alpina L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Amelanchier ovalis Medik.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Lonicera alpigena L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Hypericum pulchrum L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	1
Sedum rupestre L.		. .	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	.	1

Table 2. Differential taxa groups (DTG) and abbreviations:

I: cryophilous orophytes, subalpine to alpine, mesophilous or with mesohygrophilous character, oligotrophilous, (especially wet pole of *Juncetea trifidi* and *Loiseleurio-Vaccinion* , or chionophytes of *Nardion strictae* and *Salicion herbaceae*);
II: forest hemisciaphilous mesophilous taxa or upper forest edge and hems taxa;
III: xerophilous orophytes or with thermophilous character, montane to alpine, (especially thermophilous and xerophilous pole of *Juncetea trifidi* , *Juniperion nanae* , *Festucion variae*, *Festucion supinae* and *Festucion eskiae)* ;
IV: lawn taxa, mesophilous, mesotrophilous, with a weak acidiphilic character, from plain to montane belt; IVa: montane; IVb: tolerant;
V: lawn taxa, mesoxerophilous, little acidiphilous to neutrophilous or indifferent, from plain to montane belt, (especially *Festuco-Brometea*);
VI: heathland, hem or shrub coats taxa, acidiphilous and oligotrophilous, from plain to montane belt; **VIb**: thermophilous montane taxa or plain taxa, thermophilous at high altitude;

VII: tall-herbs, mesotrophilous to meso-eutrophilous, montane to subalpine, (especially *Mulgedio-Aconitetea*); **VIIa**: mesophilous, with thermophilous character; **VIIb**: with mesohygrophilous and cryosciaphilous characters;

VIII: constant or high frequency taxa; chamephytes of Genisto pilosae-Vaccinion and acidiphilous companions.
c: characteristic; **d**: differential; **C1**: taxa of *Loiseleurio-Vaccinietea* class (and lawn differentials of *Juncetea trifidi*); **C2**: taxa of *Calluno-Ulicetea* class (and lawn differentials of *Nardetea*). Taxa present in less than three relevés are not shown in the table.

Communities of the alliance Genisto pilosae-Empetrion hermaphroditi *all. nov.* (class of *Loiseleurio-Vaccinietea* Eggler *ex* Schubert 1960); cryophilous dwarf-heath of upper subalpine belt of Massif central under the influence of oceanic climate.

Characteristics of Alliance: *Pulsatilla alpina* subsp. *alba* (= *Anemone scherfelii* subsp. *scherfelii*), *Genista pilosa*, *Empetrum nigrum* subsp. *hermaphroditum*. Differential: *Luzula desvauxii*, *Persicaria bistorta*, *Huperzia selago*, *Gentiana lutea*. We note the absence of some orophytes present in the Alps and the Pyrénées. The other taxa of the class (or of the affine class of *Juncetea trifidi*) are: *Vaccinium uliginosum* subsp. *microphyllum*, *Cerastium alpinum*, *Avenula versicolor*, *Agrostis rupestris*, *Euphrasia minima*, *Pulsatilla alpina* subsp. *apiifolia*, *Phyteuma hemisphaericum*, *Melampyrum sylvaticum*, *Solidago virgaurea* subsp. *alpestris*, *Festuca airoides* as well as *Mutellina adonidifolia*, *Diphasiastrum alpinum* and *Trifolium alpinum*. Taxa frequent in *Genisto-Vaccinion*, such as *Arnica montana*, *Nardus stricta*, *Galium saxatile*, *Festuca rubra*, *Potentilla erecta*, *Agrostis capillaris*..., are rare or absent.

Holotypus hoc loco: "association with *Empetrum nigrum* and *Racomitrium lanuginosum* Luquet 1926" (Luquet 1926, *essai sur la géographie botanique de l'Auvergne. Les associations végétales du massif des monts Dore*. Brulliard, Saint-Dizier. Thèse de l'université de Paris, tableau XIX, p. 157 et 158). *Genista pilosa* L. and *Empetrum nigrum* subsp. *hermaphroditum* (Hagerup) Böcher, accepted names in all recent flora, have been used for the name of this new alliance and to show the double character subalpine and atlantic.

1 - Carici vaginatae-Callunetum vulgaris R.Michalet & Philippe *ex* Thébaud *et al.* 2014. Table 2, n° 1.

Material: 14 rel. including 10 rel. of Michalet & Philippe (1996), 4 rel. ined. of Thébaud (1999).

Lectotypus of the association *in* Thébaud *et al.* (2014).

***Lectotypus* of *genistetosum pilosae hoc loco*, rel. 32, table 6, p. 468 *in* Michalet & Philippe (1996).**

These are paucispecific dwarf heath dominated by *Calluna* with *Vaccinium uliginosum*. Its species combination is as follows:

Characteristic: *Carex vaginata* (77.1), *C. curvula* (36.9), *Pulsatilla alpina s. alba* (53.8) (= *Anemone scherfelii*), *Huperzia selago* (42.7);

Differential: *Agrostis rupestris* (42.9), *Euphrasia minima*, *Trifolium alpinum*, *Mutellina adonidifolia*;

Absence or low frequency of *Meum athamanticum*, *Poa chaixii*, *Arnica montana* and of certain chionophilous (*Luzula desvauxii*, *Potentilla aurea*);

Absence of xero-acidiphilous, *Luzula spicata*, *Alchemilla saxatilis* and *Jasione laevis*.

It is a mesophilous association, the most cryophilous in the Massif central, located on the gentle slopes of ubac between the puy de Sancy and the puy de la Perdrix above 1800 m, endemic community of monts Dore (Photo 1). It represents a climatophilous permaseries of the cold summits of the upper subalpine belt.

Photo 1 - Puy Ferrand (1856 m): the ridges are home to the *Carici vaginatae-Callunetum vulgaris*.

Two subassociations stand out:

1.1. *genistetosum pilosae* R. Michalet & Philippe *subass. nov. ex hoc loco*, with *Genista pilosa*, dominated by dwarf shrubs.

1.2. *typicum* (= *agrostietosum rupestris* R.Michalet & Philippe 1996), more open and more snowy with a higher proportion of herbaceous species and *Trifolium alpinum*, *Euphrasia minima*, *Agrostis rupestris*.

The association and its two subassociations have been described in detail by Michalet & Philippe (1996).

2 - Racomitrio lanuginosi-Empetretum nigri Luquet 1926 *nom. invers. hoc loco* (art. 42), table 2, n° 2 and table 4.

Material: 45 relevés including 22 from Michalet & Philippe (1996), 13 unpubl. from Thébaud (1992 to 2019), 2 from Thébaud (1988), 1 unpubl. from Delpech & Mollet (1980), 1 unpubl. by Billy, 2. from Luquet (1926), 4 from Quézel & Rioux (1954).

***Lectotypus* of the association *hoc loco*: rel. A1 table XIX, p.157-158 *in* Luquet 1926 (= rel. 234 tab. 4);** The *lectotypus* of subassociations 1, 3 and 4 are given in Thébaud *et al.*, 2014.

***Holotypus* subassociation *huperzietosum hoc loco* rel. n° 355, tab. 4.**

Its physiognomy is that of an open shaved dwarf-hearth with *Empetrum*, *Vaccinium uliginosum* and cryptogams, the latter often occupying the place of senescent dwarf-shrubs due to frost, paucispecific for vascular plants. Its species combination is as follows:

Characteristic: *Empetrum nigrum* subsp. *hermaphroditum* (70.6), *Huperzia selago* (41.6), *Cerastium alpinum* (40.3), *Solidago virgaurea* subsp. *alpestris*, *Salix herbacea* (32.5), *S. bicolor* (38.8), *Vaccinium uliginosum* subsp. *microphyllum*;

Differential: *Luzula desvauxii*, *Alchemilla transiens*, *Festuca airoides*;

Genista pilosa and the *Nardetalia* taxa are rare;

Cryptogams numerous and abundant, specially the bryophytes: *Racomitrium lanuginosum*, *Ptilidium ciliare*, *Rhytidiadelphus loreus*, *R. triquetrus*, *Lophozia ventricosa*, *Hylocomnium splendens*, *Sphagnum*, as well as *Cetraria islandica*, constant and various *Cladonia*.

This association is cryophilous, oligotrophilous and more sciaphilous and chionophilous than the previous one; it is

located on steep and rocky slopes facing north on volcanic rock, undergoing wind erosion, often in difficult to access conditions. It is mainly present above 1600 m in the upper subalpine belt of monts Dore and monts du Cantal, very rare in mont Mézenc and in monts du Forez. It represents an edaphophilous permaseries.

It includes several subassociations:

2.1. *salicetosum herbaceae* R. Michalet & Philippe *ex* Thébaud *et al.* 2014 *subass. nov. hoc loco (= Empetro hermaphroditi-Vaccinietum uliginosi sensu* Michalet & Philippe 1996 *non* Braun-Blanquet & Jenny 1926 *salicetosum herbacea* ; *lectotypus* rel. 3, tab. 6 p. 468 *in* Michalet & Philippe, 1996), with *Salix herbacea*, with low woody cover.

2.2. *huperzietosum selaginis* *subass. nov. hoc loco*; *Huperzia selago* constant and abundant, *Alchemilla transiens (= basaltica)*, *Agrostis rupestris*, seldom *Empetrum*; it is represented by a typical variant, abundant in monts du Cantal (Photo 2) and an impoverished variant of monts du Forez (= *Huperzio selaginis-Callunetum sensu* Thébaud 1988).

2.3. *typicum* subassociation [= *valerianetosum trypteridis* R. Michalet & Philippe *ex* Thébaud *et al.* 2014) with *Valeriana tripteris*, *Luzula desvauxii*, *Anthoxanthum odoratum*, *Cerastium alpinum*; richer in species, located on the more rocky convexities.

Photo 2 - Short dwarf-heath with cryptogams *Racomitrio lanuginosi-Empetretum nigri huperzietosum* Peyre Arse, monts du Cantal.

2.4. *salicetosum bicoloris* R. Michalet & Philippe *ex* Thébaud *et al.* 2014 *subass. nov. hoc loco (= Empetro hermaphroditi-Vaccinietum uliginosi sensu* Michalet & Philippe 1996 *non* Braun-Blanquet & Jenny 1926 *salicetosum bicoloris; lectotypus* rel. 8, tab. 6 p. 468 *in* Michalet & Philippe, 1996), *Salix bicolor*, more hygrophilous.

The association was originally described by Luquet (1926) and validly published under the name «association à *Empetrum nigrum* L. et à *Racomitrium lanuginosum* Brid.»; then by Quézel & Rioux (1954) in Cantal and by Michalet & Philippe (1996) who linked it to the association described by Braun-Blanquet & Jenny in the Giant Mountains. The name given by these authors is a pseudonym (*Empetro hermaphroditi-Vaccinietum uliginosi sensu auct. non* Braun-Blanquet & Jenny 1926; art. 39c and rec. 46j). Although we have indicated *Empetrum nigrum* subsp. *hermaphroditum* as a characteristic of the association, one cannot choose this infraspecific epithet to name the association because Luquet (1926) did not indicate anything on this subject (art. 45).

Communities of the suballiance Vaccinienion myrtillo-uliginosi *subass. nov. hoc loco* (class *Calluno vulgaris-Ulicetea minoris* Braun-Blanq. & Tüxen *ex* Klika *in* Klika & Hadač 1944, order *Vaccinio myrtilli-Genistetalia pilosae* Schubert *ex* Passarge 1964, alliance *Genisto pilosae-Vaccinion* Braun-Blanq. 1926).

Mesophilic to chionophilic, cryophilic, upper subalpine heathlands, mainly located in the volcanic mountains of the Massif central.

Characteristic taxa: *Knautia basaltica*, *Vaccinium myrtillus* (opt.) and *Vaccinium uliginosum* (opt., subsp. *uliginosum* and subsp. *microphyllum*). The subalpine orophytes *Pulsatilla alpina* subsp. *apiifolia* and subsp. *alpina*, *Melampyrum sylvaticum*, *Knautia basaltica*, *Campanula scheuchzeri*, *Phyteuma hemisphaericum*, *Geum montanum*, *Potentilla aurea*, *Festuca paniculata* subsp. *paniculata* allow them to be differentiated from the lower altitude sub-alliance *Carici piluliferae-Vaccinienion* and the mesophilic mountain orophytes such as *Trollius europaeus*, *Geranium sylvaticum*, *Phyteuma spicatum*, *Poa chaixii*, *Hyperichum maculatum*, from the more xerophilic sub-alliance of *Eu-Genisto pilosae-Vaccinienion*. Some other taxa of *Loiseleurio-Vaccinietea* and *Juncetea trifidi*, appear there and the forest montane taxa are less frequent (group II of table 2).

Holotypus hoc loco: «association with *Vaccinium uliginosum* and *V. myrtillus* Braun-Blanq. 1926» (Braun-Blanquet, 1926: le climax complexe des landes alpines (*Genisteto-Vaccinion* du Cantal). *Arvernia* 2; table n° 2 p. 44).

3 - Vaccinietum myrtillo-uliginosi Braun-Blanq. 1926 *nom. invers. hoc loco*. Table 2, n° 3.

Material: 52 relevés including 33 from Michalet & Philippe (1996), 11 from Quézel & Rioux (1954), 4 from Braun-Blanquet (1926), 4 ined. from Thébaud (1991 to 2016).

Lectotypus of the *typicum* association and subassociation designated *in* Schaminée *et al.*, 1993: rel. 4 of table 2 p. 44 *in* Braun-Blanquet (1926); *lectotypus* of the subassociations designated by Thébaud *et al.* 2014 *in* Michalet & Philippe (1996).

The physiognomy of this plant association is that of a dwarf-heath dominated by *Vaccinium uliginosum* and *V. myrtillus* with *Calluna vulgaris*. Its species combination is as follows:

Characteristic: *Mutellina adonidifolia* (49.8), *Melampyrum sylvaticum*, *Avenula versic*olor (51), *Gentiana lutea*, *Vaccinium uliginosum* subsp. *microphyllum*;

Differential: *Potentilla aurea* (40), *Euphrasia minima*, *Trifolium alpinum*, *Poa chaixii*, *Scorzonera pyrenaica*, *Persicaria bistorta*, *Anthoxanthum odoratum*, *Arnica montana*, *Campanula scheuchzeri*, *Trollius europaeus* (33.7).

This plant association is cryophilous, mesophilous and has a hygrophilous tendency; it is localized on the gentle high slopes around the peaks, under an oceanic climate watered in spring and summer. It is generalized in the upper subalpine belt of monts Dore (Photo 3) and monts du Cantal on volcanic rock, basalt, trachyandesite, andesitic breccias. It corresponds to a subalpine climatophilous permaseries in an oceanic climate.

Photo 3 - *Vaccinietum myrtillo-uliginosi*, summit of Paillaret, monts Dore.

Four subassociations are described:

3.1. *trifolietosum alpini* R. Michalet & Philippe *ex* Thébaud *et al.* 2014 with *Trifolium alpinum*, *Euphrasia minima*, *Luzula desvauxii*, more chionophilous.

3.2. *typicum* (Braun-Blanquet 1926) *subass. nov. hoc loco* with *Pulsatilla alpina* subsp. *apiifolia*, *Pedicularis comosa*, lacking *Pulsatilla alpina* subsp. *alba*; chionophilous grassy heathland on slopes with unfavorable exposure in the subalpine level of the monts du Cantal.

3.3. *festucetosum lemanii* R. Michalet & Philippe *ex* Thébaud *et al.* 2014, with *Festuca billyi*; the most abundant and the least mesophilous. The name «*festucetosum billyi*» would probably be more appropriate, *F. billyi* replacing *F. lemanii* in the subalpine belt.

3.4. *geranietosum sylvatici* R. Michalet & Philippe *ex* Thébaud *et al.* 2014 with *Luzula desvauxii*, *Adenostyles alliariae*, *Geranium sylvaticum*, steep concave slopes exposed to the N-W.

Braun-Blanquet (1926) described it initially under the name of «association à *Vaccinium uliginosum* and *myrtillus*»; then under that of «*Vaccinieto-Gentianetum lutae*» Braun-Blanquet, Sissingh & Vlieger (1939) *nom. superfl.* Luquet (1926) described the same community in the monts Dore under the name of "Association with *Vaccinium myrtillus* and *V. uliginosum*" which is a homonym published the same year as the name given by Braun-Blanquet without being able to define the anteriority between the two and therefore which name is valid. Michalet & Philippe have described in detail the subassociations 8.1, 8.2 and 8.4. Schaminée *et al.* (1993) corrected the initial name (art. 41b) spelling as "*Vaccinietum uliginoso-myrtilli*" and they lectotypified it. However, in the *typus*, *Vaccinium uliginosum* is more covering than *V. myrtillus* (3 against 2). The name must therefore be reversed (art. 10b and 42) in the form "*Vaccinietum myrtillo-uliginosi* Braun-Blanq. 1926 *nom. inv*ers".

4 - Euphorbio hybernae-Vaccinietum myrtilli Coquillard *ex* Thébaud *et al.* 2014. Table 2, n° 4.

Material: 65 relevés including 32 from Coquillard (1993), 20 from Michalet & Philippe (1996), 6 ined. from Thébaud (2015 to 2017), 2 from Quézel & Rioux (1954), 1 ined. from Roux (2017), 1 ined. from Billy, 1 from Delpech & Mollet (2008), 1 from Schaminée & Hennekens (*in* Thébaud 1988), 1 from Braun-Blanquet (1926). *Lectotypus* of the association and sub-associations *in* Thébaud *et al.* 2014.

It takes the form of heathland dominated by *Vaccinium* with many herbaceous plants. Its species combination is as follows:

Characteristic: *Silene vulgaris* (47.8), *Euphorbia hyberna*, *Pulsatilla alpina* subsp. *apiifolia*, *Campanula scheuchzeri*;

Differential: *Senecio doronicum* (42.9), *S. cacaliaster* (46.8), *Lactuca plumieri* (42), *Calamagrostis arundinacea* (31.1), *Trollius europaeus* (35.6), *Hieracium prenanthoides* (33.3), *Luzula sylvatica* (36.5), *Geranium sylvaticum* (67.6), *Astrancia major* (39.9), *Lilium martagon* (40), *Ranunculus platanifolius* (35.3);

It is rich in *Mulgedio-Aconitetea* species and in mesotrophilous grasslands;

The absence of oligotrophilous is observed as well as the low frequencies of *Genista pilosa* and *Calluna vulgaris*;

Meum athamanticum, *Agrostis capillaris*, *Persicaria bistorta*, *Arnica montana*, *Potentilla erecta* are constant or frequent.

This plant association is mesophilous or mesohygrophilous, chionophilous, occupying well-drained snowy slopes and often in a situation of concavities or edges, on deep soils and volcanic rock. It develops from the upper montane belt, generalized in the heavily watered volcanic mountains under oceanic influence, monts Dore and monts du Cantal. It is to be found in Cézallier and Aubrac around the highest summits. Intermediate forms with *Allio victorialis-Vaccinietum myrtilli*, depleted in atlantic taxa, are found in mont Mézenc (Roche de Cuzet...). It can fit into a dynamic edaphochionophilous series of the beech-Maple forest (*Doronico austriaci-Fagetum sylvaticae* Seytre *in* Renaux *et al.* 2019) of the upper montane belt of the western volcanic mountains.

Three main subassociations have been described:

4.1. *senecietosum doronici* R. Michalet & Philippe *ex* Thébaud *et al.* 2014, differentiated by *Geum montanum*, *Senecio doronicum*, *Ranunculus platanifolius*, *Knautia basaltica*, *Pedicularis foliosa*; Hemmed grassy blueberry in transition with the *Calamagrostion*; mesotrophilous, mesophilous, with thermophilous tendancy, and chionophilous on steep slopes, deep soils and volcanic substrate; monts Dore and monts du Cantal.

4.2. *luzuletosum desvauxii* Coquillard *ex* Thébaud *et al.* 2014; differentiated by *Luzula desvauxii*, *Polygonatum verticillatum*, *Lactuca plumieri*, *Ranunculus aconitifolius*, *Doronicum austriacum*, *Athyrium filix-femina*, *Conopodium majus*, *Rosa pendulina*; sometimes hemmed, herbaceous plants and *Vaccinium* mixed in the cover; intermediate conditions with those of the *Adenostylion*; mesotrophilous, mesohygrophilous, chionophilous on deep soil and volcanic substrate; monts Dore; present in rare stations in Mézenc, in an impoverished form without atlantic taxa.

4.3. *typicum* Coquillard *ex* Thébaud *et al.* 2014; the taxa of *Mulgedio-Aconitetea* are less numerous than in the other subassociations; differentiated by *Dianthus seguieri* subsp. *pseudocollinus*, *Achillea millefolium*, *Galium verum*, oligomesotrophilous; mesophilous subassociation on deep soils and on volcanic rock, monts Dore and monts du Cantal (Photo 4).

Photo 4 - Rich herbaceous heathland *Euphorbio hybernae-Vaccinietum myrtilli*, Pas de Peyrol, monts du Cantal (rel. 2092GT).

The association was initially described by Coquillard (1993) and validated by Thébaud *et al.* (2014). Its syntaxonomic place is intermediate between the two suballiances *Vaccinienion myrtillo-uliginosi* and *Carici piluliferae-Vaccinienion*.

5 - Patzkeo paniculatae-Vaccinietum myrtilli *ass. nov.* Tableau 2, n°5 et tableau 5.

Material: 24 relevés including 8 ined. from Thébaud (1987 à 2017), 6 from Coquillard (1993), 4 from Schaminée & Hennekens (*in* Thébaud, 1988), 2 from Michalet &Philippe (1996), 2 from Delpech & Mollet (2008), 1 from Roux (2017), 1 from Quézel & Rioux (1954).

***Holotypus* of association *hoc loco*, rel. 507 tab. 5**; ***holotypus of subassociation crepidetosum conyzifoliae hoc loco* : rel. 376 tab. 5.**

The physiognomy of this plant association is that of an often open heathland, with *Patzkea paniculata* subsp. *paniculata*, *Genista pilosa*, *Vaccinium uliginosum* and *V. myrtillus*, *Festuca billyi*, or more rarely dominated by *Festuca with* a dense sub-layer of chamaephytes; community fairly rich in taxa. Its species combination is as follows:

Characteristic: *Patzkea paniculata* subsp. *paniculata* (23.5), *Jacobaea adonidifolia* (24.1), *Jasione laevis* (26.7), *Thesium alpinum*, *Crepis conyzifolia* (31);

Differential: *Serratula tinctoria* subsp. *monticola* (33), *Centaurea nigra*, *Dianthus seguieri* subsp. *pseudocollinus* (30), *Arnica montana*, *Festuca billyi*;

Numerous taxa of oligotrophic lawns of *Nardetalia*; in monts Dore and monts du Cantal; comes into contact with the *Festucion variae* (*Arnico montanae-Festucetum paniculatae* R.Michalet & Philippe *ex* Thébaud *et al.* 2014). The most common cryptogams are *Cetraria islandica*, *Cladonia furcata*, *Hylocomium splendens* and *Rhytidiadelphus triquetrus*.

The association is helioxerophilous, oligotrophilous, with a thermophilous tendancy, on shallow or eroded soil; it is most often localized on steep slopes, exposed to the south, convex, but less slightly inclined than those of the *Festucion variae* associations, mainly on volcanic substrate. It can be found on the upper montane and lower subalpine belts of monts Dore, monts du Cantal and mont Mézenc; rarer in the monts du Forez. To look for further south, monts d'Ardèche, Tanargue, Mont Lozère (Photo 5) ... Its dynamic is difficult to specify: it can correspond to curtaseries with *Sorbus* or to series with a variant of the beech-Maple forest *Doronico austriaci-Fagetum sylvaticae* Seytre *in* Renaux *et al.* 2019.

Two subassociations are individualized:

Photo 5 - Edaphoxerophilous subalpine heathland cf *Patzkeo paniculatae-Vaccinietum myrtilli*, rel. 2655GT, cirque du rocher de l'Aigle, mont Lozère.

5.1. *crepidetosum conizifoliae* *subass. nov.*, richer in species, more mesophilous and mesotrophilous and closer to *Euphorbio hybernae-Vaccinietum typicum*, with *Crepis conyzifolia*, *Stachys officinalis*, *Centaurea nigra*, *Campanula scheuchzeri* subsp. *lanceolata*;

5.2. *typicum* *subass. nov.*, depleted, with *Campanula rotundifolia*, *Carex caryophyllea*, *Hieracium praecox*, more acidiphilous and oligotrophilous.

Some relevés of *Carici piluliferae-Callunetum vulgaris* Coquillard 1993 *nom. inval.* are similar to the association. The syntaxonomic place of *Patzkeo paniculatae-Vaccinietum* is intermediate between the two suballiances *Vaccinienion myrtillo-uliginosi* and *Carici piluliferae-Vaccinienion*. The subspecies *Patzkea paniculata* subsp. *paniculata* was chosen as the name giving taxon of this plant association (art. 10a, note 2).

Communities of the suballiance Carici piluliferae-Vaccinienion Schaminée & Hennekens *in* Schaminée Hennekens & Thébaud 1993 (class *Calluno vulgaris-Ulicetea minoris* Braun-Blanq. & Tüxen *ex* Klika *in* Klika & Hadač 1944, order *Vaccinio myrtilli-Genistetalia pilosae* Schubert *ex* Passarge 1964, alliance *Genisto pilosae-Vaccinion* Braun-Blanq. 1926).

Mesophilous communities of the montane and lower subalpine

belts of the northern Massif central and middle mountains of the Hercynian arc, Vosges, Black Forest, around the timberline, mainly on crystalline or acide rocks.

They are distinguished by forest or upper forest edge taxa such as *Anemone nemorosa*, *Melampyrum pratense*, *Allium victorialis*, *Maianthemum bifolium*, *Sorbus aucuparia*, *Convallaria majalis* and *Calamagrostis arundinacea* as well as *Carex pilufera*, *Potentilla erecta*. The orophytes of *Loiseleurio-Vaccinietea* and *Juncetea trifidi* are rare or absent.

6 - Allio victorialis-Vaccinietum myrtilli Schaminée & Hennekens *ex* Thébaud *et al.* 2014 *emend. hoc loco*. Table 2, n°6.

Material: 61 relevés including 21 from Thébaud (1988), 16 unpubl. from Thébaud (1987 to 2019), 11 from Coquillard (1993), 9 from Michalet & Philippe (1996), 2 unpubl. from Delcoigne (2019), 1 from Schaminée & Hennekens (*in* Thébaud, 1988), 1 from Delpech & Mollet (2008).

Lectotypus designated by Thébaud *et al.* (2014) *in* Schaminée & Hennekens (1992) for the association, the *stachyetosum* and *veratretosum* subassociations and *in* Michalet & Philippe (1996), for the *vaccinietosum uliginosi* subassociation (*lectotypus* n° 26 table 5 p. 466).

This plant association takes the form of an herbaceous heathland dominated by *Vaccinium myrtillus* or *V. uliginosum*, rich in herbaceous taxa. Its species combination is as follows:

Characteristic: *Stachys officinalis*, *Allium victorialis* (33.7), *Convallaria majalis* (35.8), *Hypericum maculatum* (36.5), *Veratrum album* (40.9), *Ajuga reptans* (38.4), *Maianthemum bifolium*;

Differential: *Sorbus aucuparia* (32.9), *Vaccinium myrtillus*, *Poa chaixii*, *Sanguisorba officinalis*, *Stellaria holostea*, *Melampyrum pratense* (31.5);

Includes many mesotrophilous grassland taxa and also oligotrophilous and acidiphilous taxa of *Nardetalia*, *Nardus stricta*, *Carex pilulifera*, *Anthoxanthum odoratum*, *Scorzoneroides pyrenaica*, *Galium saxatile*.

Other constant or frequent taxa: *Festuca nigrescens* subsp. *nigrescens*, *Gentiana lutea*, *Agrostis capillaris*, *Persicaria bistorta*, *Calamagrostis arundinacea*, etc.

It is an oligomesotrophilous, mesophilous or with mesohygrophilous tendancy, chionophilous plant association; mainly on crystalline substrate where it often occupies slope breaks or snow-covered basins on the slopes or in an upper edge situation; it develops in the upper montane and lower subalpine belts in the north-east of the Massif central, mainly the monts du Forez, but also occasionally in the north of Margeride (Truc de la Garde...) and mont Mézenc. It has dynamic affinities with beech-maple forests of *Acerion pseudoplatani*, *Aceri pseudoplatani-Fagetum sylvaticae* J. & M. Bartsch 1940 for the *stachyetosum officinalis* and *veratretosum* subassociations in the monts du Forez, and with *Doronico austriaci-Fagetum sylvaticae* Seytre *in* Renaux *et al.* 2019 for the *vaccinietosum uliginosi* subassociation in monts Dore and Cézallier.

Four subassociations stand out:

6.1. *vaccinietosum uliginosi* (R. Michalet *et al.* 1989) Thébaud *et al.* 2014 *comb. nov. hoc loco* [*sub Vaccinietum uliginoso-myrtilli vaccinietosum uliginosi* (R. Michalet *et al.* 1989) Thébaud *et al.* 2014], *Vaccinium uliginosum*, *Festuca billyi*, *Luzula multiflora*, *Dianthus seguieri* subsp. *pseudocollinus*, widespread on basalt where it replaces *Vaccinietum uliginoso-myrtilli* at lower altitude, in monts Dore and monts du Cantal (Elancèze...), in Cézallier (Signal du Luguet, Photo 6), on the puy de Dôme on trachyte and more rarely on phonoliths;

Photo 6 - Rich herbaceous heathland *Allio victorialis-Vaccinietum myrtilli* subassociation *vaccinietosum uliginosi*, Signal du Luguet (rel. 2803GT, monts du Cézallier).

6.2. *stachyetosum officinalis* Schaminée & Hennekens *ex* Thébaud *et al.* 2014, *Stachys officinalis*, *Linaria repens*, *Campanula scheuchzeri*, *Ajuga reptans*, more thermophilic, with east orientations, sheltered from winds or snow accumulation;

6.3. *veratretosum albi* Schaminée & Hennekens *ex* Thébaud *et al.* 2014, *Veratrum album*, *Sanguisorba officinalis*, at snowdrifts and with an hygrophilous character;

6.4. *typicum*, with *Potentilla aurea*, especially in monts du Forez (Photo 7).

The *vaccinietosum uliginosi* subassociation was initially described under the name of *Galio saxatilis-Vaccinietum myrtilli vaccinietosum uliginosi* R.Michalet & Philippe 1996, under that of *Vaccinietum uliginosi-myrtilli vaccinietosum uliginosi* Thébaud *et al.* 2014; the *Carici piluliferae-Callunetum vulgaris* Coquillard 1993 *nom. inval.* is partly related to it. The *stachyetosum officinalis* subassociation

Photo 7 - Rich herbaceous heathland *Allio victorialis-Vaccinietum myrtilli* subassociation *typicum* at the edge of *Aceri pseudoplatani-Fagetum*, monts du Forez, montagne de Monthiallier.

corresponds to *Stachyo officinalis-Vaccinietum myrtilli* Thébaud 1988 *nom. inval.*

7 - Alchemillo saxatilis-Vaccinietum uliginosi Thébaud *ex* Schaminée *et al.* 1993. Table 2, n°7.

Material: 24 relevés including 16 from Thébaud (1988), 4 from Hennekens & Schaminée (*in* Thébaud 1988), 2 ined. from Thébaud (1995, 2014), 1 from Michalet & Philippe (1996) and 1 ined. from Roux (2019).

Lectotypus designated by Thébaud *et al.* 2014 *in* Schaminée & Hennekens (1992).

Its physiognomy is that of a heathland dominated by *Vaccinium uliginosum* or *V. myrtillus* or more open and rich in cryptogam, dominated by *Calluna*. It is little differentiated compared to other associations except its floristic impoverishment. Its species combination is as follows:

Characteristic: *Trifolium alpinum* (21.4), *Alchemilla saxatilis*, *Vaccinium uliginosum*, *Luzula sudetica* (20.8), *Epikeros pyrenaeus* (21.2), *Lycopodium clavatum* (22.4);

Differential: *Luzula multiflora*, *Carex pilulifera*, *Nardus stricta*, *Anemone nemorosa* (27).

The association is oligotrophilous, mesophilous, on crystalline or acidic volcanic rock in low snow conditions. The *typicum* subassociation is cryo-anemophilous and topoxerophilous.

It grows on the upper montane and lower subalpine belts of the mountains of the north-eastern Massif central, mainly monts du Forez. It also exists, more localized in mont Mézenc (Delpech & Mollet 2008) up to the monts d'Ardèche. It corresponds to a climatophilous permaseries of the lower subalpine belt in the north-eastern crystalline Massif central. It also exists in the form of edaphoxerophilous permaseries in other mountains on trachytes (puy de Dôme) or phonoliths (Mézenc).

Two subassociations are differentiated:

7.1. *polygonetosum bistortae* (Schaminée & Hennekens) Thébaud *et al.* 2014, *Persicaria bistorta*, *Epikeros pyrenaeus*, *Luzula sudetica*, lower subalpine stage, mesophilous.

7.2. *typicum*, depleted in phanerogams and enriched in cryptogams including *Polytrichum piliferum*, *Pleurozium schreberi*, *Cetraria islandica*, *Cladonia furcata*, *C. grayi*, *C. arbuscula*; xerophilous and open, cryo-anemophilous, in lower subalpine belt.

This association was initially described as *Alchemillo saxatilis-Vaccinietum uliginosi* Thébaud 1988 *nom. inval.*

8 - Vaccinio myrtilli-Genistetum pilosae Schaminée & Hennekens *ex* Thébaud *et al*. 2014. Table 2, n° 8.

Material: 50 relevés including 32 from Thébaud (1988), 6 ined. from Thébaud (from 1987 to 2000), 6 ined. from Billy, 5 from Coquillard (1993), 1 ined. from Bernard (2015).

Lectotypus of the association and of the subassociations designated by Thébaud *et al.* 2014 in Schaminée & Hennekens (1992).

This plant association comes in the form of paucispecific heathland dominated by *Calluna*, *Genista pilosa* or *Vaccinium myrtillus*. Its species combination is as follows:

Characteristic: *Sorbus aria*, *Carex pilulifera* (23.2), *Genista pilosa*, *Narcissus pseudonarcissus* (30.5), *Hieracium umbellatum* subsp. *monticola* (26.6), *Melampyrum pratense*;

Differential: *Pinus sylvestris*, *Sorbus aucuparia*, *Molinia caerulea* (41.7), *Abies alba*, *Calamagrostis arundinacea*;

Arnica montana, *Festuca nigrescens*, *Persicaria bistorta*, *Gentiana lutea*, *Potentilla erecta* (24.7), *Galium saxatilis* are constant or frequent.

It is mesophilous, on crystalline rock and shallow slopes, widespread in the middle montane to upper montane belts of the crystalline mountains of the north of the Massif central in an attenuated oceanic climate (Photo 8): Livradois-Forez, monts de la Madeleine, Pilat. It also exists more rarely in Artense and in monts Dore on acidic volcanic rocks, trachytes and trachyandesites. It corresponds to a subatlantic climatophilous dynamic series of montane belt leading to an acidiphilous *Abies alba*/*Fagus sylvatica* forest (*Dryopterido dilatatae-Abietetum albae* Thébaud *et al.* 2014) or an acidiphilous beech-abies tree (*Solidago virgaureae-Fagetum sylvaticae* Renaux *et al.* 2019).

Four subassociations have been described:

Photo 8 - *Vaccinio myrtilli-Genistetum pilosae* montane heathland of north-eastern Massif central on crystalline rock.

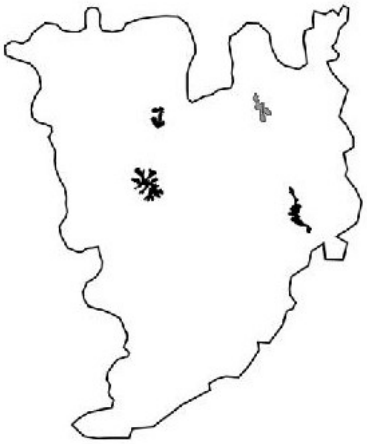
8.1. *molinietosum caerulae* Schaminée & Hennekens *ex* Thébaud *et al.* 2014 mesohygrophilous hydro-alternating, paucispecific, with *Molinia caerulea*. It is composed of two variants: poor variant with *Juniperus communis* subsp. *nana* and *Gentiana pneumonanthe*, in monts Dore (montagne de Bozat...); typical variant dominated by *Molinia caerulea*, on flat tops or weak slopes with poor drainage;

8.2. *typicum*, mixted *Genista-Calluna-Vaccinium myrtillus* mesophilous heathland; it includes the subassociation *hylocomnietosum splendentis* Thébaud 1988;

8.3. *calamagrostietosum arundinaceae* Schaminée & Hennekens *ex* Thébaud *et al.* 2014, *Calamagrostis arundinacea*, at the top of montane belt, in edges sheltered from winds.

The association was initially described under the name *Vaccinio myrtilli-Genistetum pilosae* Thébaud 1988 *nom. inval.*

Carici vaginatae-Callunetum vulgaris



Racomitrio lanuginosi-Empetretum nigri

Vaccinietum myrtillo-uliginosi

Euphorbio hybernae-Vaccinietum myrtilli

Patzkeo paniculatae-Vaccinietum myrtilli

Allio victorialis-Vaccinietum typicum, veratretosum, stachyetosum

Allio victorialis-Vaccinietum vaccinietosum uliginosi

Alchemillo saxatilis-Vaccinietum uliginosi

Vaccinio myrtilli-Genistetum pilosae

Figure 11a - Distribution of heathland associations in the mountains of the French Massif central. For the boundaries, refer to figure 1. In black, the main presence; in gray: occasional or probable presence.

Communities of suballiance Eu-Genisto pilosae-Vaccinienion (= *Phyteumo hemisphaerici-Vaccinienion* Schaminée & Hennekens *in* Shaminée Hennekens & Thébaud 1993 *pp*; class *Calluno vulgaris-Ulicetea minoris* Braun-Blanq. & Tüxen *ex* Klika *in* Klika & Hadač 1944, order *Vaccinio myrtilli-Genistetalia pilosae* Schubert *ex* Passarge 1964, alliance *Genisto pilosae-Vaccinion* Braun-Blanq. 1926).

Xerophilous heathlands, with cryophilous or thermophilous characters, from upper montane to upper subalpine belt of Massif central.

Characteristic: *Pulsatilla vernalis*, *Festuca airoides*, *Biscutella arvernensis*.

Differential: *Antennaria dioica*, *Luzula spicata* and taxa of *Juniperion nanae* such as *Juniperus communis* subsp. *nana*, *Arctostaphylos uva-ursi* and *Cotoneaster integerrimus*.

Taxa with mesophilic or with an hygrophilic chararacter, common everywhere else, are rare or absent such as *Persicaria bistorta*, *Luzula multiflora*, *Potentilla aurea*, *Poa chaixii*, *Hyperichum maculatum*...

Lectotypus of the suballiance: *Pulsatillo vernalis-Genistetum* Quézel & Rioux 1954, given *in* Schaminée *et al.* (1993).

9 - Jasione laevis-Callunetum vulgaris R. Michalet & Philippe *ex* Thébaud *et al.* 2014; Table 2, n° 9.

Material: 26 relevés including 15 from Michalet & Philippe (1996), 3 ined. from Roux (2017), 1 Bernard (*in* Roux 2017), 4 ined. from Thébaud (2014 to 2017), 1 ined. de Billy, 1 de Delpech & Mollet (2008), 1 de Braun-Blanquet (1926).

Lectotypus designated by Thébaud *et al.* (2014) *in* Michalet & Philippe (1996).

These are open dwarf-heath with *Calluna* or dwarf *Juniperus* with *Vaccinium uliginosum*, *V. myrtillus* and *Genista pilosa*, paucispecific. Its species combination is as follows: it has few differentials compared to other communities:

Characteristic: *Jasione laevis*, *Juniperus communis* subsp. *nana*, *Pulsatilla alpina* subsp. *alba* (27) (= *Anemone scherfelii*);

Differential: *Calluna vulgaris*, *Alchemilla saxatilis*;

Phyteuma hemisphaericum (21,5), *Deschampsia flexuosa*, *Gentiana lutea*, *Scorzoneroides pyrenaica*, *Alchemilla transiens* and *Carex caryophyllea* are constant or frequent.

This plant association is xerophilous, oligotrophilous and cryophilous on volcanic rocks under an oceanic climate watered in spring and summer. It is localized on dry and windy summits and high slopes of the upper subalpine belt of monts Dore. It is more rarely present in other volcanic mountains of the Massif central: Cantal and Mézenc (subassociation *juniperetosum nanae*), puy de Dôme, in intermediate or impoverished forms. It corresponds to an edaphoxerophilous permaseries.

Several subassociations have been described:

9.1. *juniperetosum nanae* R. Michalet & Philippe *ex* Thébaud *et al.* 2014 with *Juniperus communis* subsp. *nana*; particularly impoverished dwarf juniper, present mainly on acid lava and phonolith in the monts Dore, the monts du Cantal (Griou...; Photo 9), more rarely in the mont Mézenc;

Photo 9 - *Jasione laevis-Callunetum vulgaris juniperetosum nanae*, Puy Griou, monts du Cantal (rel. 1982GT).

9.2. *typicum* (= *trifolietosum alpini* R.Michalet & Philippe 1995), present in monts Dore. The subassociation *vaccinietosum uliginosi* R. Michalet & Philippe *ex* Thébaud *et al.* 2014 is poorly individualized by our analyses and appears mixed within the *typicum*. The subassociation *juniperetosum nanae*, due to its poor floristic level, is strongly individualized.

A relevé of Luquet (1926), under the name of «callunaie alpine» comes under this association, described in detail by Michalet & Philippe (1996). This association has an intermediate position between *Vaccinienion myrtillo-uliginosi* and *Eu-Genisto pilosae-Vaccinienion*.

10 - Pulsatillo vernalis-Cytisetum decumbentis Quézel & Rioux 1954 *nom. mut. nov. hoc loco*. Table 2, n° 10 and table 8.

Material: 38 relevés including 5 from Quézel & Rioux (1954), 1 from Braun-Blanquet (1926), 2 from Michalet & Philippe (1996), 29 unpubl. from Thébaud, 1 unpubl. from Roux.

Lectotypus of the association and of *typicum* designated by Schaminée *et al.* (1993): rel. 1 of table 2 p. 44 *in* Braun-Blanquet, 1926 (= rel. 227 tab. 5);

***Holotypus* of *scabiosetosum columbariae hoc loco*: n° 523 tab. 6.**

The typical plant association has the appearance of an open, shaved dwarf-heath, with dominant *Genista pilosa* and *Vaccinium uliginosum* with cryptogams and more rarely with *Juniperus communis* subsp. *nana* and *Arctostaphylos uva-ursi*. Its species combination is as follows:

Characteristic: *Cytisus decumbens* (31.1), *Silene ciliata* (43.5), *Pedicularis comosa* (49.3), *Pulsatilla vernalis* (30), *Scabiosa columbaria* var. *spreta* Jord. (51.2), *Androsace halleri* (34.3);

Differential: *Calluna vulgaris*, *Pulsatilla alpina* subsp. *apiifolia*, *Festuca arvernensis* subsp. *costei* (48.2), *Hieracium glaucinum*;

Presence of cryptogams: *Cetraria islandica*, *C. cuculata*, *Cladonia rangiferina*, *Polytrichastrum alpinum*, *Polytrichum piliferum*, *Rhytidium rugosum*.

It is a cryo-anemophilous and xerophilous community that takes place on volcanic rocks, trachyandesite or basalt, in an oceanic climate context with marked spring and summer rainfall. It constitutes an endemic community of the subalpine belt of monts du Cantal where it is mainly represented in Plomb du Cantal range. It is an edaphoxerophilous permaseries.

Two subassociations stand out:

10.1. *typicum* *subass. nov. hoc loco*: upper subalpine belt; includes a cryo-anemophilous variant with *Androsace halleri* with abundant *Luzula spicata* and *Antennaria dioica*, on rocky convexities, richer in herbaceous plants (Photo 10).

Photo 10 - *Pulsatillo vernalis-Cytisetum decumbentis* of monts du Cantal: typical subassociation (rel. 2442GT, north of col de Chèvre).

10.2. *scabietosum columbariae* *subass. nov. hoc loco* differentiated by *Scabiosa columbaria*, *Festuca paniculata* subsp. *paniculata*, *Dianthus hyssopifolius* subsp. *hyssopifolius*, *Hieracium pilosella*; depleted in cryophilous as *Phyteuma hemisphaericum*, *Agrostis rupestris*, *Pedicularis comosa*, localized in the summits of warm and sunny slopes or in the lower subalpine belt (Photo 11). Contains a variant with *Potentilla erecta*, enriched with oligotrophilous lown plants and a typical variant, more thermophilous which presents a facies with *Arctostaphylos uva-ursi*.

These two subassociations show a lot of differences between them, which was confirmed by the statistical analyses. The *scabietosum* subassociation is similar to the more thermophilous heathlands of the montane belt.

Braun-Blanquet (1926) made a relevé of this association under the name of «association with *Genista pilosa* and *Calluna*» *nom. ambig.*; Quézel & Rioux (1954) described it in detail and named it *Genisteto-Pulsatilletum vernalis*.

This last valid name was chosen by Schaminée *et al.* (1993) to replace the ambiguous name «Association with *Genista pilosa* and *Calluna* Braun-Blanq. 1926» *nom. ambig.* given by Braun-Blanquet; these authors have reversed it (nom. invers. art. 10b and 42) in the form of «*Pulsatillo vernalis-Genistetum*». Although not using a specific epithet in the first name of the plant association, Quézel & Rioux quote «*Genista pedunculata* L'Herit.» (p. 369) as an elective characteristic of the association. This taxon, synonymous of *Cytisus decumbens* (Durande) Spach (taxon accepted in *Flora gallica*, the plant list, POWO, IPNI) is present in the *typus* of the association. On the one hand in the name given here the specific epithet is therefore added (rec. 10c) and an the other hand it is replaced by the valid name accepted today (nom. mut. mov. Art. 45) under the name «*Pulsatillo vernalis-Cytisetum decumbentis* Quezel & Rioux 1954 *nom. mut. nov.*».

It represents the southern vicariant of *Jasione laevis-Callunetum* Michalet & Philippe 1996 of monts Dore.

Photo 11 - *Pulsatillo vernalis-Cytisetum decumbentis* subassociation *scabietosum columbariae* (rel. 1903GT Brèche d'Enfloquet).

11 - Biscutello arvernensis-Arctostaphyletum uvae-ursi* ass. nov. *hoc loco; table 2, n° 11 and table 7.

Material: 23 relevés including 7 from Schaminée & Hennekens (*in* Thébaud 1988), 2 from Lemée (1953), 4 from Thébaud & Roux (2017), 2 from Thébaud (2019), 2 from Delpech & Mollet (2008), 6 ined. from Delpech (1980).

***Holotypus* of *association hoc loco*: rel. 1 tab. p. 68** (= rel. 746 tab. 7) in **Lemée** [1953: Observations sur la végétation actuelle et son évolution postglaciaire dans le massif du Mézenc. *in* 80^{e} session extraordinaire (1952) dans les Cévennes et dans les Causses. *Bull. Soc. Bot. France* **100**(10)];

***Holotypus* of *anemonetosum nemorosae*: rel.19 tab. 1 p. 40 à 42 *in* Delpech & Mollet** (2008, essai de typification de quelques végétations landicoles du Vivarais (Ardèche, France). *Acta Bot. Gallica*, **155**(1) (= rel. 883 tab. 7).

Its physiognomy is that of a very short, shaved dwarf-heath with *Juniperus communis* subsp. *nana* and *Arctostaphylos uva-ursi* or *Calluna* or more rarely *Vaccinium uliginosum* (Photos 12 & 13). Its species combination is as follows:

Characteristic: *Arctostaphylos uva-ursi* (55.1), *Juniperus communis* subsp. *nana* (42.1), *Cotoneaster integerrimus*, *Pulsatilla vernalis* (74.1), *Biscutella arvernensis* (50.8) and *Agrostis marysae-tortiae*;

Differential: *Calluna vulgaris*, *Festuca nigrescens* subsp. *microphylla*;

Phyteuma hemisphaericum, *Meum athamanticum*, *Arnica montana*, *Carex caryophyllea*, *Cetraria islandica*, *Cladonia furcata* are constant or frequent.

The association is cryoxerophilous and cryo-anemophilous on windy summits, mainly above 1600 m, on volcanic rock, phonolith, trachyte. It develops in the upper subalpine belt of the mont Mézenc, of which it is endemic, in the context of a subcontinental climate in internal area of the Massif central, with strong thermal contrasts and deficit of precipitation. It is a subalpine climatoxerophilous permaseries of windy summits and slopes.

Photos 12 & 13 - *Biscutello arvernensis-Arctostaphyletum uvae-ursi* of mont Mézenc ; above: northeast slope under the summit ; below : rel. 2312GT, Roche Chaulet.

Several sub-units are differentiated:

11.1. *typicum*, with *Biscutella arvernensis*, *Antennaria dioica*, *Agrostis rupestris*, on snow-cleared and windy summits, of the upper subalpine, especially around the top of Mézenc; prone to wind erosion;

11.2. *anemonetosum nemorosae* Thébaud and C. Roux *subass. nov. hoc loco*, differentiated by *Anemone nemorosa*, *Scorzoneroides pyrenaica*, *Potentilla erecta*, depleted in cryophilous, on poorly exposed high slopes where snow remains longer;

11.3. poor *sub-unit*, more thermophilous and lower altitude than the type, on rocks or large boulder scree; it is located on neighboring summits of mont Mézenc (Taupernas Photo 14), Montfol, etc.) with an intermediate floristic composition with *Centaureo pectinatae-Juniperetum nanae*, dominated by *Arctostaphylos uva-ursi*, differentiated by *Festuca paniculata* subsp. *paniculata*, *Cotoneaster integerrimus*, *Calamagrostis arundinacea*.

Photo 14 - *Biscutello arvernensis-Arctostaphyletum uvae-ursi* poor sub-unit, rel. 2302 GT; Suc de Taupernas.

This plant community was initially described by means of two relevés by Lemée (1953), and by Delpech & Mollet (2008) These three authors linked it to an association of Pyrénées (= *Genisto purgantis-Arctostaphyletum uvae-ursi sensu auct. non* Braun-Blanq., G.Sissingh & Vlieger 1939). Schaminée *et al.* (1993) affiliated their Mézenc relevés with the the previous association (*Pulsatillo vernalis-Genistetum sensu* Schaminée *et al.* (1993) non Quézel & Rioux 1954). Our study shows, on the contrary, the originality of this plant association. These last two association names are pseudonyms and a new association is published here (art. 39c). Its name is formed from the taxon «*Biscutella arvernensis* Jord.», which is valid and accepted (*Flora gallica*, the plant list, POWO, IPNI). It corresponds to the «*Anemone vernalis-Calluna*-groupement» by Choisnet & Mulot (2008).

12- Centaureo pectinatae-Juniperetum nanae Choisnet & Mulot *ass. nov. hoc loco*; table 2, n° 12 and table 8.

Material: 26 records including 25 from the National Botanical Conservatory of the Massif Central (16 from Bertran, 2 from Choisnet, 2 from Ménard, 4 from Mulot, 1 from Seytre) and 1 from Delpech & Mollet (2008).

***Holotypus* of the association *hoc loco*: n° 7528 tab. 8** (= 518066 CBNMC).

***Holotypus* of *vaccinietosum uliginosi hoc loco*: n° 7515 tab. 8** (= 518126 CBNMC).

Its physiognomy is that of chamephytic heathland with scattered small shrubs, dominated by *Juniperus communis* subsp. *nana*, *Calluna vulgaris* and *Arctostaphylos uva-ursi*. Its species

combination is as follows:

Characteristic: *Centaurea pectinata* (64.8) (Photo 15), *Sorbus mougeotii* (52.9), *Juniperus communis* subsp. *nana* (47.7), *Cotoneaster integerrimus* (53.5), *Arctostaphylos uva-ursi* (56.4);

Differential: *Calamagrostis arundinacea* (36.3), *Lilium martagon*, *Rosa pendulina* (34.9), *Polygonatum odoratum*;

Subalpine cryophilous taxa are rare; presence of forest edge and hem taxa.

Photo 15 - *Centaurea pectinata* L., eastern side of Taupernas.

This plant association is located in sunny biotopes, sheltered from the winds, often not far from the upper forest edge, in the upper montane and subalpine belts of the massif du Mézenc (Photo 16), on phonolith, between 1300 and 1700 m. The floristic composition marked by a few mesophilous mesotrophilous taxa of *Mulgedio-Aconitetea* seems to reflect a certain snow cover. It can correspond to an edaphophilous permaseries or be part of a curtaseries, in more or less pronounced dynamics with shrubby coats.

Photo 16 - *Centaureo pectinatae-Juniperetum nanae* rel. 2303GT in mountain of Mézenc, Suc de Taupernas.

Two subassociations are described:

12.1. ***vaccinietosum uliginosi*** *subass. nov.* Choisnet & Mulot, more cryophilous than the type; located on the slopes in favorable exposures of the subalpine belt, between 1500 and 1740 m.

12.2. ***typicum*** *subass. nov.* Choisnet & Mulot: grows on the upper mountain level between 1300 and 1500 m; it includes a very poor variant on boulder scree.

This plant association was initially described by Choisnet & Mulot (2008) under the names "*Cotoneaster integerrimus-Juniperus sibirica*-Groupement" (= *vaccinietosum uliginosi*) and "*Arctostaphyllos-Juniperus sibirica*-Groupement" (= *typicum*). The name of the association is formed from the taxa «*Centaurea pectinata* L.» (accepted in *Flora gallica*, the plant list, POWO, IPNI) and «*Juniperus communis* subsp. *nana* (Hook) Syme» [= *Juniperus nana* Willd., accepted in *Flora gallica* and Taxref V. 14 (Gargominy *et al.* 2020)].

13 - Phyteumo hemisphaerici-Callunetum vulgaris (Braun-Blanq. 1953) *ass. nov. hoc loco*; table 2, n° 13 and table 9.

Material: 32 relevés including 24 unpubl. by Thébaud and 8 unpubl. by Roux.

Holotypus hoc loco: **rel. n° 627 tab. 9.**

Its physiognomy is that of a very short, shaved, often open, dwarf-earth (boulders, wind or agro-pastoral erosion...), mainly dominated by *Calluna vulgaris* and *Vaccinium uliginosum*, more rarely by *Genista pilosa* or *Juncus trifidus*. It is paucispecific. Its species combination is as follows:

Characteristic: *Juncus trifidus* (45.7), *Hieracium schmidtii* (72.8), *Festuca airoides* (49.3), *Sesamoides pygmaea* (32.5), *Phyteuma hemisphaericum* (opt.), *Calluna vulgaris* (opt.);

Differential: *Antennaria dioica* (41.2), *Plantago holosteum* (35.3), *Vaccinium vitis-idaea*, *Calluna vulgaris*, *Juniperus communis* subsp. *nana*;

Lacking the procession of mesophilous and mesotrophilous taxa like *Gentiana lutea*, *Meum athamanticum*, *Persicaria bistorta*, etc.

The association is cryo-anemophilous, oligotrophilous, xerophilous, and grows on crystalline rock on the high slopes and summits of mont Lozère and mont Aigoual. It is marked by the summer drought of the Mediterranean climatic and has a clear anthemerobic character, resulting from old intensive sheep overgrazing ("drailles" and "transhumance"). It is an endemic plant association of Cévennes, a subalpine climatophilous permaseries of this region.

It has three variants:

13.1. with *Juncus trifidus*, cryo-anemophilous, present in mont Lozère and mont Aigoual (Photo 17);

Photo 17 - *Phyteumo hemisphaerici-Callunetum* variant with *Juncus trifidus* (near rel. 600CR, pic de la Fageolle, mont Aigoual).

13.2. *with Sesamoides pygmaea*, on flat, eroded and windy tops, with sandy accumulation, paucispecific; it presents a strong floristic individuality (Photo 18).

Photo 18 - *Phyteumo hemisphaerici-Callunetum vulgaris* eroded v. with *Sesamoides pygmaea* (rel. 2624GT, mont Lozère, around grand Clapier).

13.3. *typical*, in the form of *calluna-Vaccinium* heath, on summits and high slopes; it can be more or less enriched in herbaceous taxa of *Nardetalia* (Photo 19).

Photo 19 - *Phyteumo hemisphaerici-Callunetum typical v.* (rel. 2610GT, mont Lozère, summit of Finiels).

It has been described under the name of «lande primitive» at Mont Lozère by one relevé of Braun-Blanquet (1953).

14 - Vaccinio vitis idaeae-Genistetum pilosae *ass. nov. hoc loco*. Table 2, n° 14 and table 10.

Material: 56 relevés including 16 unpubl. from Thébaud (2002 to 2018), 13 unpubl. from Roux (2019), 6 from Thébaud (1988), 6 from Barret & Klesczewski (2006), 6 by de Foucault (2017), 3 by Delpech & Mollet (2008), 2 unpubl. from Delpech & Mollet (1979), 3 unpubl. from Billy, 1 from Braun (1915).

***Holotypus* of association and subassociation *typicum hoc loco*: rel. 975 table 10**;

***Holotypus* of subassociation *cytisetosum oreomediterranei:* rel. 3 table 9 p. 352 *in* B. Foucault** [2017, données phytosociologiques nouvelles sur la végétation des Cévennes occidentales (Lozère) et du Haut-Languedoc (département de l'Hérault). *Bull. Soc. Bot. du Centre-Ouest N.S.* **48**];

***Holotypus hoc loco* of subassociation *meetosum:* rel. 599 table 10.**

The physiognomy of this plant association is that of a paucispecific heathland dominated by *Calluna vulgaris*, *Genista pilosa* or *Vaccinium myrtillus*, with sometime *V. vitis-idaea* and *Genista anglica*. Its species combination is as follows:

Characteristic: *Vaccinium vitis idaea* (33.4), *Galium saxatile*, *Alchemilla saxatilis*, *Hypochaeris maculata* (11.7), *Diphasiastrum tristachyum* (20);

Differential: *Nardus stricta*, *Genista anglica* (24.6), *Festuca airoides*, *Luzula campestris* (24.6), *Cytisus oromediterraneus* (20.6), *Jacobaea adonidifolia*;

Deschampsia flexuosa, *Calluna vulgaris*, *Genista pilosa* and *Vaccinium myrtillus* are constant or very frequent;

Many subalpine orophytes are missing, as well as low-altitude thermophilous taxa and mesophilous ones abundant in the heathlands of the northern Massif central, *Gentiana lutea*, *Persicaria bistorta*, *Anemone nemorosa*.

It is oligotrophilous, mesophilous or mesoxerophilous, tends to thermophilous and is localized on crystalline rock. It develops under a climate of hot summers and a lack of summer rainfall, in the middle montane and upper montane belts, mainly in the southern and central eastern area of the Massif central: south of Margeride, Cévennes, mont Lozère, monts d'Ardèche, mont Aigoual; it reaches the warm slopes of the lower subalpine of mont Lozère and exists in intermediate forms in the north of the Massif central, in a subcontinental sheltered climate. The association belongs to acidiphilous climatophilous dynamic series of montane belt including beech forest (*Deschampsio-Fagetum* Lemée, = *Solidago virgaureae-Deschampsietum flexuosae* Renaux *et al.* 2019) preceded by transient stages of *Pinus sylvestris* (*Teucrio scorodoniae-Pinetum sylvestris* Billy *ex* Thébaud *et al.* 2014...).

Three subassociations are differentiated:

14.1. *cytisetosum oromediterranei* (B. Foucault) *stat. nov.* and *comb. nov. hoc loco* [*sub Cytiso oromediterranei-Vaccinietum myrtilli*, from de Foucault (2017) p. 339 et tab. 9 p. 352 : données phytosociologiques nouvelles sur la végétation des Cévennes occidentales (Lozère) et du Haut-Languedoc (département de l'Hérault). *Bull. Soc. Bot. du Centre-Ouest* N.S. 48]; differentials taxa are *Cytisus oromediterraneus* and *Jacobaea adonidifolia*; it is more xerothermophilous and localized in the middle to upper mountane level of the Cévennes, south of Margeride, Tanargue, and the monts d'Ardèche (Photo 20). It is made up of three very distinct variants: a typical variant, acidiphilous, a variant with *Galium verum*, *Genista sagittalis*, *Sorbus aria*, topothermophilous and less acidiphilous, often on rock richer in bases, gneiss, volcanic rocks, present on the slopes at favorable exposure of Tanargue and mont Lozère. A third variant, more oligotrophilous and impoverished, without *Vaccinium vitis-idae* can be distinguished in monts d'Ardèche (Choisnet & Mulot 2008), not presented here.

Photo 20 - *Vaccinio vitis-idaeae-Genistetum pilosae* subassociation *cytisetosum oromediterranei*, Signal de Randon, Margeride.

14.2. *typicum* *subass. nov. hoc loco*, paucispecific with *Vaccinium vitis-idaea*, *Pinus sylvestris*, *Campanula rotundifolia*; mesophilous taxa are missing; the most oligotrophilous taxa of *Nardetalia* are well represented; on flat or low slopes, edaphomesophilous and climatoxerophilous, oligotrophilous, on crystalline rock, in the upper montane belt of Margeride (Photo 21) and mont Lozère; also present in the south-east of the monts du Forez in a sheltered climate. Two variants can be distinguished: a variant with *Potentilla erecta* enriched in taxa of the *nardetalia*, more grazed, and a typical variant.

Photo 21 - *Vaccinio vitis-idaeae-Genistetum pilosae typicum*, rel. 594CR, Truc de Fortunio Margeride.

14.3. *meetosum athamantici* *subass. nov. hoc loco*, richer in species, *Meum athamanticum*, *Persicaria bistorta*, *Achillea millefolium*, *Poa chaixii*, *Dianthus seguieri* and poor lawn species; blueberries are often dominating; confined to deep soils, often linked to a topography favoring a longer snowfall; it is present on the upper montane and lower subalpine belts in Margeride, Cévennes, mont Lozère (Photo 22), Aigoual, Tanargue. Two variants are distinguished, a typical variant and a more mesoxerophilous variant.

Photo 22 - *Vaccinio vitis-idaeae-Genistetum pilosae* subassociation *meetosum athamantici*, cirque at the west of Signal des Laubies, rel. 2619GT, mont Lozère.

The *cytisetosum oromediterranei* subassociation is resulting here from a downgrading of the *Cytiso oromediterranei-Vaccinietum myrtilli* B. Foucault 2017 (art. 27c *stat. nov.*) into a subassociation, then from its recombination (art. 26. *comb. nov.*) into *Vaccinio vitis-idaeae-Genistetum pilosae*. This subassociation includes the "*Leontodon pyrenaicus-Vaccinium myrtillus*-Groupement" from Choisnet & Mulot (2008), the "blueberry heathland" from Barret & Klesczewski (2006). The *typicum* subassociation includes the «*Diphasiastrum* community» described in crystalline Aubrac by de Foucault (1987).

Communities of alliance Diantho hyssopifolii-Vaccinion myrtilli Boullet *et al. ad interim.* (class *Calluno vulgaris-Ulicetea minoris* Braun-Blanq. & Tüxen *ex* Klika *in* Klika & Hadač 1944; Order *Vaccinio myrtilli-Genistetalia pilosae* Schubert *ex* Passarge 1964).

Communities with a mesoxerophilous character, more thermophilous than all the previous communities here described and at lower altitude up to montane belt. It includes acidiphilous communities or with neutrophilous character. The alliance is centered on south-western Europe, present to the Pyrénées and the Massif central.

Its characteristic plants are *Jacobaea adonidifolia* and *Dianthus hyssopifolius* subsp. *hyssopifolius*, thermophilous orophytes of southern Europe. These communities are differentiated from other alliances of the Class by mesoxerophilous taxa of *Festuco-Brometea*, *Achillea millefolium*, *Genista sagittalis*, *Galium verum*, *Thymus pulegioides*, *Hieracium pilosella*, *Helianthemum nummularium* and *Brachypodium rupestre*. In addition, compared to *Genisto pilosae-Vaccinion*, many orophytes are missing. From *Calluno vulgaris-Genistion pilosae* P.Duvign. 1945, alliance of lower altitude, orophytes as *Centaurea nigra*, *Jasione laevis* occur. For a more complete diagnosis and validation of the alliance see Boullet *et al.* (forthcoming).

15 - Galio saxatilis-Vaccinietum myrtilli R.Michalet, Coquillard & Gueugnot 1989. Table 2, n° 15.

Material: 71 relevés including 39 from Michalet *et al.* (1989), 17.unpubl. from Roux (2017), 8 unpubl. from Billy, 2 from Doche (1986), 1 from Braun (1915), 1 from Roux (2019), 1 unpubl. from Thébaud (2018), 1 from Delpech & Mollet (2008), 1 from Thébaud (1988).

Holotypus in Michalet *et al.*, 1989.

Lectotypus of the *festucetosum filiformis* subassociation *in* Thébaud *et al*. 2014.

Its physiognomy is that of a grassy heathland, rich in species. Its species combination is as follows:

Characteristic: *Ranunculus tuberosus* (42), *Viola canina* (44), *Stellaria graminea* (38.7), *Avenula pratensis* (60.2);

Differential: *Brachypodium pinnatum* coll. (47.7), *Genista sagittalis*, *Galium verum* (55.7), *Achillea millefolium* (46.1), *Stachys officinalis* (36), *Lathyrus linifolius* subsp. *montanus* (37.8), *Festuca lemanii*, *Centaurea jacea* (45.6), *Pimpinella saxifraga* (33.7).

This plant association is mesoxerophilous, oligomesotrophilous and tends to neutrophilous, mainly on volcanic rocks, slag and unconsolidated trachyandesitic, trachytic or basaltic covers. It develops in the middle montane level of chaîne des Puys, monts Dore, monts d'Aubrac. Also exists in monts d'Ardèche (Choisnet & Mulot 2008), in basaltic Velay, in monts du Forez (Pierre Bazanne) or mont Aigoual, on volcanic rocks, schists or mica schists. In chaîne des Puys, Roux (2017) has shown that it enters a climatophilous dynamic series leading to a slightly acidiphilous beech forest (*Luzulo sylvaticae-Fagetum sylvaticae* Cusset 1963; Photo 23).

Photo 23 - *Galio saxatilis-Vaccinietum myrtilli*, Clierzou (chaîne des Puys), in dynamic succession towards the beech forest *Luzulo sylvaticae-Fagetum*.

Four subassociations have been described by Michalet *et al.* (1989):

15.1. *festucetosum filiformis* R. Michalet *et al. ex* Thébaud *et al.* 2014 (? = «xero-acidiphile» Michalet *et al*. 1989), impoverished, chaîne des Puys, Aubrac, basaltic Velay, monts Dore;

15.2. *typicum* R. Michalet *et al.* 1989 (= *salicetosum capreolae* Michalet *et al*., 1989) (Photo 24);

Photo 24 - *Galio saxatilis-Vaccinietum myrtilli typicum*, north slope of the puy de Dôme.

15.3. *nardetosum strictae* R. Michalet *et al.* 1989 with *Hieracium pilosella*, *Danthonia decumbens*, *Nardus stricta*, in a context of overgrazing.

15.4. *dianthetosum monspessulani* R. Michalet *et al.* 1989, mesophilous and mesotrophilous, concavities on the ubacs of the cones of chaîne des Puys.

The *senecietosum adonidifolii* subassociation is elevated here to association status under the name *Teucrio scorodoniae-Callunetum vulgaris stat nov*. (see below, ass. 16). The subassociation *vaccinietosum uliginosi* Michalet & Philippe 1996 was recombined under the name *Vaccinietum uliginoso-myrtilli vaccinietosum myrtilli* by Thébaud *et al.* (2014), then here under the name *Allio victorialis-Vaccinietum myrtilli vaccinietosum uliginosi (comb. nov.)*.

16 - Teucrio scorodoniae-Callunetum vulgaris (R. Michalet, Coquillard & Gueugnot) *stat. nov. hoc loco* [*sub.* «*Galio saxatilis-Vaccinietum myrtilli senecietosum adonidifolii*»: Michalet *et al.* 1989: landes et herbages des édifices volcaniques de la chaîne des Puys (Massif central francais). I-Synsystématique, *Coll. Phytosoc. X*VI, Paris 1988: *holotypus* rel. 58 tabl. 1p 664]. Table 2, n° 16 and table 11.

Material: 35 relevés including 12 from Roux (2017), 12 unpubl. from Billy, 10 from Michalet *et al.* (1989), 1 unpubl. by Thébaud (2015).

Holotypus subassociation juniperetosum communis hoc loco: **rel. 827 tab. 11 *hoc loco***, (= rel. H472 tab. XI, manuscripts of F. Billy).

This plant association appears as paucispecific heathland dominated by *Calluna* or less often by *Vaccinium myrtillus*, with the presence of phanerophytes or nanophanerophytes and hem plants. Its species combination is as follows:

Characteristic: *Teucrium scorodonia* (64.2), *Jacobaea adonidifolia* (16.2), *Cytisus scoparius* (47.7), *Calluna vulgaris* (opt.);

Differential: *Pinus sylvestris* (27.7), *Sorbus aria* (20.5), *Betula pendula*, *Corylus avellana* (42.7), *Brachypodium pinnatum* coll. (*Brachypodium rupestre* subsp. *rupestre*) (29), *Festuca filiformis* (19), *F. ovina* subsp. *guestfalica*, *Digitalis purpurea* (26).

It is xerophilous, acidiphilous and tends to thermophilous, often around rocky outcrops and ridges of trachytic domes or crystalline rocks. It develops mainly from the submontane belt to the middle

montane belt, everywhere in Massif central but especially in the northeastern area, under an attenuated oceanic to subcontinental climate: chaîne des Puys and surrounding crystalline plateaus in a sheltered climate, as far as Haut-Allier and Nord-Margeride, Livradois-Forez, Meygal and low area of Mézenc; it is present as far as the Lacaune mountains. The presence of deciduous trees could suggest a fleeting stage of recolonization; in reality these dense, very xeric heathlands can represent slow dynamic steps towards a stationary pine forest; according to Roux (2017), in chaîne des Puys, they are a stage in an edaphoxerophilous series leading to the pine forest of *Teucrio scorodoniae-Pinetum sylvestris vaccinietosum myrtilli* Billy *ex* Thébaud *et al.* 2014. But it probably fits into the composition of other dynamic mountain series.

Two subassociations are defined:

16.1. *typicum*, very well differentiated by montane orophytes, *Vaccinium myrtillus*, *Sorbus aucuparia*, *Rubus idaeus*, *Dianthus hyssopifolius* and by *Corylus avellana*, *Solidago virgaurea* subsp. *virgaurea*, *Potentilla erecta*. These are dominated by *Calluna* and *Genista pilosa*, taking place in the montane belt, in transition towards the edge communities, on thin soils and acid rocks, trachytes or granites. We can distinguish a typical variant (16.1.1) enriched with hem plants and *Nardetalia* taxa, on the trachytic domes of chaîne des Puys, a depleted variant (16.1.2; Photo 24 & 25), where blueberries can be abundant, on granite and trachyte. Michalet *et al.* (1989) also mentioned this depleted variant with a very dense low woody cover. A third variant with *Cotoneaster integerrimus* (grouped with 16.1.2 in tab. 2) is present only on the puy de Dôme. The whole is relatively heterogeneous.

Photo 24 - *Teucrio scorodoniae-Callunetum vulgaris typicum*, on trachytic rocks of Grand Sarcoui, chaîne des Puys.

16.2. *juniperetosum communis* with *Juniperus communis* subsp. *communis*, *Genista sagittalis*, *Cytisus oromediterraneus*, *Silene nutans*, taxa of *Sedo-Scleranthetea*; more thermophilous because at lower altitudes, and very xerophilous, developed in the upper hill or submontane belt, on crystalline base. It is impoverished in montane orophytes compared to the previous subassociation. Its relationship with lower elevation heathlands of *Calluno-Genistion* and with *Festuco filiformis-Callunetum* R.Michalet *et al.* are to be deepened.

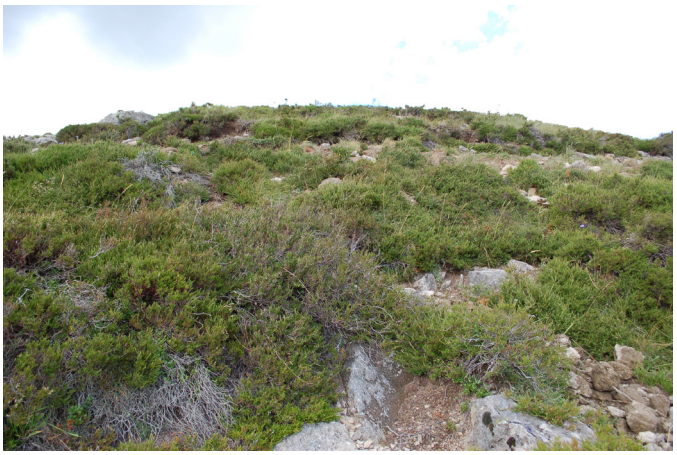


Photo 25 - *Teucrio scorodoniae-Callunetum vulgaris typicum*, on trachytic rocks of Petit Suchet, chaîne des Puys.

The *typicum* subassociation corresponds to *Galio saxatilis-Vaccinietum myrtilli senecietosum adonidifolii* R. Michalet *et al.* 1989a wich is here reclassified to the status of association (art. 27d, *stat. nov.*), in agreement with the authors who underlined its strong floristic individuality. It includes the "*Senecio adonidifolius-Vaccinium myrtillus*-Groupement" Choisnet & Mulot 2008 *pp*. A relevé of Braun (1915), carried out at mont Aigoual, under the name of *Genisto pilosae-Callunetum vulgaris* Braun-Blanq. 1915 (*nom. amb.* art. 36) belongs to this association.

17- Euphorbia hyberna-Calluna vulgaris community (Doche 1986). Tableau 2, n°17.

Material: 8 relevés including 7 from Doche (1986) and 1 unpubl. from F. Billy.

It is a heathland dominated by *Calluna* or *Vaccinium myrtillus*, hemmed and penetrated by shrubs, with *Euphorbia hyberna*, paucispecific. Its species combination is as follows:

Characteristic: *Euphorbia hyberna* (58.4);

Differential: *Fagus sylvatica* (59.9), *Sorbus aria* (41.2), *Campanula scheuchzeri* (30.3) *Genista anglica* (53.7), *Galium verum* (48.4), *Poa pratensis* (51.1);

Absence of common subalpin plants like *Vaccinium uliginosum*, *Scorzoneroides pyrenaica*.

It is a mesophilous with a neutrophilous tendancy, on basalt, between 1150 and 1430 m, under an oceanic climate, on the montane belt in Aubrac, on basaltic rocks. It occurs also west of monts Dore and it can be looked for in the west of monts du Cantal; It is part of a dynamic climatophilous series of atlantic montane belt, step leading to the neutrophilous beech forest (*Euphorbio hybernae-Fagetum sylvaticae* Billy *ex* Thébaud *et al.* 2014) studied by Doche (1986).

This community results from Doche surveys, established in a dynamic study perspective; it needs to be deepened in particular in its relations with the other heathlands described in western volcanic mountains such as *Galio saxatilis-Vaccinietum myrtilli* of which it may represent a depleted and hemmed stage.

Jasiono laevis-Callunetum vulgaris

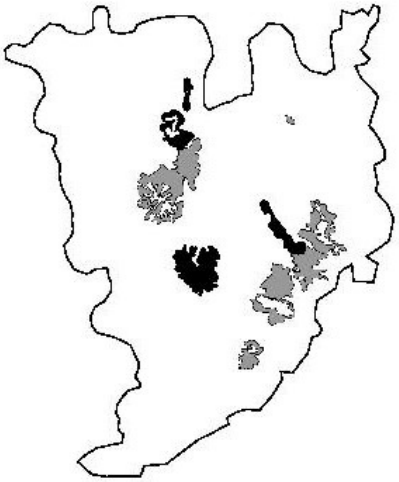
Pulsatillo vernalis-Cytisetum decumbentis

Biscutello arvernensis-Arctostaphyletum uvae-ursi

Centaureo pectinatae-Juniperetum nanae

Phyteumo hemisphaerici-Callunetum vulgaris

Vaccinio vitis-idaeae-Genistetum pilosae



Galio saxatilis-Vaccinietum myrtilli

Teucrio scorodoniae-Callunetum vulgaris

Figure 11b - Distribution of heathland associations in the mountains of the French Massif central (continued). For the boundaries, refer to figure 1. In black, the main presence; in gray: occasional or probable presence.

Discussion and conclusions

General syntaxonomic aspects

The heathlands of the French Massif central are classified in several phytosociological units. Outside the Atlantic domain, where they belong to the class *Calluno vulgaris-Ulicetea minoris* Braun-Blanq. & Tüxen *ex* Klika & Hadač 1944, they mainly belong to *Genisto pilosae-Callunetea vulgaris* Boullet, Choisnet & Thébaud *ad interim*, that includes subatlantic to subcontinental communities. In the mountains of Auvergne, Braun-Blanquet (1926), defined an alliance of subatlantic distribution, dedicated to the western mountains, *Genisto pilosae-Vaccinion* Braun-Blanq. 1926, which he describes as vicariant of *Rhododendro-Vaccinion* present further east in the Alps. This alliance has since been accepted and taken up by all authors until the most recent (Michalet & Philippe 1996; Bardat *et al.* 2004; Thébaud *et al.* 2014; Mucina *et al.* 2016). Schaminée *et al.* (1993) subdivided *Genisto pilosae-Vaccinion* into two suballiances, the *Phyteumo hemisphaerici-Vaccinienion*, for the upper subalpine belt, above 1650 m and the *Carici piluliferae-Vaccinienion*, below this altitude, which brings together several associations from the Massif central and Vosges (Carbiener 1966). From the plains to the hilltop level in north-western Europe, the heathlands belong to a second alliance, retained in the European classification (Mucina *et al.* 2016), the *Calluno-Genistion pilosae* PA.Duvign. 1945 (= *Genistion tinctorio-germanicae* B. Foucault 1990 *pp nom. nud. in* the PVF1). PVF1 also cites a third alliance, more xerothermophilic and southern European, present especially in the Pyrénées, under study, called *Calluno vulgaris-Arctostaphylion uvae-ursi* Preising 1949 *nom. nud*.

Another class cited in the Massif central, that of the arctico-alpine and subarctico-subalpine dwarf-hearth *Loiseleurio procumbentis-Vaccinietea microphylli* Eggler *ex* R.Schub. 1960. Michalet & Philippe (1996) affects it, and the subalpine-alpine acidiphilous alliance *Loiseleurio procumbentis-Vaccinion microphylli* Braun-Blanq. *in* Braun-Blanq. & H. Jenny 1926, two associations of monts Dore: *Empetro hermaphroditi-Vaccinietum uliginosi* Braun-Blanq. *in* Braun-Blanq. & H.Jenny 1926 and *Carici vaginatae-Callunetum vulgaris* R.Michalet & Philippe 1996. In this same class is defined *Juniperion nanae* Braun-Blanq. *in* Braun-Blanq. *et al.* 1939, alliance of dry or hot asylvatic and acidic heathland present in the upper subalpine belt of the Alps and the Pyrénées. This latter is recognized in Mézenc (Lemée 1953) and in mont Lozère, by Braun-Blanquet (1953).

The plant communities that we have described in this article in the Massif central have been compared with the other French heathlands in a forthcoming publication written in collaboration within the framework of the prodrome des végétations de France (PVF2, Boullet *et al.*). This led us to revise the hierarchical units of the classification of montane and subalpine heathlands of the Massif central. The results confirm for the Massif central this overall classification. The presence of the *Loiseleurio procumbentis-Vaccinietea* class, is confirmed, thus underlining the climatic harshness of certain summits mainly monts Dore, but also monts du Cantal and mont Mézenc. Our results even allow us to go further and, in relation to the declination of PVF2 in progress, to describe and validate a new alliance *Genisto pilosae-Empetrion hermaphroditi all. nov. hoc loco*, of subatlantic acidiphilic dwarf-heath of the upper subalpine level of the Massif central.

However, the presence of *Juniperion nanae* is not confirmed, due to a large number of taxa of *Genisto pilosae-Vaccinion* in the affected vegetation.

Besides, we confirm the existence of a montane xerothermic alliance, within which several associations of the Massif central can be placed. The name of *Calluno vulgaris-Arctostaphylion uvae-ursi* not being able to be retained (Bardat *et al.* 2004), and *Euphorbio-Callunion vulgaris* Schubert 1960 being a continental alliance according to Mucina *et al.* (2016), the PVF2 proposes to create a new alliance common to the Massif central and the Pyrénées, named *Diantho hyssopifolii-Vaccinion myrtilli* Boullet *et al. ad interim*.

Our results also confirm the statistical validity of most of the plant associations previously described. Only a few subassociations, discussed in the previous section, are not. However, certain associations appear to be poor in characteristic taxa, with large overlapping ranges, sometimes making it difficult to diagnose certain relevés. This is the case of *Jasiono laevis-Callunetum vulgaris*, of the monts Dore, and associations 6, 7 and 8 of the monts du Forez (Fig. 8).

We also underline the strong individualization, within their clusters, of *Pulsatillo vernalis-Cytisetum decumbentis scabietosum* in Cantal and of *Centaureo pectinatae-Juniperetum nanae* in Ardèche, which led us to bring them closer to vegetations of other clusters (Fig. 5).

In addition, we were led to describe five new associations: *Phyteumo hemisphaerici-Callunetum vulgaris* from the upper Cévennes in mont Lozère and Aigoual, *Vaccinio vitis-idaea-Genistetum pilosae* from Margeride, Cévennes and southern Ardèche, *Biscutello arvernensis-Arctostaphyletum uvae-ursi* and *Centaureo pectinatae-Juniperetum nanae* from Mézenc, *Patzkeo paniculatae-Vaccinietum myrtilli* from subalpine warm and dry slopes from the entire Massif central. *Teucrio scorodoniae-Callunetum stat. nov.* corresponds to a subassociation raised to the rank of association. *Racomitrio lanuginosi-Empetretum nigri* Luquet 1926 is rehabilitated when the previous authors had assigned it to an association described in the Sudeten mountains.

Subdivisions and lectotypification into Genisto pilosae-Vaccinion Braun-Blanq. 1926

Since the study of Schaminée & Hennekens (1992) and Schaminée *et al.* (1993) relating to the *Genisto pilosae-Vaccinion* of middle western European mountains, a great deal of phytosociological research has been carried out in the Massif central. Doche (1986) in Aubrac, Michalet *et al.* (1989) in chaîne des Puys had not been taken into account by these authors. Coquillard (1993), Michalet & Philippe (1996) in monts Dore supplemented the data with new associations of heathland. Delpech & Mollet (2008) in the Vivarais, Roux (2017) on the puy de Dôme, de Foucault (2017) in the Cévennes, provided additional information as well as numerous unpublished relevés from Billy of Basse-Auvergne, from Choisnet & Mulot (2008) of Ardèche, from Barret & Klesczewski

(2006) of Cévennes. The surveys carried out as part of this work concerning other major massifs, such as monts du Cantal, mont Lozère and mont Aigoual, Margeride, Mézenc. To carry out this study, we therefore used a much more complete sampling of the Massif central: that is, 990 relevés for all the heathlands and 675 relevés for the mountainous part, against 178 in the study by Schaminée *et al.* of 1993. These considerations explain that, for the Massif central, we obtained more complete results than these authors with 16 plant associations in total and more specifically 9 plant associations for *Genisto pilosae-Vaccinion*, against only 5 individualized by Schaminée *et al.*

Braun-Blanquet (1926) published the *Genisteto-Vaccinion* on the basis of two associations: «association à *Genista pilosa* et *Calluna*», and «association à *Vaccinium uliginosum* and *V. myrtillus*». These two syntaxons constitute the original diagnosis usually retained since as the first effective publication of the alliance (art. 1). Braun-Blanquet did not holotypify the alliance.

Schaminée *et al.* (1993) divide it into two suballiances. The first is the *Phyteumo hemisphaerici-Vaccinienion*, which includes the two associations of the initial Braun-Blanquet diagnosis. Thus they consider the *Phyteumo-Vaccinienion* to be the typical suballiance of the alliance. They holotypify this suballiance by the *Pulsatillo vernalis-Genistetum* Quézel & Rioux 1954, a name chosen to replace that «association with *Genista pilosa* and *Calluna*», considered as *nomen ambiguum* and to be rejected. The *Pulsatillo vernalis-Genistetum* Quézel & Rioux 1954 is thus the *lectotypus* of the alliance and article 24b concerning autonyms applies: the *Phyteumo hemisphaerici-Vaccinienion* Schaminée & Hennekens in Schaminée *et al.* 1993 becomes *Eu-Genisto-pilosae-Vaccinienion.*

The second suballiance is the *Carici piluliferae-Vaccinienion* Schaminée & Hennekens *in* Schaminée *et al.* 1993, holotypified by *Allio victorialis-Vaccinietum*, an association described later in the Forez mountains (Schaminée & Hennekens 1992).

A third suballiance is published here: the *Vaccinienion myrtillo-uliginosi suball. nov. hoc loco*, typified by association with V*accinium uliginosum* and *V. myrtillus* Braun-Blanq. 1926.

On the synecological and synchorological levels, the three previous suballiances are defined as follows. *Eu-Genisto pilosae-Vaccinienion* gathers subalpine xerophilous communities of the Massif central, in transition with *Juniperion nanae*, climatoxerophilous (eg *Biscutello arvernensis-Arctostaphyletum* from Mézenc) or edaphoxerophilous (eg *Pulsatillo vernalis-Cytisetum decumbentis*). The *Carici piluliferae-Vaccinienion* Schaminée *et al.* 1993 is unchanged. It includes the mesophilous communities from the montane belt to the lower subalpine belt of the crystalline subatlantic middle mountains, Massif central, Vosges, Black Forest... *Vaccinienion myrtillo-uliginosi* corresponds to the mesophilous communities of the subalpine level of the Massif central on volcanic rocks, mainly in the western mountains in an Atlantic climate. In fact our results show, in addition to the differentiation by altitude, already demonstrated by Schaminée *et al.*, an important discrimination according to humidity, a gradient which was already clearly demonstrated by Braun-Blanquet (1926, p.46, §2) between the two initial associations of *Genisto pilosae-Vaccinion*.

Contribution of climatophilous heathland communities to the biogeographical and bioclimatical knowledge of the Massif central

The discrimination of heathland vegetation of the French Massif central is primarily linked to a thermal gradient, itself a function of altitude. Communities of plains to submontane belt, are strictly followed by communities of montane belt, then communities located in the area of the upper forest edge, in 1450 and 1600 m. The most cryophilous communities are located above 1600 m, primarily in monts Dore, monts du Cantal, mont Lozère and mont Mézenc. Mont Aigoual, of lower altitude under 1565 m, is, in the lot, an exceptional figure, probably testifying to an increased wind action limiting the average summer temperature. The existence of this major cut in the subalpine belt had already been pointed out: Thébaud (1988), Thébaud *et al.* (1992) had deduced from it a scheme of vegetation layering on the highest mountains of the Massif central, in the form of two "sub-belts", a lower subalpine belt and an upper subalpine one. Since these work this idea had been taken up and then integrated by several authors, Coquillard *et al.* 1994; Michalet & Philippe (1996). In monts Dore and monts du Cantal, this distinction is particularly evident, with a drop of 400 m; it is also, but less clearly, for Mézenc and mont Lozère. It is also compatible with the subdivisions given inside the subalpine belt by Ozenda (1985, 2002) which gives in the Alps 3 sub-belts for the subalpine along an altitudinal section of about 600 m: a lower subalpine belt, mainly formed by *Picea abies* and *Pinus uncinata* forests, a middle subalpine belt, mostly dominated by chamaephytes with specific phanerophytes such as *Pinus cembra* and *Larix decidua* and an upper belt formed by very short dwarf-heaths and more grassy communities in transition with the alpine belt. In the Massif central, none of these subalpine tree species is spontaneous, which helps to explain the presence on large areas at the top, despite modest altitudes, of numerous heathland permaseries. It is also evident that this distinction within the subalpine level of the Massif central is also due to the wind effect, very sensitive on the highest summits, in particular for the massifs subject to the atlantic influence and those close to the mediterranean: certain summits of modest altitude such as the puy de Dôme, from 1300 m (Roux 2017) or Aigoual, from 1310 m (Klewsczevski *et al.* 2020), which emerge only a little from the forest edge, yet shelter vegetation whose floristic composition and structure, are distinctly subalpine and asylvatic (Roux 2017; Klesczewski *et al.* 2020).

The vegetation of the studied heathlands also reflects the climatic contrasts that exist within the Massif central, often highlighted by geographers and meteorologists (Estienne 1956; Suchel 1985; Etlicher 1986). But the new fact reflected in the vegetation is that this influence is also expressed on the highest summits: opposition between the mountains of the north and those of the south due to the influence of the Mediterranean climate marked by a strong summer drought; the floristic composition of the subalpine climatophilous heathlands of the south is marked by an almost complete extinction of the mesophilous or hygrophilous present in the north and, on the contrary, by many oroxerophilous taxa. This is particularly the case with climatoxerophilous *Phyteumo hemisphaerici-Callunetum*, common to monts Lozère and Aigoual. Similarly, the existence of an «internal zone» within the Massif central (Ozenda 1985),

grouping together the volcanic Velay (Mézenc...) or crystalline (south of the Margeride) corresponds to a drier subcontinental climate. This makes its effects felt as far as the subalpine vegetation where we can observe, on the massif du Mézenc, the heathlands of the Massif central that are floristically closest to the alliance of *Juniperion nanae*. Concerning the montane belt, the individualization of the climatoxerophilous association *Vaccinio vitis-idaea-Genistetum pilosae*, in the southern and central-eastern area of the Massif central, in opposition to the more northern or atlantic mountain heaths, is also, in this regard, revealing.

The biogeographic table of occurrence of plant communities (Tab. 3) highlights four major biogeographic and bioclimatic subdivisions for the highest ranges of Massif central. They partially confirm those highlighted by Thébaud & Roux (2018, Fig. 3) on the basis of ombrothermal diagrams. For each of them, the pairs of montane / subalpine climatophilous communities are differentiated below.

- Western volcanic chains under an oceanic climate (chaîne des Puys, monts Dore, Cézallier, monts du Cantal, Aubrac), with significant and well distributed rainfall, especially with high summer rainfall (> 400 mm for the localities indicated in figure 4): montane-subalpine climatophilous pair «*Galio saxatilis-Vaccinietum* / *Vaccinietum uliginoso-myrtilli*».
- North-eastern crystalline chain under an oceanic to suboceanic climate (Livradois-Forez, monts de la Madeleine, Pilat, crystalline north of Vivarais, north of the Margeride), with significant and well-distributed rainfall, also with high summer rainfall: climatophilous montane-subalpine pair «*Vaccinio myrtilli-Genistetum* / *Alchemillo saxatilis-Vaccinietum*».
- Eastern volcanic chains on phonoliths rocks with a subcontinental climate (Meygal, mont Mézenc, volcanic Vivarais) with a contrasted rainfall pattern with winter minima, lower global rainfall and clear summer deficit: mountain-subalpine climatophilous pair *Teucrio scorodoniae-Callunetum typicum (Centaureo pectinatae-Juniperetum nanae)* / *Biscutello arvernensis-arctostaphyletum*.
- Southern crystalline chains under Mediterranean climatic influence (Cévennes, mont Lozère, mont Aigoual, south of Margeride, granitic Aubrac, south of Vivarais), with a clear summer deficit rainfall but which are the most important in the Massif central in autumn-winter (Pache *et al.* 1996): montane-subalpine climatophilous pair «*Vaccinio vitis-idaea-Genistetum* / *Phyteumo hemisphaerici-Callunetum*».

Teucrio scorodoniae-Callunetum and *Galio saxatilis-Vaccinietum* are also fairly generalized plant associations in the mountain range, the first very xerophilic, especially on acid rock, granites, trachytes, phonoliths, the second on more basic rocks, basalts, trachyandesites, shale...

In conclusion, the heathlands of the Massif central are related to the great extent and the significant disparities of this mountain, especially climatic. They are good indicators, by their floristic variations which result in a large number of phytosociological units, plant associations and subassociations, well represented in the upper montane and subalpine belts. In this last belt, where chamephytes «are kings», the consequent altitudinal staggering and the variety of topoclimatic conditions allow their optimal expression. Their great heritage interest, particularly as habitats of European interest (European directive «habitats»: n° 4030 and 4060) and their preponderant place at the heart of extensive sylvo-pastoral systems require sustained attention from natural space managers. Our contribution to the in-depth phytosociological and ecogeographical knowledge of these systems will hopefully help them in their task.

Aknowledgment

The authors thank Augustin Chenut and Ida Delpy, bachelor's of sciences students at UCA for entering relevés, Robert Portal for verifying *Poaceae*, Christiane Chaffin for her help with the genus *Alchemilla*, Renée Skrzypczak, for identifying bryophytes, Yves Meinard and Sylvain Coq, for their help in the field, Mario Klesczewski from the Languedoc Roussillon Conservatory of Natural Areas for his reception and communication of relevés, Nicolas Guillerme for the communication of relevés from the National Botanical Conservatory of the Massif central and the two reviewers who significantly contributed to improving this article.

Table 3- Occurrence of plant associations by biogeographical groups of mountain ranges within the Massif central.

biogéographical regions/plant communities	Artense Combrailles	Plateaux cristallins d'abri	Cantal	monts Dore	Aubrac	Cézallier	Chaîne Puys	Velay basalt.	Mézenc/meygal	Livradois-Forez	Montagne Bourbonnaise	Pilat Nord Vivarais cristallin	MargerideNord	monts d'Ardèche Tanargue Valadous	margeride sud, Gardille	Aigoual	mont Lozère	vallées cévenoles	Haut-Languedoc
Pulsatillo vernalis-Cytisetum typicum			x																
Pulsatillo vernalis-Cytisetum scabiosetosum			x																
Carici vaginatae-Callunetum genistetosum pilosae				x															
Carici vaginatae-Callunetum typicum				x															
Vaccinietum myrtillo-uliginosi trifolietosum			x	x															
Vaccinietum myrtillo-uliginosi festucetosum			?	x															
Vaccinietum myrtillo-uliginosi geranietosum			?	x															
Vaccinietum myrtillo-uliginosi typicum			x	x															
Groupement à Euphorbia hyberna et Calluna			(x)		x														
Racomitrio lanuginosi-Empetretum salicetosum bicoloris			?	x															
Racomitrio lanuginosi-Empetretum salicetosum herbaceae				x															
Racomitrio lanuginosi-Empetretum huperzietosum			x	x															
Racomitrio lanuginosi-Empetretum typicum			x	x					x	(x)									
Jasione laevis-Callunetum juniperetosum nanae			x	x			(x)		(x)										
Jasione laevis-Callunetum typicum				x															
Biscutello arvernensis-Arctostaphyletum typicum									x										
Biscutello arvernensis-Arctostaphyletum anemonetosum									x										
Centaureo pectinatae-Juniperetum nanae typicum									x										
Centaureo pectinatae-Juniperetum nanae vaccinietosum uliginosi									x										
Euphorbio hybernae-Vaccinietum luzuletosum				x					(x)										
Euphorbio hybernae-Vaccinietum senecietosum			x	x	?	?													
Euphorbio hybernae-Vaccinietum typicum			x	x	?	?													
Patzkeo paniculatae-Vaccinietum			x	x		?			x	(x)									
Galio saxatilis-Vaccinietum nardetosum			?			(x)	x	?											
Galio saxatilis-Vaccinietum dianthetosum							x		?										
Galio saxatilis-Vaccinietum typicum			?	x		x	x	?	?					x					
Galio saxatilis-Vaccinietum festucetosum				x	x		x	x	?	(x)				x	x	x	(x)		
Allio victorialis-Vaccinietum vaccinietosum uliginosi			x	x	?	x	x		(x)										
Allio victorialis-Vaccinietum veratretosum									x	x									
Allio victorialis-Vaccinietum stachyetosum										x		?	(x)						
Allio victorialis-Vaccinietum typicum										x		?							
Alchemillo saxatilis-Vaccinietum typicum							x		x	x				(x)					
Alchemillo saxatilis-Vaccinietum polygonetosum									x	x									
Vaccinio myrtilli-Genistetum molinietosum				x						x									
Vaccinio myrtilli-Genistetum calamagrostietosum				(x)						x	x	x	(x)						
Vaccinio myrtilli-Genistetum typicum	(x)									x	x	?	(x)						
Teucrio scorodoniae-Callunetum juniperetosum		x					x		?	x	?			x					
Teucrio scorodoniae-Callunetum typicum							x		x	x	?		x	x		?			x
Vaccinio vitis idaeae-Genistetum typicum										x			x	x	x	?	x		?
Vaccinio vitis idaeae-Genistetum cytisetosum				(x)										x	x	?	x	x	?
Vaccinio vitis idaeae-Genistetum meetosum				(x)										x	x	x	x		
Phyteumo hemisphaerici-Callunetum var. typique														(x)		x	x		
Phyteumo hemisphaerici-Callunetum var. Juncus trifidus																x	x		
Phyteumo hemisphaerici-Callunetum var. Sesamoides																	x		

Phytosociological synopsis of the heathlands studied here

(In bold: new syntaxa; underlined: associations studied in this work)

CALLUNO VULGARIS-ULICETEA MINORIS Braun-Blanq. & Tüxen *ex* Klika *in* Klika & Hadač 1944

VACCINIO MYRTILLI-GENISTETALIA PILOSAE Schubert *ex* Passarge 1964

Diantho hyssopifolii-Vaccinion myrtilli all. nov. Boullet *et al. ad interim* (?= *Calluno vulgaris-Arctostaphylion uvae-ursi* Tüxen & Preising *in* Preising 1949 *nom. nud.*)

Galio saxatilis-Vaccinium myrtillus R.Michalet Coquillard & Gueugnot 1989

Festuco filiformis-Callunetum vulgaris R.Michalet Coquillard & Gueugnot 1989

Teucrio scorodoniae-Callunetum vulgaris (R. Michalet, Coquillard & Gueugnot) ***stat.nov.***

juniperetosum communis subass. nov.

Groupement à *Euphorbia hyberna* et *Calluna vulgaris* (Doche 1984)

Cytiso oromediterranei-Ericetum cinereae B. Foucault 2017

Genisto pilosae-Vaccinion Braun-Blanq. 1926

Vaccinienion myrtillo-uliginosi suball. nov.

Vaccinietum myrtillo-uliginosi Braun-Blanq. 1926 *nom. invers.*

Euphorbio hybernae-Vaccinietum myrtilli Coquillard *ex* Thébaud *et al.* 2014

Patzkeo paniculatae-Vaccinium myrtilli ass. nov.

crepidetosum conizifoliae subass. nov.

typicum subass. nov.

Eu-Genisto pilosae-Vaccinienion (autonym = *Phyteumo hemisphaerici-Vaccinienion* Schaminée & Hennekens *in* Schaminée *et al.* 1993)

Jasione laevis-Callunetum vulgaris Michalet & Philippe *ex* Thébaud *et al.* 2014

Pulsatillo vernalis-Cytisetum decumbentis Quézel & Rioux 1954 ***nom. mut. nov.***

scabietosum columbariae subass. nov.

Biscutello arvernensis-Arctostaphyletum uvae-ursi ass. nov.

typicum subass. nov.

anemonetosum nemorosae subass. nov.

Centaureo pectinatae-Juniperetum nanae **Choisnet & Mulot** ***ass. nov.***

vaccinietosum uliginosi subass. nov.

typicum subass. nov.

Phyteumo hemisphaerici-Callunetum vulgaris ass. nov.

Vaccinio vitis-idaeae-Genistetum pilosae ass. nov.

cytisetosum oromediterranei (B.Foucault) ***stat. nov. et comb. nov.***

typicum subass. nov.

meetosum athamantici subass. nov

Carici piluliferae-Vaccinienion Schaminée & Hennekens *in* Schaminée *et al.* 1993

Allio victorialis-Vaccinietum myrtilli Schaminée & Hennekens *ex* Thébaud *et al.* 2014

vaccinietosum uliginosi comb. nov.

Vaccinio myrtilli-Genistetum pilosae Schaminée & Hennekens *ex* Thébaud *et al.* 2014

Alchemillo saxatilis-Vaccinietum uliginosi Thébaud *ex* Schaminée *et al.*1993

LOISELEURIO PROCUMBENTIS-VACCINIETEA MICROPHYLLI Eggler *ex* Schubert 1960

RHODODENDRO FERRUGINEI-VACCINIETALIA MICROPHYLLI Braun-Blanq. *in* Braun-Blanq. & Jenny 1926

Genisto pilosae-Empetrion hermaphroditi all. nov.

Carici vaginatae-Callunetum vulgaris R.Michalet & Philippe *ex* Thébaud *et al.* 2014

genistetosum pilosae ***subass. nov. ex hoc loco.***

Racomitrio lanuginosi-Empetretum nigri Luquet 1926

huperzietosum selaginis subass. nov

Supplement 1

Global classification analysis (MTC) carried out on 995 relevés of heathland in the Massif central and selection of montane and subalpine for the second stage of analyses.

Supplement 2a and 2b

Ordered final table of relevés of montane and subalpine heathlands and header data of tables 4 to 11.

Supplement 3

Article translated in French. Please note, the article in French is not an effective publication. This is only a supplement (art. 1 ICPN).

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Table 4 - *Racomitrio lanuginosi-Empetretum nigri* Luquet 1926.

Association		*Racomitrio lanuginosi-Empetretum nigri*																																												
ordinal number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
num. turboveg repository		1	3	3	8	9	7	7	3	7	7	3	5	3	3	3	3	5	4	5	2	2	2	5	2	3	2	2	2	2	2	2	2	2	2	2	1	1	2	2	2	1	1	1	1	1
grey relevés = *typus*		0	8	8	5	1	2	2	5	2	2	5	0	5	8	7	5	0	8	0	0	0	1	3	3	4	1	1	0	1	0	1	0	0	0	0	9	9	0	3	0	9	9	9	9	9
		9	3	4	8	0	6	5	7	4	3	4	0	9	2	1	5	4	3	1	1	4	0	2	4	9	5	4	3	3	8	1	9	2	7	6	9	8	0	5	5	7	5	6	4	3
cryptogams inventoried yes/no		N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	inc.	Y	inc.	N	N	inc.	N	N	N	N	inc.	N	N	N	N	N	O	N	N	N	N	N	N
		huperzietosum selaginis																							*typicum (= valerianetosum)*										*salicetosum bicoloris*						*salicetosum herbaceae*					
sub-units		poor v.				typical variant																																								
Strate herbacée																																														
Melampyrum pratense L.				1			+	+		+	+	1		+																																
Huperzia selago (L.) Bernh. ex Schrank & Mart.	C.ass.	+	2	2		+		+	2	2	1	1	1	2	+	2	2	+	2	1	+	+	+																			+			+	
Alchemilla alpina coll. (A. basaltica et autres)		4		2	1			1	1	+	1	+				1	2	2	+	2	+		+	+	+	1	+	+																+		
Melampyrum sylvaticum L. I													+		+	+				1				+		+	+			1		1	+		1	+										
Cerastium alpinum L.	C.ass.																+	1			+		+		+		+		+	+	+			+	+	1		+						+		
Persicaria bistorta (L.) Samp.												+			1	1	1	1	1	+		+	2	+	+	+	+	1	+	1		+		+			+				+					
Pulsatilla alpina s. alba Zamelis																					+	+	1				2	+	+	2	1	+	+	1	2	2	+	+	1		+	+	+	+	+	
Luzula desvauxii Kunth	D.ass.											1					1							2	+		+	1	1	1	+	+		+					1	+	+			1		+
Mutellina adonidifolia s. mutellina (L.) Reduron												+																1	+	+		+	+								+	+	+			1
Anthoxanthum odoratum L.	D.s.ass.																									+		1	+	1	+	+														
Valeriana tripteris L. II	D.s.ass.				1																				+	+						+	+							+						
Salix bicolor Willd.																									+				1			+	+	+	+	1	1	2	2	+						
Salix herbacea L.																																										2	2	3	3	4
Vaccinium uliginosum L.			1	2	2	5	1	2	3	3	2	3	3	4	2	3	3	3	2	3	+	3	4	2	1	3	2	3	2	3	3	3	3	+	+	2	4	2	2	+	3	3	3	+		+
Deschampsia flexuosa (L.) Trin.		+	2	2	1	1			1			2	2	1	2	2	2	2		2	1	1	+	1		2	2	2	2	3	1	2	+	1	3	3	1	+	2		2		1	+	1	2
Empetrum nigrum L. (*incl. hermaphroditum*)	C.ass.				3	2	4	3	1	3	3		2		2				2	3	3	3	2	2	2	2	3	1	3	+	2	1		4	4	4	3	4	4	3	3		2		1	+
Vaccinium myrtillus L.		2	1	2	1	1			1	+		2	1	2	1	1		2	1	4	2	1	2	1	+	2	+	2	+	3	3	1		+	2	2			2	+	+					
Phyteuma hemisphaericum L.		1				+		+	+	+	+	+	1	2	+	1	1	1	1	+	1	+	+				+		+	+	+		+	+		+		+	+		+	+	1	+		
Calluna vulgaris (L.) Hull		+	2	4			+	+	1	1	+	3	1	2	3	2	2	+	1	1		+	+	+	+	2		+	+	+	+	2	+					+		+						
Avenula versicolor (Vill.) Laínz							+	+	+	+	+	+		+	1	2	1	1			2	+	1				1	+	1	+	1	+	1	1	+		1	1			+	1		1		
Scorzoneroides pyrenaica (Gouan) Holub *s. pyr.*				1		+			1	+	+		1	1	1	1	2	1	+	1	+	+	1			+	+	+	+	1	1	+		1								+	+	1		
Festuca airoides Lam.	D.ass.					+						+	+	1	1	1	2	1	2		+	+					1		1				+	1								1	2	+	+	
Agrostis rupestris All.							+	+	+	+		+			1		1	+						1	+																	+	+	2		
Genista pilosa L.							+	+		+	+			+			+				+	+	+								+				+	+			+							
Solidago virgaurea s. alpestris (Walstd. Kit.) Gremli	C.ass.		+	1									+			+				1	+				+	+	+		+			+				+								+		
Festuca rubra coll.		1										2			1			2																+						+	+					
Phyteuma spicatum L.																									+		+			+					+	1		+								
Luzula multiflora (Ehrh.) Lej.												+			+		1											+				+														
Luzula spicata (L.) DC.													+					+			+				+				+																	
Hieracium praecox Sch.Bip.					+																					+	+		+		+															
Leucanthemum vulgare coll. (incl. delarbrei)																								+		+	+		+											+						
Festuca billyi/lemanii																							+							+	1	+				+										
Galium pumilum Murray																											+		+					+	+	1										
Galium saxatile L.								+																									+				+	+	+							
Hieracium murorum L.																					+											+	+	+												
Juniperus communis s. nana (Hook.) Syme					1			+			1										1																									
Gentiana lutea L.				+					+				+																	+																
Saxifraga bryoides L.										+	1														+																			+		
Androsace halleri L.										+	+														+						+															
Euphrasia minima Jacq. ex DC.												1					1																+											+		
Carex caryophyllea Latourr.									2					1									+																							
Trifolium alpinum L.									1																						2												+			
Pulsatilla alpina alpina/apiifolia									+																+															+						
Biscutella laevigata coll.												+											+															+								
Calamagrostis arundinacea (L.) Roth													+															+		+																
Sorbus aucuparia L.																						+										+					1									
Saxifraga paniculata Mill.																									+								+	+												
Lotus corniculatus L.																									+				1					+												
Strate muscinée																																														
Hylocomium splendens (Hedw.) Schimp.				2		4	1	2	2	2	1	2	4	2	4	3	3	4		3				5	+	3														+						
Cetraria islandica (L.) Ach.	C.ass.		1	3		+	+	+	2	+	+	1		2	1	2	1	+	1	1					+															+						
Polytrichastrum alpinum (Hedw.) G.L.Sm			2	2					2				2	1	1	2	2	2	2	+				+																						
Cladonia sp.						1			2				1	3	2	2	2	1	1	2				1																						
Racomitrium lanuginosum (Hedw.) Brid.	C.ass.						+	+		+	+			1	1	3	3	2							2															+						
Dicranum scoparium Hedw.			1	2									1		2			+		2				+	+															+						
Rhytidiadelphus triquetrus (Hedw.) Warnst.						+			2			2	2		+					1					+															+						
Rhytidiadelphus loreus (Hedw.) Warnst.						r							1		+	1		2		1						1																				
Ptilidium ciliare (L.) Hampe									1			1		1	+	1	1			1																										
Cladonia uncialis (L.) Wigg.			1	2			+	+		+																																				
Cladonia rangiferina (L.) Web. ex Wigg.			1	2															1						+															+						
Cetraria sp.			+				1	2		3	2																																			
Racomitrium sp.							+	+		+	+									1																										
Cladonia gracilis (L.) Willd.			2	2																					+															+						
Cladonia macroceras (Del.) Athi							+	+		+	+																																			
Cladonia arbuscula (Wallr.) Flot.							+			+	+																																			
Polytrichum piliferum Hedw.			+									2		2																																
Pleurozium schreberi (Willd. ex Brid.) Mitt.															+	2										+																				
Lophozia ventricosa (Dicks.) Dumort.															+	+		1																												
Polytrichastrum formosum (Hedw.) G.L.Sm.			1																						1															1						
Cladonia pyxidata (L.) Hoffm.				2																					+															+						

Companions species occurence less than 3:

Meum athamanticum 357: 1, 371: +; *Euphrasia sp.* 357: 1, 355: 1; *Pedicularis comosa* 354: 1, 209: +; *Alchemilla vulgaris coll.* 234: +, 209: +; *Rhinanthus minor* 203: +, 211: +; *Potentilla aurea* 203: +, 211: +; *Adenostyles alliariae* 349: 1, 211: +; *Campanula rotundifolia* 349: +, 211: +; *Knautia basaltica* 349: +, 215: +; *Salix lapponum* 203: 2, 196: +; *Dryas octopetala* 209: 1, 235: 1; *Diphasiastrum* 726: +; *Festuca paniculata s. paniculata* 357: +; *Hieracium sp.* 724: +; *Rhinanthus pumilus* 354: +; *Picea abies* 354: +; *Alchemilla species* 500: +; *Ranunculus platanifolius* 500: +; *Carex umbrosa* 382: +; *Silene ciliata* 371: +; *Phegopteris connectilis* 501: +; *Rhinanthus species* 501: +; *Geranium sylvaticum* 532: +; *Knautia integrifolia s. integrifoli* 234: +; *Saxifraga hypnoides* 234: +; *Thymus pulegioides* 234: +; *Luzula sylvatica* 349: 2; *Jacobaea adonidifolia* 349: +; *Doronicum austriacum* 349: +; *Knautia arvernensis* 349: +; *Hieracium prenanthoides* [211: +; *Persicaria vivipara* 209: +; *Betula pubescens coll.* 199: 1; *Viola lutea s. lutea* 198: +; *Pyrola minor* 235: +; *Minuartia verna* 235: +; *Cladonia grayi* 383: 1, 384: 2; *Pohlia nutans* 384: +, 371: +; *Ptilium crista-castrensis* 726: +, 349: +; *Sphagnum subnitens* 500: 2, 501: 2; *Racomitrium fasciculare* 359: 1, 371: 3; *Rhytidiadelphus squarrosus* 500: +, 532: +; *Pseudotaxiphyllum elegans* 500: +, 349: +; *Pogonatum urnigerum* 500: +, 349: +; *Plagiothecium denticulatum* 504: +, 349: +; *Rhytidium rugosum* 234: +, 235: +; *Cladonia furcata* 384: 2; *Cladonia squamosa* 384: 2; *Dicranum spadiceum* 357: 1; *Nardia* 500: +; *Diplophyllum albicans* 500: +; *Tritomaria exsectiformis* 382: +; *Dicranum fuscescens* 382: 2; *Lophocolea heterophylla* 371: +; *Jungermannia gracillima* 371: +; *Cynodontium polycarpon* 504: 1; *Polytrichum commune* 501: 1; *Sphagnum quinquefarium* 532: 2; *Sphagnum capillifolium* 349: 3.

Table 4. **Groups of differential taxa. I : taxa of heathlands with xerophilous character; II : taxa mesophilous or mesohygrophilous, aerohygrophilous ou chionophilous.**

Table 5 - *Patzkeo paniculatae-Vaccinium myrtilli ass. nov.*

Association		***Patzkeo paniculatae-Vaccinietum myrtilli***																							
ordinal number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
num. turboveg repository		1	1	8	6	5	5	1	1	5	5	1	5	8	3	2	9	9	9	9	9	9	3	3	0
grey relevés = *typus*		2	1	8	4	2	7	0	2	3	0	2	0	8	7	5	6	6	6	6	5	4	7	5	8
		5	9	9	4	2	1	4	4	0	3	6	7	8	5	1	8	5	1	2	8	3	6	3	8
subassociations		***typicum***												***crepidetosum conyzifoliae***											
Campanula rotundifolia L. **Ia**	*D.s.ass.*	+	+			+	+	+	+		1	+													
Carex caryophyllea Latourr.	*D.s.ass.*			+	1	1		+		1	2	2	+	+	1										
Persicaria bistorta (L.) Samp.							1	+		1		+	+	+	+				+						
Luzula multiflora (Ehrh.) Lej.							1	1	+		+	+			+	+	+	+				+			
Nardus stricta L. **Ib**											2	+	+	+		+	2	3		+	+				
Galium saxatile L.											1	+			2		1	2	2	1	+				
Agrostis capillaris L.		+		+	1										+		+	+	+		+				
Viola lutea s. lutea Huds.		+				+				+						+	+	+	+	+					
Stachys officinalis (L.) Trévis	*D.s.ass.*																1	+	+	+	+				
Calamagrostis arundinacea (L.) Roth		+																	1	3	+		2	+	+
Crepis conyzifolia (Gouan) A.Kern.	*D.s.ass.*													+					+	+	1	+	1		
Campanula scheuchzeri s. lanceolata (Lapeyr.) J.M.Tison			+	+										+	+	+			+	+	+	1	1	+	
Patzkea paniculata s. paniculata (L.) G.H.Loos	*C.ass.*		+	4									+	+				+	1	+	3	3	2	1	1
Solidago virgaurea L. **II**							1							+	1		+	+	+	+	1	1	1		1
Jacobaea adonidifolia (Loisel.) Mérat	*C.ass.*			+		+									+			+	+	+		+	1	+	1
Centaurea nigra L.	*D.s.ass.*																+		+	+	+	+	1	+	+
Achillea millefolium L.	*D.s.ass.*																		+	1	+	+			
Vaccinium myrtillus L.	*C.ass.*	3	2	2	2	1	2	2	2	2	+	3	3	4	2	2	+	3	3	1	3	3	1	2	+
Calluna vulgaris (L.) Hull		+	2	2	4	3	3	3	1	1	3	3	3	2	2	1	3	1	+	2		+	4	3	3
Deschampsia flexuosa (L.) Trin.		2	2	+	2	2	2	1	2	2	2	2	2	1	2	1	1	+	2	+			1	1	+
Genista pilosa L.			1	+	2	2	+	1	2	+	1	+	2	+	+	+	+	1		2		+	1	2	+
Gentiana lutea L.				+	2	1	2	+		+	1		2	+	2	+	+	2	2	2	+	+	2	+	+
Serratula tinctoria s. monticola (Boreau) Berher	*D.ass.*		+	+		+	+			1	+		1	1	2	+	1	1	1	1	+	1	2	+	+
Arnica montana L.	*D.ass.*		+	+	2	1		+		2	1	+	2	+	1	+	+	+		+	+	+	+		
Vaccinium uliginosum L.		4	4		2	2	2	2	4	3	1	3	3	2	4	4				+	1		1		
Potentilla erecta L.			+	2	1				+		2	1	1	2	1	+	1	1		+	1	+	1	+	
Meum athamanticum Jacq.			1	1						+	1	+	1	1	2	+	2	+	+	+	+	+	1	+	
Dianthus seguieri s. pseudocollinus (P.Fourn.) Jauzein						+	1	+	+			+	1	+	+	+	+	1	+	+	+	+				
Festuca rubra coll.		2	1	+				2	1	2	2	1		1	3		2	+				+		+	
Scorzoneroides pyrenaica (Gouan) Holub *s. pyrenaica*						+		+	1	+	1	+	1		1	+	+	1		+		1			+
Jasione laevis Lam.	*C.ass.*				1		1	+			+					+	+	1	+	+			1	1	
Festuca lemanii/billyi							2	1		1			2				1	1	1	2		+			+
Thesium alpinum L.									+				+		+			+	+	+					
Hieracium praecox Sch.Bip.					1		+				+													+	+
Sanguisorba officinalis L.			+											+			+		+				+		
Lathyrus linifolius s. montanus (Bernh.) Bössler			+	+					+					+										+	
Trifolium alpinum L.						1							+		1				+					+	
Succisa pratensis Moench						+				1			+						+			+			
Lotus corniculatus L.			+			+				+		+		+											
Sorbus aucuparia L.						+	+								+						+				
Hieracium murorum L.			+					+	1											+					
Phyteuma hemisphaericum L.		+	+						1															+	
Potentilla aurea L.												+			+	+	+								
Anthoxanthum odoratum L.		+						+							1	+									
Juniperus communis s. nana (Hook.) Syme				+										+											3
Pulsatilla alpina s. apiifolia (Scop.) Nyman										2			+			+									
Leucanthemum delarbrei Timb.-Lagr. ex Lamotte				+											1									+	
Linaria repens (L.) Mill.							+												+					1	
Alchemilla alpina coll.		+							1			+													
Melampyrum sylvaticum L.							+								1	+									
Carex umbrosa Host						+	+									+									
Alchemilla saxatilis Buser								+						+											1
Carex pilulifera L.			1						2												+				

Companions taxa occurrence less than 3 :

Sorbus aria 958: +, 376: +; *Cytisus oromediterraneus* 965: +, 376: +; *Hieracium laevigatum* 961: +, 962: 1; *Rhinanthus minor* 571: +, 125: +; *Hieracium umbellatum* 571: +, 104: +; *Luzula sylvatica s. sylvatica* 353: +, 375: 2; *Silene nutans* 965: +, 962: +; *Hieracium lachenalii* 958: +, 943: +; *Hieracium pilosella* 965: +, 503: +; *Briza media* 968: +, 943: +; *Hieracium species* 888: +, 889: +; *Danthonia decumbens* 968: +, 503: 2; *Avenula* 251: +, 125: +; *Senecio doronicum* 965: +, 376: +; *Poa chaixii* 961: +, 888: +; *Alchemilla transiens* 522: 1, 571: 1; *Bartsia alpina* 251: +, 375: +; *Epikeros pyrenaeus* 251: +, 375: +; *Antennaria dioica* 522: +, 644: 1; *Leucanthemum vulgare* 943: +, 124: +; *Coincya cheiranthos* 251: +, 376: +; *Festuca airoides* 522: +, 530: 1; *Silene vulgaris* 353: +, 507: +; *Anemone nemorosa* 119: +, 124: +; *Galium mollugo s. erectum* 522: +, 530: 1; *Hypericum maculatum* 251: +, 968: +; *Myosotis alpestris* 530: +; *Gnaphalium sylvaticum* 962: +; *Leontodon hispidus* 943: +; *Geranium* 530: +; *Galium verum* 961: +; *Lactuca plumieri* 958: +; *Mutellina adonidifolia s.* 251: 1; *Conopodium majus* 962: +; *Luzula* 961: +; *Euphorbia* 119: +; *Cerastium arvense* 125: +; *Hypericum perforatum* 888: +; *Hieracium cantalicum* 376: 1; *Knautia* 251: +; *Genista* 968: 2; *Galium pumilum* 125: +; *Tephroseris helenitis s. arvernensi* 530: +; *Genista tinctoria s. delarbrei* 530: +; *Euphrasia micrantha* 353: 1; *Euphrasia minima* 124: +; *Phyteuma spicatum* 943: +; *Scorzonera humilis* 888: +; *Rumex acetosa* 965: +; *Viola species* 376: +; *Pulsatilla alpina s. alba* 104: +; *Lilium martagon* 888: +; *Veronica officinalis* 968: +; *Rumex* 888: +; *Rubus* 889: +; *Sanguisorba minor* 943: +; *Thymus pulegioides s. pulegioides* 943: +; *Brachypodium pinnatum* 962: 2; *Agrostis rupestris* 522: +; *Biscutella arvernensis* 353: +; *Gentiana pneumonanthe* 962: +; *Carex species* 125: +; *Melampyrum pratense* 251: +; *Cytisus decumbens* 126: +; *Euphorbia hyberna* 958: 2; *Thymus pulegioides s. chamaedrys* 353: +; *Narcissus pseudonarcissus* 961: +; *Cotoneaster integerrimus* 888: +; *Convallaria majalis* 376: 1; *Lycopodium clavatum* 251: +.

Table 5. **Groups of differential taxa. I : oligotrophilous ; Ia : xerophilous ; Ib : mesophilous to mesohygrophilous. II : mesotrophilous mesoxerophilous.**

Table 6 - *Pulsatillo vernalis-Cytisetum decumbentis* Quézel & Rioux 1954

Association		***Pulsatillo vernalis-Cytisetum decumbentis***																																			
ordinal number		1	2	3	4	5	6	7	11	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
num. turboveg repository		2	3	5	3	4	0	0	2	2	5	2	4	5	2	5	4	4	3	3	5	5	5	5	5	5	5	5	5	6	5	5	3	3	3	5	3	3	2
grey relevés = *typus*		6	5	1	7	9	9	9	6	6	1	2	9	3	6	1	9	9	7	7	1	1	1	2	2	2	3	2	3	2	3	1	6	7	8	1	5	6	6
		4	0	6	2	3	9	0	5	1	4	7	6	6	3	8	7	8	0	3	9	2	3	1	4	3	5	0	1	9	3	7	1	7	0	5	8	3	0
Subassociations		***typicum***																					***scabiosetosum columbariae***																
variants		***typical variant***																***Androsace halleri v.***					***Potentilla erecta v.***							***typical variant***									
facies																																	*Arctostaphylos f.*						
Luzula spicata (L.) DC. **Ia**	*D.s.ass.*	+	+	+	+	+	+	+					+			+	+	2	1	2	1						+					+							
Scorzoneroides pyrenaica (Gouan) Holub *s. pyrenaica*	*D.s.ass.*		+		+	1	+		+	+		+	2	+	+	2	1	1	1					1									1						
Agrostis rupestris All.	*D.s.ass.*					+	1	+	+	+	+	+	1	+		1	1	2	1																				
Luzula multiflora (Ehrh.) Lej.	*D.s.ass.*			+			+	+	+	+					+		1																						
Persicaria bistorta (L.) Samp. **II**								+	+	+		+	2	+		1	2	1																					
Potentilla aurea L.		+												1	1	+	1	1																					1
Silene ciliata Pourr. **Ib**	*C.ass.*				+					+					+		1	1	1	1	1				+														
Androsace halleri L.								+										1	1	1	1	+						1				+							
Campanula rotundifolia L.			+													+				1	1	1	1	1	+	+	+	1	1						+				
Potentilla erecta (L.) Rausch																					+		+		+	+	+	+	+								+		
Hieracium pilosella L.	*D.s.ass.*													+							+	1	+	1	+		1						1	+		+			
Scabiosa columbaria L. **III**	*D.s.ass.*																				1				+	+	1	+			+	1		1		+	1	+	
Dianthus hyssopifolius L. *s. hyssopifolius*	*D.s.ass.*																						+				+			1	1	+		1	+	1	+		
Festucapaniculata (L.) Schinz & Thell. *s. paniculata*	*D.s.ass.*							+																+	+	1					2		2	2	1	1	1	1	
Arctostaphylos uva-ursi (L.) Spreng.																																	2	3	3	1	4	3	2
Sedum forsterianum Sm.																												1				+		1	1	+	1		
Achillea millefolium L.																															+	+		1	+		1		
Genista pilosa L.		3		2	1	2	1	2	+	3	2	+			2	+	2	+	+	1	1	2	2	2	2	2	2	2	+		1	2	2	+	+	1	2	2	3
Calluna vulgaris (L.) Hull	*D.ass.*	4	3	4	3	2	1	3	5	3	4	5	+		3	+	2	+	+	1		4	4	3	3	4	2				2	+	4	2	2	1	1	3	3
Deschampsia flexuosa (L.) Trin.			2	1	1	1	1	+	2		+	2	2		+	2	3	2	1	2	2	+	+	3	+		1		2	1	+	1					1		+
Vaccinium uliginosum L.		2	2	1	2		2		+	1	1	+	2		+	1	3	+				1	1		+			2	3				+	2	1	+			2
Carex caryophyllea Latourr.					1		2	1			1					1	2	1	+	2	1	1	2	2		1	1	1	2	2	+		1			+			
Vaccinium myrtillus L.					1	1	2	+	1	+		1	1	2		1			+	1				+				+	2	4				2	2	+		1	+
Phyteuma hemisphaericum L.		+				1	2	1	+	+	+	+	2		+	+	1	2	+		+	+			+		+					+							+
Festuca airoides Lam.			1	+	2	2	+				1		2			2	1		2	3	2	+			1		1	1				+		1	1			+	
Gentiana lutea L.		1		+	1	1	+	+				+					1			1		+	1		+	1	+				+		+	1		+			+
Lotus corniculatus L.				+		1				+	+		+		+	+					+	+	+	+		+	+	+		+	+	+		+					
Cladonia species			2		1				+			+	1		+		2	2	2		1	2						2	1			2	3						+
Antennaria dioica (L.) Gaertn.											1			2		+		2	2	2	2	2	1	1	1		2					1	1	1			2		
Alchemilla transiens (Buser) Buser			+	+	2	1				1			2				1			3			+	+		1		1				2			2			+	
Pedicularis comosa L.	*D.ass.*	+	+	1					+	+	1	+	2	+	+	+											+	+				+	1						
Pulsatilla alpina s. apiifolia (Scop.) Nyman	*D.ass.*			+		+			+		+	+	1	2	1	1	+				1						1				1		+						+
Pulsatilla vernalis (L.) Mill.	*C.ass.*	1							+	2	1	+		1	2	+					2	1	+		+	1	1					+							
Trifolium alpinum L.		1					+		1	2	1	1				+	2		2			1	+	1	+				+										
Jasione laevis Lam.			+	+			+	+						2		+				+		1	+	+						+	+			1					
Alchemilla saxatilis Buser							+	+			1					1	+	2	3		1	1	2				1			+							2		
Hieracium praecox Sch.Bip.			+	+	1	+		1										1					1								+	1				+	1	1	
Festuca arvernensis s. costei Auquier & Kerguelen	*Dass.*			+		+												2		2	+			2	+		1		1					2	2				
Cetraria species		1							+	1		2	1		1		1		2													1				2			1
Meum athamanticum Jacq.								+			+					+	+													1	+		+	+	+			+	
Leucanthemum delarbrei Timb.-Lagr. ex Lamotte								+										+					+				+					+	+	1	+	1		+	
Arnica montana L.							+				1			2		+	2					+	+				+			+									
Serratula tinctoria s. monticola (Boreau) Berher		+						+	+			+													+	+				2			1						+
Euphrasia micrantha Rchb.			1	+							+											+	+		+	+							1						
Jacobaea adonidifolia (Loisel.) Merat				+	+	1														1					+										1	+		+	
Viola lutea s. lutea Huds.				+				+					1									+	+			+							1					+	
Juniperus communis s. nana (Hook.) Syme		1						+											1	1														1	3	2			1
Ranunculus tuberosus Lapeyr.														+		+		1	1	+			+	+			+												
Nardus stricta L.		+												1								+	+	2		1	1			+									
Agrostis capillaris L.							+							+								+	1	1					1	2	+								
Biscutella arvernensis Jord.			1		1	2							1		+										+	+													
Thymus pulegioides s. chamaedrys (Fr.) Litard.																		1		1							1	+		+	2	1							
Cytisus decumbens (Durande) Spach	*C.ass.*								+	1		+			+													2				1							
Thesium alpinum L.																+						+	+							+			+					+	
Silene rupestris L.								1												1					+						+				1	1			
Hieracium sp.																			+									+					+	+	+				
Thymus pulegioides L. *s. pulegioides*														+							1		+			+								1				+	
Solidago virgaurea L.					1	+	+	1				+																											
Poa alpina L.																+	+	1			1											+							
Succisa pratensis Moench											+						+					+			+		+												
Carex pilulifera L.						1										1					1				1	+													
Cytisus oromediterraneus Rivas Mart. & al.			+	2																											2					1	2		
Galium mollugo s. erectum Syme						+										+		+									+					+							
Cerastium arvense L.											+			+										+				1	+										
Galium saxatile L.										+				1														+	+	+									
Noccaea caerulescens s. virens (Jord.) Kerguelen															+	+		1														+							+
Festuca arvernensis s. arvernensis Auquier *et al.*																									+			1			+	2				2			
Centaurea jacea s. nigra (L.) Bonnier & Layens																				+							+			1			1					+	
Luzula campestris (L.) DC.					+	1										+								+															
Euphrasia minima Jacq. ex DC.		+					+								+																								+
Koeleria pyramidata (Lam.) P.Beauv.														+							2						+					+							
Epikeros pyrenaeus (L.) Raf.															+	+	+							+															
Cerastium alpinum L.								+										1	+														+						
Helictotrichon sedenense (Clarion ex DC.) Holub													1						2		1														1				

Companions species occurrence less than 4:

Festuca nigrescens 497: +, 512: +, 629: 2; *Hieracium vogesiacum* 493: 1, 498: +, 363: +; *Festuca species* 264: +, 261: +, 523: 1; *Thymus species* 261: +, 263: +, 358: 1; *Festuca lemanii* 90: 2, 99: 2, 524: +; *Pimpinella saxifraga* 519: +, 535: +, 517: +; *Campanula scheuchzeri s. lanceolata* 536: +, 358: 1, 363: +; *Laserpitium latifolium* 533: +, 361: +, 363: +; *Coincya cheiranthos* 261: +, 523: +; *Lilium martagon* 523: +, 533: +; *Helianthemum nummularium* 361: +, 377: +; *Scleranthus perennis* 524: +, 358: +; *Minuartia verna* 519: 1, 517: +; *Sempervivum arachnoideum* 520: +, 377: 1; *Avenula versicolor* 496: +, 90: +; *Dianthus seguieri s. peudocollinus* 493: +, 521: +; *Crepis conyzifolia* 90: +, 629: 1; *Myosotis alpestris* 535: +, 517: +; *Anthoxanthum odoratum* 519: +, 531: +; *Senecio doronicum* 90: +, 629: +; *Festuca billyi* 370: +, 358: +; *Dianthus gratianopolitanus* 520: 1, 380: +; *Gentianella campestris* [0] 361: +, 363: +; *Carex species* [6] 372: +, 370: +; *Bupleurum ranunculoides s. ranuncul* 520: 1, 517: +; *Lotus alpinus* 361: +, 363: +; *Pulsatilla alpina s. alba* 90: +, 99: +; *Anemone nemorosa* 518: +, 536: +; *Thymus polytrichus* 524: +, 531: 1; *Poa chaixii* 263: +, 260: +; *Viola species* 519: +, 533: +; *Rhinanthus species* 264: +, 263: +; *Mutellina adonidifolia s. mutellina* 263: +; *Luzula desvauxii* 350: 1; *Empetrum nigrum s. hermaphroditum* 350: 3; *Viola canina* 629: +; *Galium pumilum* 516: +; *Melampyrum pratense* 350: 1; *Stachys officinalis* 361: +; *Cyanus montanus* 90: +; *Genista sagittalis* 377: 2; *Rhinanthus minor* 380: +; *Calamagrostis arundinacea* 533: + ; *Rosa pendulina* 515: +; *Saxifraga granulata* 535: +; *Rhinanthus pumilus s. pumilus* 493: 1; *Valeriana tripteris* 363: 1; *Saxifraga paniculata* 517: 1; *Thalictrum minus* 260: +; *Scleranthus species* 377: 1; *Luzula sylvatica s. sylvatica* 516: +; *Trifolium species* 521: +; *Ranunculus species* 361: +; *Vaccinium vitis-idaea* 264: +; *Cerastium fontanum* 535: +; *Cynodontium bruntonii* 370: 1; *Euphrasia species* 493: +; *Euphrasia officinalis s. pratensis* 90: +; *Catabrosa aquatica* 361: +; *Alchemilla alpigena* 523: 1; *Carex umbrosa s. umbrosa* 227: +; *Cotoneaster integerrimus* 520: 2; *Botrychium lunaria* 535: 1; *Agrostis species* 358: +; *Astrantia species* 518: +; *Lycopodium clavatum* 350: +; *Hypochaeris radicata* 524: +; *Linaria repens* 377: 1; *Orobanche rapum-genistae* 533: +; *Potentilla heptaphylla s. fagineico* 533: +; *Gentiana verna* 535: +; *Plantago alpina* 512: +; *Hieracium piliferum* 516: +; *Hieracium lachenalii* 523: 1; *Galium mollugo s. mollugo* 533: +; *Leontodon hispidus* 377: +; *Antitrichia curtipendula* 520: 3; *Cephaloziella divaricata* 370: +; *Ceratodon purpureus* 370: 2; *Dicranum fuscescens* 496: 1; *Dicranum scoparium* 370: 1; *Hylocomium splendens* 350: 3, 496: 3, 531: 3; *Hypnum cupressiforme* 370: 1, 531: 1; *Nardia scalaris* 350: 1; *Pleurozium schreberi* 531: 2; *Pogonatum urnigerum* 350: +; *Polytrichastrum alpinum* 496: +, 370: +, 531: 2; *Ptilidium ciliare* 498: +; *Ptilium crista-castrensis* 350: 1; *Racomitrium lanuginosum* 496: 2; *Racomitrium species* 515: 2; *Rhytidiadelphus loreus* 350: +; *Rhytidiadelphus triquetrus* 496: +, 370: 1; *Rhytidium rugosum* 370: 1, 517: 1, 531: 3.

Tableau 6. **Groups of differential taxa. Ia et Ib : cryophilous taxa of upper subalpin bet ; II : taxa with mesophilous to mesohygrophilous character ; III : xerophilous and mesoxerophilous taxa.**

Table 7 - *Biscutello arvernensis-Arctostaphyletum uvae-ursi ass. nov.*

Association		*Biscutello arvernensis-Arctostaphyletum uvae-ursi*																						
ordinal number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
num. turboveg repository		9	8	1	1	1	1	1	1	7	5	7	1	1	8	9	8	1	5	9	9	5	8	5
grey relevés = typus		0	8	1	1	1	1	1	1	4	2	4	1	1	7	0	8	0	2	1	1	2	8	2
		3	0	1	4	3	8	5	6	7	9	6	2	7	9	1	3	8	8	3	1	6	1	5
sub-units		*typicum*													*anemonetosum sylvaticae*						*poor sub-unit*			
Agrostis rupestris All.	*D.s.ass.*				1	1	1	1	2															
Leucanthemum vulgare/delarbrei					+		+	+						+	1									
Antennaria dioica (L.) Gaertn.	*D.s.ass.*	1	1	1	2	2				+	+	+	1	+	+									
Biscutella arvernensis Jord. **I**	*C.ass.*		+	1	1	+	+	+	1	1		+		+	+									
Pulsatilla vernalis (L.) Mill.	*C.ass.*	1	1	1	1	2	+	+	+	1	+	1	+	+	1	+	+	+						
Phyteuma hemisphaericum L.		+	+	+	2	2	+	1	2	1	+	1	1	2	1	1	1	1	+		+			
Meum athamanticum Jacq.						1	+	+	+	+	+	1		+	1	+	+	+	1	+	+			
Arnica montana L.					2	1		+		+	+	+	+	+	1	+	+	+	2			+		
Anemone nemorosa L. **II**	*D.s.ass.*									+					+	+	+	+	+			+		
Scorzoneroides pyrenaica (Gouan) Holub *s. pyreaica*	*D.s.ass.*							+							+	+	+	+	1	+				
Potentilla erecta (L.) Rausch.	*D.s.ass.*														+	+	+	+						
Succisa pratensis Moench																+	+	+						
Calluna vulgaris (L.) Hull	*D.Ass.*	5	5	5	3	4	3	3	4	3	4	4	3	4	3	4	4	4	1	3	3	3	+	2
Genista pilosa L.		+	+	+	2	1	2	1	1		1	+	2	+	+	1	1	1	1	1	+	1		+
Vaccinium myrtillus L.		+	+	+	+	+		+			2	+	2	+	+	1	1	1	1	+	r	2	1	2
Deschampsia flexuosa (L.) Trin.		+	+	+	1	2	+	2	+	1	2	1	2	2	+	+	+	+	2	2	1	1	1	1
Juniperus communis s. nana (Hook.) Syme	*C.ass*	1	1	1	r	+	1	2	2	2	1	2		2	2	3	3	3	1	2	3	2	3	3
Arctostaphylos uva-ursi (L.) Spreng.	*C.ass*	2	2	2			5	5	3	3		3		4	2	+	+	+		2	3	2	4	2
Festuca nigrescens Lam.		+	+	+	+	1	2	2	2	+	1	1	+	+	1				+			1		+
Gentiana lutea L.					+	+	+	+	r	+		+			+	+	+	+		1		1		1
Carex caryophyllea Latourr.		2	2	2	2				1		1		2		1	2	2	2			+	+		
Vaccinium uliginosum/microphyllum							2			1	2	1	2	+	+				3	2		3	3	2
Nardus stricta L.		+	+	+	+	+		+							+	1	1	1						
Cetraria sp.		+		+	+	+							2	+		1		1	+					
Viola lutea s. lutea Huds			+		+	1	+					1			+		+							
Serratula tinctoria L.		+	+	+												1	+	1						
Hieracium murorum L.						+	1	+	r				+	+										
Campanula rotundifolia L.					+		+	1	+						+						r			
Cladonia sp.					+	+							2	+		+		+						
Agrostis capillaris L.		+	+	+											+									+
Festuca airoides Lam.											2								+	1	2			+
Hieracium praecox Sch.Bip.											+									+	r	+		+
Carex sp.						2	1	2						2										
Carex pilulifera L.													2		+					+	r			
Thymus pulegioides L.					+	+	+																	
Euphrasia stricta L.					1	+							+											
Cotoneaster integerrimus Medik.	*C.ass.*						+			+														1
Rosa pendulina L.										+													+	+
Hieracium sp.												+			+				+					
Alchemilla saxatilis Buser												+			+									+
Carex umbrosa Host																			1	+	r			
Pinus mugo s. uncinata (Ramond ex DC.) Domin															+						r			2
Viola saxatilis F.W.Schmidt		+														+								
Festuca paniculata (L.) Schinz & Thell. *s. paniculata*							+														r			
Carex praecox Schreb.										1		1												
Alchemilla alpina coll.							+												+					
Vaccinium vitis-idaea L.											+			+										
Viola sp.				+														+						
Molinia caerulea (L.) Moench			+																				+	
Melampyrum sylvaticum L.																						+		+

Table 7. Companions present less than 2 times:

Crocus vernus 881: +; *Maianthemum bifolium* 528: +; *Persicaria bistorta* 528: +; *Picea abies* 526: +; *Centaurea pectinata* 118: 1; *Sorbus mougeotii* 525: +; *Luzula multiflora* 525: +; *Polygala vulgaris* 114: +; *Aquilegia vulgaris* 118: +; *Sanguisorba officinalis* 528: +; *Huperzia selago* 881: +; *Pinus sylvestris* 526: 1; *Allium victorialis* 881: +; *Agrostis species* 528: +; *Thymus polytrichus* 911: 1; *Biscutella laevigata s. laevigata* 903: 1; *Thesium alpinum* 114: +. *Calamagrostis arundinacea* 118: +.

Table 7. **Groups of differential taxa. I**: xeroclinophilic subalpine orophytes; **II**: mesophilic and mesohygrophilic mountain orophytes.

Table 8 - *Centaureo pectinatae-Juniperetum nanae* Choisnet & Mulot *ass. nov.*

Association ordinal number		*Centaureo pectinatae-Juniperetum nanae*																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
num. turboveg repository		7512	7513	7511	7519	7514	7518	7516	7522	7521	7520	7517	7552	7515	7551	7526	7527	7523	7528	7524	7532	7530	7531	7525	7529	7533	882
sub-units		*vaccinietosum uliginosi*														*typicum*									*poor variant*		
Serratula tinctoria s. monticola (Boreau) Berher		+	+	+	+																						
Solidago virgaurea L.		+	+	+	+	+	+	1	+	+							+										
Meum athamanticum Jacq. **I**	*D.s.ass.*	+	+	1	+		+	1	+	+		+						+									
Carex pilulifera L.								+	1	+	+	1															
Alchemilla alpina coll.										2	+	+	+														
Vaccinium uliginosum L.	*D.s.ass.*				1		2	4	2	1	1	2	3	1	3												
Rubus idaeus L.				+	+		+	+		1				+			+								+		
Centaurea pectinata L.	*C.ass.*				1	1	1		+	+			1			2	+	+	+	1				2			
Sorbus mougeotii Soy.-Will. & Godr.	*C.ass.*					+				+						+	+	+		+	+						
Cytisus oromediterraneus Rivas Mart. & *al.*	*D.s.ass.*							+			+					+		2	1		1	2	1	3	+		
Rosa pendulina L.	*D.s.ass.*												+				+	1	+	+	+	1	1				
Lilium martagon L. **II**															+			+			+	+					
Betula pendula Roth																			1	+	+						
Polygonatum odoratum (L.) All.																				+		+	+				
Juniperus communis s.nana (Hook.) Syme	*C.ass.*	3	3	2	2	2	2	1	1	4	1	1	4	3	3	3	+	2	3	2	3	2	2		1	3	
Calamagrostis arundinacea (L.) Roth	*D.ass.*	1	1		2	1	2	2	+	+			1	1	2	+	+	+	+	+	1	1		1	+	1	1
Calluna vulgaris (L.) Hull		3	3	5	3	4	4	2	4	3	2	3	1	3	1	1		2	2	2	2	2	2	3	4	3	2
Deschampsia flexuosa (L.) Trin.		1	1	1		1	2	2	1	1	2	1	+	1	1	2	2	1	1	+	+			1	1	1	
Vaccinium myrtillus L.		2	+	1	+	1	2	3	1	2	1	2	+	1	1	2	+		2	1	2		2		1		1
Genista pilosa L.		+	+	2	1	1	2	1	3	1	2	3		+	+	1	+	1		1		2		+	+		+
Arctostaphylos uva-ursi (L.) Spreng.		3	3		2	3	2			2	4	2		4		4	5	4	2	4	4	5	3	3	3	3	5
Gentiana lutea L.		2	2	2	1		1			+			1	+	1		+				+	+		+		1	
Festuca paniculata s. paniculata (L.) Schinz & Thell.	*D.ass.*	1	1	2	3	+	3	+	1	2	+			2	1			+		+							1
Cotoneaster integerrimus Medik.	*C. ass.*	+	+	+		+	+	+			+	+	+	+	+	1		1									+
Campanula rotundifolia L.						+			+	+	+	+	+			+	+		+	+	+				+	+	
Hieracium murorum L.		+	+	+						+			+		+								+				
Festuca nigrescens Lam.		+	+																								+
Festuca airoides/filiformis									1	1	+				+												
Nardus stricta L.									1	2	2													+			
Lathyrus linifolius v. montanus (Bernh.) Bëssler						+					+										+	+					
Galium saxatile L.		+	+						+																		
Hieracium glaucinum Jord.		+	+							+																	
Potentilla erecta (L.) Rausch.				1		+			1																		
Dianthus seguieri s. peudocollinus (P.Fourn.) Jauzein								+			1	1															
Arnica montana L.				+					2					+													
Jacobaea adonidifolia (Loisel.) Mérat				1														+		+							
Thymus polytrichus A.Kern. ex Borbß							+		+												+						
Abies alba Mill.										+							+				+						
Anthoxanthum odoratum L.		+	+																								
Hypericum maculatum Crantz				+				1																			
Pinus cembra L.							+			+																	
Luzula multiflora (Ehrh.) Lej.								+		+																	
Polygonatum verticillatum (L.) All.					+													+									
Allium victorialis L.													+		1												
Teucrium scorodonia L.																			2			1					
Galium verum L.																								+	+		
Conopodium majus (Gouan) Loret			+																								
Hieracium schmidtii Tausch				+																							
Fagus sylvatica L.					1																						
Aquilegia vulgaris L.						+																					
Leucanthemum vulgare Lam.						+																					
Thesium alpinum L.						+																					
Cryptogramma crispa (L) R. Br.							+																				
Pinus sylvestris L.							2																				
Tanacetum vulgare L.									+																		
Polygala vulgaris L.									+																		
Lotus corniculatus L.									+																		
Succisa pratensis Moench									+																		
Poa chaixii Vill.										+																	
Valeriana tripteris L.													+														
Phyteuma hemisphaericum L.															+												
Corylus avellana L.																	+										
Prenanthes purpurea L.																	+										
Sorbus aucuparia L.																	+										
Rhamnus alpina (L.) W. Vent																						+					
Laserpitium latifolium L.																						+					
Amelanchier ovalis Medik.																						2					
Lonicera alpigena L.																						1					
Thymus pulegioides L.																						1					
Festuca ovina coll.																							1				

Tableau 8. Groups of differential taxa. **I** : lawns and heathlands, montane and subalpine taxa ; **II** : taxa of montane hems and schrub-coats.

Table 9 - *Phyteumo hemisphaerici-Callunetum vulgaris ass. nov.*

Association		*Phyteumo hemisphaerici-Callunetum vulgaris*																														
ordinal number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
num. turboveg repository		6	6	9	6	9	9	9	9	5	5	6	5	5	5	6	6	6	6	6	5	5	6	6	9	9	9	6	6	6	6	6	6
grey relevé = *typus*		1	0	7	2	8	7	9	9	9	9	0	9	9	9	2	0	2	0	0	9	9	0	1	7	9	8	0	0	2	1	0	0
		4	6	7	7	9	6	1	0	2	5	0	8	1	4	1	4	2	1	2	7	6	7	0	8	2	0	8	9	8	3	3	5
Variants		v. à *Juncus trifidus*					typical variant																				*Sesamoides pygmaea* v.						
Juncus trifidus L.	*C.ass.*	+	1	3	2	1	+																								+		
Luzula campestris (L.) DC.						1	+	+	r																								
Lotus corniculatus L.							+	+	r				+												r							
Agrostis capillaris L. **I**							+	+	+																	1						
Viola canina L.							+		+															r								
Arnica montana L. **II**	*D.ass.*		+					+					+	1	+	1	+	+							1								
Festuca billyi Kerguelen & Plonka		+								1			+	1	+	1	r	1	+									r	+				
Nardus stricta L.	*D.var.*								1	1	+	1	1	1				+	+	+	1			+		+							
Trifolium alpinum L.	*D.var.*							1		2	1		1	+		+	+			2	2		1		+							1	+
Vaccinium vitis-idaea L. **III**	*D.ass.*									1	2	1	2	2	+							2					1		+	+			
Sesamoides pygmaea (Scheele) Kuntze	*C.ass.*																											1	1	+	1	1	+
Euphrasia cf. micrantha Rchb.	*C.ass.*																1														+	1	1
Calluna vulgaris (L.) Hull	*D.ass.*	+	5	3	2	+	2	4	3	2	+	1	4	4	4	+	4	4		1	4	3	3	4	3	4	1	4	4	3	2	4	3
Festuca airoides Lam.	*C.ass.*		+	2	2	2	2	2	2	1	+	1	2	+	1		1	+	2		1	1	3	1	1	2	2	+	+	1	1	1	1
Genista pilosa L.			1	1	3	+	2	2	2	2		+	+	+			+	1	1	+		2	+		3	+	2		+		+		1
Antennaria dioica (L.) Gaertn.	*D.ass.*			+	1			1	2	1	+		+	2	1	+	+	+	+		1	2	2	1	1	+	2	2	+	+			
Vaccinium myrtillus L.		2	+	1	1	4	3		2	1	3	1	1	2		4	+			4	+	+		+	1	1			+	+			
Deschampsia flexuosa (L.) Trin.		2		1	1	+	2	+	1	1	2	+	+	2		2		+		2	+	+			1	1	+				+		
Alchemilla saxatilis Buser		+			+	1			2	3	1	1	2	2	+	1		+	2		2	2	+	r		2	2	+				+	
Carex caryophyllea Latourr.			+	1	1	1	2	1	2	2	2	2	1	2	+	1		+	2	2	2	+		+	2	2						
Hieracium schmidtii Tausch	*C.ass.*	+	+	+	+		+		2				1	1	1	1	+	1		1			2	1				1	1	+	1	+	+
Phyteuma hemisphaericum L.	*C.ass.*	+		+	1			1	1		+		+				+	1	+		+	1	+		r	+				+	+	+	+
Vaccinium uliginosum L. *s. microphyllum*		3	1			1	1				3	4	1		+	1			2	1	+	+	1	+							+	+
Luzula spicata (L.) DC.				+	+	r					+			+	+						+	+	+					+	+		+	+
Pinus sylvestris L.												+	+	+	2														1		+	+	+
Scorzoneroides pyrenaica (Gouan) Holub				1				1	+											2					+	+						
Jasione laevis Lam.										+					+			+		+										1		+
Plantago holosteum Scop. *s. holosteum*	*D.ass.*			+				+	1	+										+				1			1					
Juniperus communis s. nana (Hook.) Syme	*D.ass.*	1	2														2		2											1			
Alchemilla transiens (Buser) Buser				1		1	1													1					+							
Anthoxanthum odoratum L.					+			+		1								+											+			
Agrostis rupestris All.				+					1	2	+											+										
Festuca nigrescens Lam.						+	+			1		+														1							
Sorbus aucuparia L.			+			r	r																		r								
Euphrasia sp.				+					1	+																						
Galium saxatile L.						1				+																r						
Rumex acetosella L.															+			+						1								
Pinus mugo s. uncinata (Ramond ex DC.) Domin														+	1		+															

Tableau 9. Companions species occurrence less than 3:
Luzula nivea 977: +, 989: 1; *Anemone nemorosa* 976: r, 990: r; *Carex pilulifera* 990: +, 991: 1; *Linaria repens* 603: +, 613: +; *Festuca paniculata s. paniculata* 989: +, 622: +; *Melampyrum pratense* 614: +, 602: 1; *Luzula multiflora* 977: +, 600: +; *Thymus polytrichus s. britannicus* 596: +, 597: +; *Cytisus oromediterraneus* [6] 613: +, 622: +; *Thymus polytrichus s. polytrichus* [6] 990: r, 991: +; *Hieracium praecox* 991: +, 992: 1; *Thymus species* 628: +, 592: +; *Hieracium pilosella* 991: 1, 594: +; *Cerastium arvense* 976: r; *Allium lusitanicum* 622: +; *Cerastium fontanum* 991: +; *Hypochaeris maculata* 991: +; *Festuca rubra s. rubra* 602: 1; *Juniperus communis s. communis* 980: 1; *Thymus pulegioides s. pulegioides* 627: 1; *Rosa pendulina* 614: 2; *Persicaria bistorta* 602: +; *Gentiana lutea* 614: +; *Epikeros pyrenaeus* 602: 1; *Euphrasia officinalis s. pratensis* 627: 1; *Dianthus hyssopifolius* 977: +; *Luzula sylvatica s. sylvatica* 614: 1; *Pulsatilla vernalis* 596: 1; *Galium mollugo s. erectum* 976: 1; *Succisa pratensis* 976: r; *Pinus species* 628: +; *Festuca arvernensis s. costei* 989: +; *Valeriana tripteris* 614: +; *Festuca ovina* 592: 2; *Veronica officinalis* 989: +; *Serratula tinctoria* 976: 1; *Polygonatum verticillatum* 614: 1; *Serratula tinctoria s. monticola* 622: 1; *Campanula rotundifolia* 992: +; *Meum athamanticum* 991: +; *Molopospermum peloponnesiacum* 614: +; *Galium pumilum* 976: +.

Tableau 9. **Groups of differential taxa. I : oligotrophilous mesophilous indifferent to altitude ; II : orophytes oligotrophilous méesophilous (*Nardetalia*) ; III orophytes with a xerophilous character.**

Table 10 - *Vaccinio vitis-idaeae-Genistetum pilosae ass. nov.*

Association		*Vaccinio vitis-idaeae-Genistetum pilosae*																																																						
ordinal number		1	2	3	4	5	6	7	8	9	38	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	24	27	28	29	30	31	32	33	34	35	36	37	39	51	52	44	40	41	42	43	45	46	47	48	49	50	53	54	55	56
num. turboveg repository		8	6	6	6	8	8	3	8	9	6	8	6	3	6	6	6	6	3	3	3	3	6	4	4	4	4	4	9	9	9	6	9	6	4	6	9	9	6	9	9	9	9	6	5	5	6	8	5	5	9	9	9	6	9	7	6
grey relevés = *typus*		5	1	5	1	9	9	2	9	0	2	5	5	0	5	5	5	5	3	3	3	3	3	5	5	5	5	5	9	8	7	3	8	1	8	2	7	7	2	8	8	8	9	1	9	9	2	4	8	9	8	7	8	5	0	4	1
		7	6	7	7	2	9	9	0	0	0	1	3	3	6	5	2	4	3	0	2	1	5	3	4	5	7	6	5	7	9	9	1	8	2	4	5	3	3	3	4	8	4	5	0	3	6	2	9	9	2	4	5	1	5	4	2
Subassociations		*cytisetosum oromediterranei*																						*typicum*																					*meetosum athamantici*												
Variants		*Galium verum v.*							typical variant															*Potentilla erecta v.*					typical variant																typical variant									*Hieracium pilosella v.*			
Genista sagittalis L.		1	1	+																																	+													+							
Sorbus aria (L.) Crantz		1	2		1	+	+	+																								1							+																		
Galium verum L. I		1	+	+	+	+	+		+	r	+	1																												+													2	1			
Cytisus oromediterraneus Rivas Mart. & *al.*	D.s.ass.	1	+	+	1	+	+	1	+		1	1	2		+		2	+	1	2	1		+																								+	+									1									
Jacobaea adonidifolia (Loisel.) Mérat						1	1		+	r				+						+	1	1																													+							+	+	
Carex pilulifera L.														+	2							2	1		1	2	1	1	1	+														+									1						
Festuca filiformis Pourr. II						1																		1	1	1	+		1																													
Potentilla erecta (L.) Rausch.																								1	1	+	1	+																								+					
Nardus stricta L.														2				3	+			1					2	+	2	1											+	+	r				2	1	1	2	1	1				+	1	+	
Arnica montana L.																								1												+			+	+	r		1	1	2	+	1		2	+	+	+	+	1	+		
Persicaria bistorta (L.) Samp.	D.s.ass.															1	+																							2	1	2			1	+			+	+	1	1	2				
Dianthus seguieri s. peudocollinus (P.F.) Jauzein												1																			1						+	+					+			1		+	+	+	2	+					
Serratula tinctoria L. III	D.s.ass.				1																																							+	+		3	+	+	+	r	1					
Meum athamanticum Jacq.	D.s.ass.		+		+			1							+																											+				+	+		+	+		2	+	+		
Achillea millefolium L.					+	+	+																																															r	r	+	+	+	+
Hieracium pilosella L. IV																		1										+																					+					1	+	+	
Leucanthemum vulgare var.																																																						+		+	+
Vaccinium myrtillus L.		1	2	+	2	3	3	4	3	3	2	1	3	+	1	3	4	r	4	3	3	3	1	2	2	2	1	3		1	3	3	3	4	1	3	3	3	2	3	3	3	2	3	1	4	2	2	2		3	3	4	+	+	1	4
Calluna vulgaris (L.) Hull		1	3	5	3	3	3		4	4		1	5	4	5	3	4	5	1	2	1		3	4	4	4	5	4	3	5	3	2	4		4	2	3	3	3	4	4		4	4	2		1	2	4	+	3	2		4	4	5	
Deschampsia flexuosa (L.) Trin.			1	1	2	+	+	2	1	1	1	1				1		2	2	2		2	1	2	1		2	+		1	1	4	1	1	1	2	2	+	+	2	2	2	1		2	2	2	1	+	2	2	2	2		+		+
Genista pilosa L.		1	2	2	3	3	3	2	3	3	2			2	2	3		3	2	1	2	2	1	3		2	2	1	2	2	2	+			2	+	2		2		2	+	2	1			2	1		2	2	2		+	1	2	1
Carex caryophyllea Latourr.					+	+	+				1																			1	+		+	1	1		1	2	1	1	+	1		+	3	2	1		2	1	1	+	1	1	+	+	
Festuca airoides Lam.	D.ass.		1		+									2					2	2	2	2							2	1	1		1	+			1	2	+	1	2	+	+	1	2	+	1		2	1	1	1		1			
Galium saxatile L.	C.ass.		+	1					+						1						1	1		1	1	+	2	+				2			1	+			+			1	+	1		+					+	r	+	+	+		
Alchemilla saxatilis Buser				+		+	+		+				1		+	+		1											r	r				+	1						r	2		+		+			1	+			1	+	1	+	+
Vaccinium vitis-idaea L.	C.ass.		1	1	1											+	2	2	+							3	2					2	3	2		2		2	2					2	2	4	3				2	2	2					
Luzula campestris (L.) DC.																			1	1	1	1	1				+	+	1	+	+										+	r	+	+							+	r	+		+	+	
Festuca nigrescens Lam.			1		1				+																	+	+	+								1	1		1	1	+	+	1							1	1						
Genista anglica L.	D.ass.			2									3				+	2					+			+		2	2											1	1									1					3		
Scorzoneroides pyrenaica (Gouan) Holub							+		+															+			1	+		r						+				1	1	1										r			+		
Agrostis capillaris L.								1			+									1								+	r			1		+					+									+		+					1		1
Festuca billyi Kerguelen & Plonka			+	2	+						4				1	2		2																		2	1			+				+					+					+			1
Juniperus communis L. *s. communis*		1	+	+	1					+			+													+		+				2								1				+				1								1	
Anthoxanthum odoratum L.																				1			1		1												+		1	+								+				+		+		r			+	+
Pinus sylvestris L.																		+					1	1	+		+		1	2		3		1	1							+												+			
Antennaria dioica (L.) Gaertn.													1					+		+								+															+		+	+				1	+				+		+	
Hieracium praecox Sch.Bip.																				+									r	+								r		+	+	2	1								+	+	+				
Campanula rotundifolia L.										+																							+	+							r				+	+	+	+		+				+			
Poa chaixii Vill.		1	+		+												+																															+				1			+		1
Sorbus aucuparia L.					+	+	+		+																						+			2		3															+						
Anemone nemorosa L.													1		+	+	3								+																	+							+			+					
Jasione laevis L.																												1					1								+			+				+	+				+			+
Luzula multiflora (Ehrh.) Lej.									+	1								+								+										1	+																					
Hieracium schmidtii Tausch											+																			+				+										+					+					r			+
Stellaria holostea L.		1	1		2												1								1																		1								1						
Viola canina L.					+									1														+						+																			+			+	
Hypochaeris maculata L.	C.ass.					+	+																																																+	+	
Crepis conyzifolia (Gouan) A.Kern.			+																														+													+		1					+			+
Plantago holosteum Scop.											+			1						1														2																						+	
Solidago virgaurea L. s. virgaurea																												r													r	+									+					2
Festuca rubra coll.								1														1																																	+		
Lathyrus linifolius s. montanus (Bernh.) Bëssler			+																					1																												2			+	
Cerastium arvense L.																		+																				r		+													r				
Maianthemum bifolium (L.) F.W.Schmidt								1																								2		+																		1					
Rumex acetosella L.																				1	1																												+					+			
Alchemilla alpina coll.		1								+		2																																													
Succisa pratensis Moench																														+							+															+					
Veronica officinalis L.													1												+																												+			
Luzula nivea (L.) DC.																																			+			+										+								
Lilium martagon L.		+			1																																											+			+					
Trifolium alpinum L.																		+																												+				1							
Alchemilla transiens (Buser) Buser													1								1																																1				
Pinus mugo s. uncinata (Ramond ex DC.) Domin			1																																									+				1								
Luzula spicata (L.) DC.																		+											+																										+	
Festuca ovina coll.		1										1																										1																		
Rumex acetosa L.																																										r											+				+
Rubus idaeus L.								1													1	2																																		
Hieracium umbellatum L.						+	+																	1																																		
Hieracium murorum L.																											+																											+		

Table10. Companions species occurrence less than 3:

Thymus pulegioides 454: 1, 620: 1; *Galium pumilum* 654: 1, 454: 1; *Ranunculus tuberosus* 842: +, 744: +; *Cerastium pumilum* 330: 1, 331: 1; *Lotus corniculatus* 635: 1, 651: +; *Melampyrum pratense* 639: 2, 988: 1; *Festuca paniculata s. paniculata* 851: 1, 626: +; *Juniperus communis s. nana* 857: 3, 890: +; *Cotoneaster integerrimus* 857: 1, 851: 2; *Calamagrostis arundinacea* 851: 1, 457: +; *Cytisus scoparius s. scoparius* 657: 1, 656: +; *Hieracium lactucella* 890: +, 900: r; *Hieracium species* 482: 1, 884: +; *Agrostis stolonifera* 454: 1, 612: 1; *Dianthus hyssopifolius s. hyssopifolius* 617: +, 612: 1; *Festuca rubra s. rubra* 974: +, 985: 2; *Linaria repens* 332: 1, 599: +; *Allium lusitanicum* 620: +, 626: +; *Vaccinium uliginosum* 329: 1, 612: 1; *Fagus sylvatica* 616: 2, 624: 2; *Plantago subulata* 905: +, 129: +; *Cytisus decumbens* 457: +; *Thesium alpinum* 988: r; *Campanula scheuchzeri s. lanceolata* 482: +; *Solidago virgaurea s. alpestris* 851: +; *Polygonatum verticillatum* 982: 1; *Silene vulgaris* 616: +; *Rosa pendulina* 329: 1; *Anemone species* 656: 1; *Salix aurita* 639: +; *Avenula pubescens* 985: 1; *Saxifraga granulata* 744: +; *Scorzoneroides autumnalis* 842: +; *Scorzonera humilis* 984: r; *Valeriana tripteris* 857: 1; *Agrostis species* 589: +; *Viola lutea s. lutea* 842: +; *Abies alba* 623: +; *Tulipa sylvestris s. australis* 652: +; *Thymus polytrichus s. britannicus* 651: +; *Teesdalia nudicaulis* 333: 1; *Cerastium fontanum* 651: +; *Thymus praecox* 303: 1; *Hylotelephium telephium* 851: 1; *Thymus serpyllum coll.* 744: +; *Festuca species* 899: 1; *Carlina vulgaris* 329: 1; *Molinia caerulea* 453: +; *Agrostis rupestris* 589: +; *Diphasiastrum tristachyum* 635: 2; *Gentiana lutea* 842: +; *Juncus squarrosus* 995: +; *Picea abies* 995: +; *Cuscuta species* 612: 1; *Hieracium lachenalii* [453: +; *Centaurea jacea s. nigra* 985: +; *Potentilla heptaphylla s. fagineico* 985: +; *Potentilla neumanniana* 744: +; *Euphrasia officinalis s. pratensis* 599: +; *Conopodium majus* 890: +; *Polygala vulgaris* 744: +; *Plantago alpina* 654: + ; *Danthonia decumbens* 905 : +.

Table 10. **Groups of differential taxa. I : thermophilouss mesoxerophilous ; II : lawn mesophilous oligotrophilous ; III : mesophilous and oligomesotrophilous ; IV : mesoxerophilous.**

Table 11 - *Teucrio scorodoniae-Callunetum vulgaris* (R. Michalet, Coquillard & Gueugnot) *stat.nov.*

Association		*Teucrio scorodoniae-Callunetum vulgaris*																																
ordinal number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	20	22	23	24	25	26	27	28	29	30	31	32	33	34	35
num. turboveg repository		8	8	8	3	8	8	8	8	8	5	5	6	8	8	8	8	5	5	5	0	5	5	5	5	5	5	0	0	0	0	0	0	0	0	0
grey relevés = *typus*		1	0	2	6	0	2	1	2	1	5	7	4	4	4	3	3	7	4	4	6	5	6	4	5	4	5	8	8	3	3	3	4	3	3	4
		8	9	1	5	8	7	9	6	3	9	7	1	7	5	2	1	2	1	2	3	0	9	7	8	8	2	1	2	2	5	1	1	8	9	0
subassociations		*juniperetosum communis*									*typicum*																									
variants											poor variant							v.PdD			typical v.														
Genista sagittalis L.	*D.s.ass.*	+		+						1																										
Cytisus oromediterraneus Rivas-Mart. *et al.*	*D.s.ass.*		2	2					+																										
Rumex acetosella L.		1			+	+		+					1																						
Juniperus communis L. *s. communis*	*D.s.ass.*	1	1			+	2	+	1	1				1																						
Thymus pulegioides L.	I		1	1				+	+														+								1	+			
Sedum rupestre L.	*D.s.ass.*				+		+		+																										
Hieracium praecox Sch.Bip.							+	+	+	+	1	+						1					+												
Hieracium pilosella L.					+			+	+	+		+									3		1										+		
Vaccinium myrtillus L.	II	*D.s.ass.*									4	2	3	2	2	1	4	1	1	1	+	2	1	1	+	1	1	+	+							
Brachypodium pinnatum (L.) P.Beauv.		*D.ass.*				+	+													1	+	+	+	1	2	1	1					3				
Agrostis capillaris L.			1																			+	+	1	2	1	+						+	+	
Corylus avellana L.	III	*D.s.ass.*									2				1							2	1	1	+	1	1		+	+		+	+	+	+	+
Hieracium murorum L.																					+	+					+	+	1	1	+	1	+	+	+	
Viola canina L.			+											+															+	+		1	+	1	+	+
Calamagrostis arundinacea (L.) Roth		*D.s.ass.*																	1	1										1	+	+	+	+		+
Scorzoneroides pyrenaica (Gouan) Holub																		+												+	+	+	+	4	2	
Fagus sylvatica L.	II																										1					+	+		+	+
Calluna vulgaris (L.) Hull			3	3	4	3	3	4	4	3	3		3	3	4	4	4	1	3		1	3	4	4	1	4	1	5	1	4	4	1	2	3	3	4	+
Genista pilosa L.			2	1		3	1	1	1	3	3		1	3	2	1	2		2	1		+	3	1	1	2	1	2	+	1	1	+	2	1	3	3	+
Deschampsia flexuosa (L.) Trin.				1	1	2	1	1		1	1	2	2	2	1	+	+		2	1	1	+	1	2	1	2		1	+	2	2	+	2	1	2	3	+
Teucrium scorodonia L.		*C.ass.*			+		+	1	+	+	1	1	1			+	1			1			1	+			1	+		+			+	2	+	2	
Campanula rotundifolia L.				+				+		+		+							1	1	1	+		1	1			+	+	+	+	+	+	+	+		+
Pinus sylvestris L.		*D.ass.*				3	1	1	+	1	1												+				1		+	+	+	+	+	3	+	+	
Sorbus aria (L.) Crantz							+	+		1			2	1		1		1		1						1	1		+	+		+	+	+	+	
Cytisus scoparius (L.) Link		*D.ass.*	1	2	1		3	1								1	1								2	1	1	+	+	+	+	+				
Anthoxanthum odoratum L.					+	2			+				+			1							2	1		1	+	+							
Jacobaea adonidifolia (Loisel.) Mérat			1		+														1		1			1	+			+	1			+	+		
Linaria repens (L.) Mill.				+					+						+					1	1	+		1		1									
Festuca filiformis Pourr.		*D.ass.*				2	1		1																+							+	+	+		
Carex pilulifera L.				1	+			+							+										+							+	+		
Sorbus aucuparia L.		*D.s.ass.*															2		1						2	1							+	+	+	
Picea abies (L.) H.Karst.						+					2												+									+	+	+	
Galium saxatile L.								1						1	1		1																+	+		
Festuca rubra coll.					+										+							+					+						+	+		
Gentiana lutea L.		*D.s.ass.*											2					+	1						2								+	+		
Betula pendula Roth							+		+								1					1			1		1									
Dianthus hyssopifolius L. *s. hyssopifolius*												+						+						1		1			+		+				
Silene nutans L.		*C.ass.*					+		1	+			+					+								1										
Solidago virgaurea L.													+	+				+		1												+				+
Potentilla erecta (L.) Rausch.														1	1	1									+								1	+		
Rubus idaeus L.																			1			1					1							+	1	+
Quercus robur L.						+			+																2							+	+			
Luzula campestris (L.) DC.			+				+			+			1									+														
Festuca lemanii Bastard												1						2				2					+					+				
Achillea millefolium L.							+												1	1					+								+			
Salix caprea L.																						2		1			1						+	+		
Festuca sp.		1		+					1	+																										
Digitalis purpurea L.									+										1	1													+			
Alchemilla alpina coll.									1									1															+		+	
Stachys officinalis (L.) Trévis.																+						+		1								+			
Nardus stricta L.		+															1																+			+
Antennaria dioica (L.) Gaertn.																					+								+			+	+		
Galium pumilum Murray				1	+																												+			
Quercus petraea Liebl.							+	+														+														
Cotoneaster integerrimus Medik.	*D.var.*																	2	1	1																
Jasione laevis Lam.												+									+								+						
Helianthemum nummularium (L.) Mill.			1																				+		1										
Festuca ovina coll.																			1	1						1										
Danthonia decumbens (L.) DC.																					1								+				+			
Hypericum pulchrum L.																														+		+	1			

Table 11. Companions species occurrence less than 3:
Betula pubescens 39: +, 41: +; *Senecio ovatus* 550: +, 552: +; *Festuca rubra coll* 35: +, 39: +; *Jasione montana* 818: +, 826: +; *Silene vulgaris* 827: +, 558: +; *Pteridium aquilinum* 832: 2, 831: 1; *Carex caryophyllea* 818: +, 63: 2; *Veronica officinalis* 31: +, 41: +; *Carlina vulgaris* 365: +, 40: +; *Polygala serpyllifolia* 39: +, 41: +; *Micropyrum tenellum* 819: +, 826: +; *Euphorbia cyparissias* 542: 1, 541: 1; *Viola lutea s. lutea* 832: +, 38: +; *Epilobium angustifolium* 808: +, 559: +; *Senecio viscosus* 819: +, 813: +; *Centaurea jacea* 41: +; *Pleurozium schreberi* 559: 2; *Polypodium vulgare* 831: 1; *Polygala vulgaris* 813: +; *Galium verum* 847: +; *Prenanthes purpurea* 559: 1; *Thesium alpinum* 577: 1; *Aira caryophyllea* 818: +; *Potentilla recta* 547: 1; *Taraxacum laevigatum* 40: +; *Vicia orobus* 832: +; *Tussilago farfara* 40: +; *Scleranthus perennis* 826: +; *Rubus species* 559: 1; *Rubus hirtus* 831: +; *Rumex acetosa* 31: +; *Hypochaeris maculata* 827: +; *Avenula pratensis s. pratensis* 38: +; *Dianthus seguieri s. peudocollinus* 558: 1; *Amelanchier ovalis* 826: +; *Arnica montana* 845: 1; *Astrantia major* 39: +; *Fraxinus excelsior* 548: 1; *Aira praecox* 818: +; *Galeopsis tetrahit* 808: +; *Dianthus deltoides* 821: +; *Cirsium vulgare* 63: +; *Cirsium arvense* 39: +; *Carex species* 641: 2; *Erythronium dens-canis* 832: +; *Dianthus species* 82: +; *Lotus corniculatus* 813: +; *Linaria vulgaris* 82: +; *Hypericum maculatum* 847: +; *Luzula multiflora* 31: +; *Dianthus seguieri s. pseudocollinus* 40: +; *Meum athamanticum* 847: +; *Maianthemum bifolium* 38: +; *Hieracium umbellatum* 572: +; *Hieracium species* 547: 1; *Goodyera repens* 365: +; *Hieracium prenanthoides* 40: +; *Jasione species* 82: +; *Ilex aquifolium* 831: 1; *Hypochaeris radicata* 365: +.

Table 11. **Groups of differencial taxa. I : taxons mesoxerophilous to xerophilous and with a thermophilous character ; II : montane taxa ; III : mesophilous taxa of hems and forest edges.**