Reasoned Inventory of the Lichens and Lichenicolous Fungi of the Cascades of Mortain (department of Manche, 50)

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Abstract
The authors present the results of the lichenological inventory of the natural site of the Cascades of Mortain in the department of Manche. The lichen vegetation is briefly described; a list of 263 taxa is given, from which are extracted 24 species of interest in French flora. *Anisomeridium biforme* (Borrer) RC Harris (not a very common species in France), *Arctomia incurva* (Pers.) Hale (fairly rare species in France), *Arthonia graphidicola* Coppins (fifth French site), *Arthothelium ruanum* (Massal.) Körb. (rare in France), *Bactrospora patellarioides* (Nyl .) Almq. (rare in France), *Buellia griseovirens* (Turner and Borrer ex Sm.) Almb. (fairly common in the mountains), *Chaenotheca phaeocephala* (Turner) Th Fr (rare at hill level), *Cresponea premna* (Ach.) Egea and Torrente var. *premna* (not very common in France), *Enterographa elaborata* (Lyell ex Leight.) Coppins & P. James (rare in France), *Enterographa hutchinsiae* (Leighton) Massal. (rare in France), *Hydropunctaria rheitrophila* (Zsch.) Keller, and Gueidan Thus (fairly rare), *Lecania hyalina* (Fr.) R. Sant. (not very common in France), *Lecanora jamesii* JR Laundon (rare in France), *Mycoblastus caesius* (Coppins & P. James) Tønsberg (known only in Lower Normandy), *Opegrapha ochrocheila* Nyl. (known in three French departments), *Placynthium flabellosum* (Tuck.) Zahlbr. (distribution in France very poorly understood because of confusion with *Placynthium rosulans* (Th Fr) Zahlbr.) *Porina ahlesiana* (Körb.) Zahlbr. (very rare in France), *Porina guentheri* (Flot.) Zahlbr. (rare in France), *Punctelia Reddenda* (Stirt.) Krog (very rare in France), *Pycnothelia papillaria* (Ehrh.) Duf. (not common in France), *Pyrenula chlorospila* (Nyl.) Arnold (fairly rare), *Pyrrhospora cinnabarina* (Sommerf.) Choisy (known in four French departments), *Ramonia subsphaeroides* (Tav.) Vezda (rare, new to northern France), *Strigula ziziphi* (A. Massal.) Cl Roux and Serusi. (new to northern France).

The authors highlight the risks of environmental damage to the wealth of lichens, suggest some avenues for preservation of their environment, and finally highlight the uniqueness, in the eyes of other French regions, of the site as a plain.

Résumé

Les auteurs présentent les résultats de l'inventaire lichénologique du site naturel des Cascades de Mortain dans le département de la Manche. La végétation lichénique est sommairement décrite, une liste de 263 taxons est donnée dont sont extraits 24 espèces intéressantes pour la flore Française. *Anisomeridium biforme* (Borrer) RC Harris, *Arctomia incurva* (Pers.) Hale, *Arthonia graphidicola* Coppins, *Arthothelium ruanum* (Massal.) Körb., *Bactrospora patellarioides* (Nyl .) Almq., *Buellia griseovirens* (Turner and Borrer ex Sm.) Almb., *Chaenotheca phaeocephala* (Turner) Th. Fr., *Cresponea premna* (Ach.) Egea and Torrente var. *premna*, *Enterographa elaborata* (Lyell ex Leight.) Coppins & P. James, *Enterographa hutchinsiae* (Leighton) Massal., *Hydropunctaria rheitrophila* (Zsch.) Keller, and Gueidan Thus, *Lecania hyalina* (Fr.) R. Sant., *Lecanora jamesii* JR Laundon, *Mycoblastus caesius* (Coppins & P. James) Tønsberg, *Opegrapha ochrocheila* Nyl., *Placynthium flabellosum* (Tuck.) Zahlbr. (Répartition française mal connue par suite d'une confusion avec *Placynthium rosulans* (Th Fr) Zahlbr.) *Porina ahlesiana* (Körb.) Zahlbr., *Porina guentheri* (Flot.) Zahlbr., *Punctelia Reddenda* (Stirt.) Krog, *Pycnothelia papillaria* (Ehrh.) Duf., *Pyrenula chlorospila* (Nyl.) Arnold, *Pyrrhospora cinnabarina* (Sommerf.) Choisy, *Ramonia subsphaeroides* (Tav.) Vezda, *Strigula ziziphi* (A. Massal.) Cl Roux and Serusi.

Les auteurs mettent en évidence les risques environnementaux de dégradation de la richesse lichénique, proposent quelques pistes de préservation des milieux et enfin mettent en évidence la singularité du site pour une station de plaine au regard des autres régions françaises.

Introduction

During the period from 7 to 11 July 2008, the Cascades of Mortain nature site (a Sensitive Natural Area of the department of Manche, in the communities of Mortain, Le Neufbourg and Romagny) was the object of lichenological study, with the aim of preparing a reasoned inventory of the lichens and lichenicolous fungi at the site.

Sixty-two surveys were completed; including 17 surveys conducted on bedrock subject to flooding by water courses, 17 on non-flooding bedrock, 27 on tree bark, twigs and dead wood and finally 1 survey on bryophytes or on the ground.

A lichen inventory was welcome since no publication to date had been devoted to this area of great potential.

Methodology

Eight sites within the domain **(Figure 1)** were systematically studied. Once the samplings were completed and after taking note of the species identified in the field, all the collected samples were carefully studied in the laboratory to determine all the species present on the media.

The laboratory determinations were performed using a binocular loupe (magnification 6x to 50x), a transmission microscope equipped with an interference contrast device (magnification 60x to 1500x), the usual chemical reagents [K (aqueous solution of potassium hydroxide 20%), C (aqueous solution of sodium hypochlorite: commercial concentrated solution diluted twice), N (aqueous solution of nitric acid at 50%), I (Lugol's iodine solution), P (paraphenylenediamine: freshly prepared alcohol solution)].

In addition to lichens, non lichenised lichenicolous fungi encountered during the laboratory examinations and non lichenised non lichenicolous fungi usually mentioned in lichenology works were determined. The works used for the determination are cited in the bibliography. Lichens of the genus *Lepraria* were not determined, as this requires chemical analysis by thin layer chromatography, which was not possible in the context of this work.

The relational database: *Lichens and Lichenicolous Fungi of France* (Roux et al., 2009 version) which includes not only lichens but also the non lichenised lichenicolous fungi and non lichenised non lichenicolous fungi usually treated by lichenologists, was used for updates to the nomenclature of the species. For some species, comparisons with voucher specimens kept in the Des Abbayes lichen herbarium (REN-ABB), were very useful for identification purposes (see http://lslp.univ-rennes1.fr/herbier/index.html ; contact : Prof. Joel Boustie, Faculty of Pharmaceutical Sciences and Biology, University of Rennes 1).

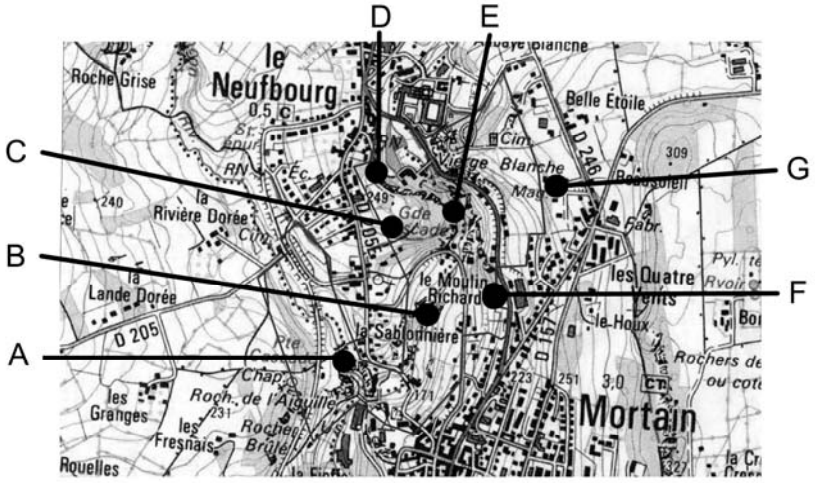

Fig. 1 : Geographical location of sites prospected.

General features of the site

1 - Location

The study site is located in the communities of Mortain, Romagny and Le Neufbourg in the south of the department of Manche (50) in Lower Normandy, in the natural region of the Mortainais (**Figures 2a et b**).

Fig. 2a et b - Natural regions of Normandy.

2 - Climate

The meteorological station of Saint-Hilaire-du-Harcouët, located about 15km to the south-west, is the nearest to the study site.

The Mortain region is known to be one of the rainiest of Normandy (**Figure 3**) where the annual mean reaches 1300 mm / year (wet ombroclimate according to Géhu et al., 1984).

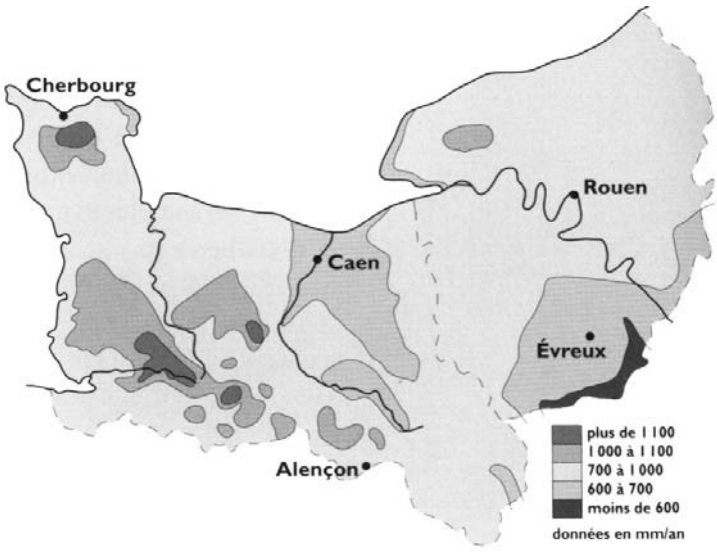

Fig. 3 - Precipitation in Normandy by height classes according to Guerin (2003).

Clouds coming from the Channel precipitate as rain at the relief formed by the hills of Mount Signal, which culminates at 368 metres. This rainfall appears particularly remarkable for a lowland station in France.

The maritime influence generates mild temperatures with a low amplitude between the winter and summer months. Periods of frost are rare.

The ombrothermic Gaussen diagram (**Figure 4**) is characteristic of a temperate oceanic climate. It shows no period of water shortage, because of the quantity and relatively homogeneous distribution of the rainfall as well as the low summer temperatures. The average temperature T is 10.5°C; the average of the minima of the 3 coldest months is 1.5°C; the average of the maxima of the three coldest months is 8.5°C. These characteristics correspond, according to Géhu et al. (1984), to the Atlantic hill level.

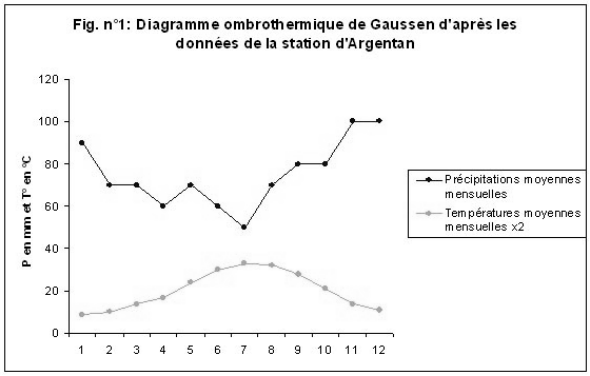

Fig. 4 - Ombrothermic diagramme (Saint-Hilaire-du-Harcouët station).

These regional climatic features are accentuated on the site by the topography, the vegetation and water system (**Figure 5**). Thus, in the wooded ravines around the waterfalls, the humidity is very high and the temperature variations are buffered by the containment.

On rocky ridges, microclimatic conditions are instead modified by their significant exposure to wind and sunlight, particularly in terms of changes in humidity and temperature.

Fig. 5 : Ravine of the great waterfall.

3 - Topography

The area of Mortain is situated in the most rugged area of the department of Manche culminating in the Signal St. Martin of Chaulieu at 368 metres. The highest point is around 250 metres on the heights of Mortain and Le Neufbourg reaching a minimum at the level of the river Cance of approximately 170 metres. The difference in elevation is approximately 80 metres which is significant for a site located in the plains.

This unique geomorphological configuration results in the presence of steep slopes and large rocky outcrops (**Figure 6**).

Fig. 6 : Rocky outcrops.

4 - Geology

The Mortainais is located in the northeastern Armorican Massif. The area of the Cascades of Mortain is a zone of complex fracture, the gorge of Mortain is dominated by contours due to Armorican sandstone. The Cance cuts a gorge through a slab of sandstone and intersects several layers by waterfall: the Petite Cascade downstream and the Grande Cascade upstream.

The study area is largely dominated by sandstone, including rocky outcrops. The presence of granite at the bottom of the gorge is not directly visible but is reflected in the presence of more neutrophilic forest communities downstream of the site.

5 - Phanerogamic Vegetation

The sandstone bedrock encourages the development of acidophilic vegetation. Mesophilic grassland grazed or mowed on brown acid soils is sometimes farmed, where the topography allows. In the bottom of valleys these are more or less hydromorphic.

Large brambles grow in clearings and also invade grasslands freely. Indeed, isolated between the towns of Mortain and Le Neufbourg this marginal agricultural land is subject on the one hand to abandonment and on the other to certain property pressures.

Elsewhere, especially on the steepest slopes, forest predominates. On sandstone, acidophilic beech groves with holly settle on ochreous brown podzolic soil. Downstream of the site, the granite sides of the Cance are populated by beech groves of meso-acidophilic *Luzula sylvatica* on brown acid soil.

The banks and islets of the courses of the Cance and the Cançon host alluvial forests (**Figures 7 et 8**) of various species: *Acer pseudoplatanus, Alnus glutinosa, Fraxinus excelsior,* etc.

Fig. 7 : Islets on the Cance.

Figure 8 : Ravine of the small waterfall.

The moist and shaded rocky outcrops of the ravines favour characteristic chasmophytic vegetation including two rare species of ferns legally protected in France: *Trichomanes speciosum* and *Hymenophyllum tunbrigense.*

On well-exposed cliffs (**Figure 9**), fragments of acidophilic heathland with *Calluna vulgaris* and *Deschampsia flexuosa* populate ledges and hospitable cracks.

Finally, in urban areas, there are human habitats (old walls, buildings, etc.) and ornamental plantings, including some lines of old trees (**Figure 10**, *Tilia spp).*

Fig. 9 : Rocky ledge.

Fig. 10 : Line of lime trees.

6 - Human factors

Most often a jumbled topography does not permit the implementation of agro-pastoral development. The slopes are then occupied by woodland whose exploitation also remains marginal. These features give the site a great naturalness coupled with strong ecological continuity in the woodlands and rocky outcrops.

Note the presence of a small old isolated quarry whose working faces have been colonized by diverse lichen populations.

Human activity does not so far pose a major threat to the lichen heritage there. The trends to be emphasised as most likely to harm the stands are the development of rhododendrons and laurels palms in the undergrowth, the potential deterioration of water quality of the Cance and Cançon for aquatic populations, the fairly drastic logging activity for reasons of safety or exploitation, and expanding urbanization.

Among these threats, the development projects of the climbing club seem the most worrying at the moment;

7 - Summary

The study area appears to be particularly unusual for a plain, whether in terms of climatic, geo-morphological or historical characteristics. The exceptional microclimate conditions of the area, the presence of significant natural rocky outcrops and ancient woodlands with little or no exploitation allow the development of species and groups of corticolous and saxicolous lichens remarkable for the region.

Description of samplings

The 62 samples were taken in eight zones named A to G (**Figure 1**). The last position H is located in the Rue de la Petite Chapelle in Mortain and is not marked on the map.

A - Zone of the small waterfall (date 07/07/2008).

1: On the rock of a vertical wall situated in the field below the rocky ridge overlooking the small waterfall, general and local orientations: SE.

2: on the rock of the ridge that overlooks the small waterfall, general and local orientation SE.

3: same as 3 but on the ground between the rocks of the crag, general and local orientations SE.

4: on decaying wood, diameter of 0.15 m and 2 m high, found at 0.75 m above ground, below the rocky ridge overlooking the small waterfall.

5: on the 0.4 m diameter trunk of an ash approximately 15 m high, located below the rocky ridge overlooking the small waterfall, sampled at 1.5 m above the ground, general and local orientation E.
6: on the rock of a heavily shaded vertical wall located on the path that leads to the small waterfall, general and local orientations SE.
7: on submerged rock located in the low-water channel of the stream, the "Cançon", of the small waterfall, about 100 m upstream from the confluence with the river Cance; general and local orientation SE.
8: near sample 7, located on rock at the lower part of the bed of the Cançon; general and local orientation SE.
9: on rock in soil located at the lower part of the bed of the Cançon at the base of the small waterfall, general and local orientation SES SE.
10: on very shady rock located at the lower part of the bed of the Cançon at the base of the small waterfall; general and local orientation SE.
11: on top of a boulder located at the confluence of the Cançon and the Cance, in the lower part of the bed of the Cance, general and local orientation SE.
12: on the rock of a vertical wall used for climbing at the base of the small waterfall; general and local orientation S.
13: on a tree stump at the base of the climbing wall (near sample 12); general and local orientation S.

B – Zone of the site called "the Richard mill" (date 08/07/2008).
14: on the 0.8 m diameter trunk of a maple around 20 metres high, sampled at 1.50 m from the ground, general orientation N and local NE.
15: on the 1 m diameter trunk of a 20 m high maple located on the bank of the Cance, general and local orientation N.
16: on the 0.4 m diameter trunk of a 15 m high beech, sampled at 2 m above the ground located on the Cance, general and local orientation N.
17: on the vertical rock located in the upper part of the bed of the Cance; general and local orientation E.
18: on the horizontal rock located in the lower part of the bed of the Cance, general and local orientation E.
19: on the 1 m diameter trunk of a 20 metre high ash at the edge of a pasture, general and local orientation E.
20: on the 0.30 m diameter trunk of a 15 m high beech located on the Cance, sampled at 3 m above the ground, local and general orientation NE.
21: on a rock inclined at 45 ° located in the upper part of the bed of the Cance, general and local orientation E.
22: on the 0.15 m diameter trunk of an ash about 15 m high located on the path to Moulin Richard; general and local orientation E.

C – Zone of the Parking area located above the great waterfall (08/07/2008)
23: on twigs of a larch approximately 30 m high; general and local orientation E.
24: on the 0.7 m diameter trunk of an oak approximately 30 m high, sampled at 1.5 m above the ground; general and local orientation SSE S.
25: on the rock of a vertical wall located along the walking trail that leads to the great waterfall; general and local orientation E.

D – Zone of the abandoned quarry located above the ponds and the great waterfall (11/07/2008)

26: on a block located in the field, general and local orientation E (dated 08/07/2008).
27: on vertical rock located above the old quarry at the limit of the vegetation; very imperfect samples because of the difficulty of sampling; general and local orientation NNE E.
28: on the smooth seeping rock of a vertical wall along the edge of the quarry, general orientation NNE and local E.
29: On the part near the ground of a block of fallen rock at the base of the quarry, general orientation NNE and local E.
30: at the top of a block of fallen rock at the base of the quarry, general orientation NNE and local NE.
31: on rock of a seeping rock wall tilted at 45 °, general orientation NNE and local E.
32: on rock wall overhanging a block located in the fallen rocks at the base of the quarry, general and local orientation E.

E - Zone of the large waterfall (09/07/2008)
33: on the 0.3 m diameter trunk of an approximately 15 m high maple at the edge of the Cance 300 m downstream from the great waterfall, sample taken at 1.5 m above the ground; general orientation SE and local S.
34: on horizontal rock located in the upper part of the bed of the Cance, 250 m downstream from the great waterfall; general orientation SE and local W.
35: on rock inclined at 45 ° located in the low flow channel of the Cance about 250 m downstream of the great waterfall; general and local orientation SE.
36: on rock inclined at 45 ° located at the lower part of the bed of the Cance, approximately 200 m downstream of the great waterfall; general and local orientation SW.
37: on the 0.15 m diameter trunk of a 10 m maple, sampled at 0.5 m above the ground, 200 m downstream from the great waterfall; general and local orientation SW.
38: on top of a block located at the lower part of the bed of the Cance, 200 m downstream from the great waterfall; general SSE orientation.
39: on a horizontal rock located in the low flow channel of the Cance about 150 m from the great waterfall; general SSE direction.
40: on the 0.3 m diameter trunk of a 15 m beech located approximately 150 m downstream of the great waterfall; sampled at 3 m above ground; SSE general and local orientation SW.
41: on the 0.8 m diameter trunk of a 20 m oak approximately 100 m downstream from the great waterfall, sample taken at 2 m above ground; general orientation SSE and local W.
42: on the 0.1 m diameter trunk of a 10 m maple located about 100 m downstream from the great waterfall, sample taken at 1 m above ground; general orientation SSE and local SE.
43: on rock inclined at 45 ° located at the lower part of the bed of the Cance at the level of the great waterfall; general and local orientation S SE.
44: on rock lying horizontally in the lower part of the bed of the Cance at the level of the great waterfall; general orientation S and local SE.
45: on the rock of a seeping vertical rock wall located at the level of the great waterfall; general and local orientation S.
46: on vertical rock located in the upper part of the bed of the Cance at the base of the great waterfall; general orientation SSE and local SE.
47: on the 0.8 m diameter trunk of a 20 m oak located at the level of the footbridge of the great waterfall, sample taken at 2 m above the ground; general orientation SSW and local W.
48: on the 0.8 m diameter trunk of a 20 m oak located at the level of the footbridge of the great waterfall, sample taken at 2 m above the ground; general orientation SSW and local NW.
49: Scattered terricolous or muscicolous samples from the base of the great waterfall.

50: on top of a block in the floodplain of the Cance located at the footbridge of the great waterfall; general orientation SSE and local NW.
51: on a rock lying horizontally in the lower part of the bed of the Cance, 5 m downstream from the footbridge; general SSE orientation.
52: various samples from twigs at the level of the great waterfall.
53: on the 0.4 m diameter trunk of a 20 m maple located on the path to the great waterfall that goes up to the road, sample taken at 1.5 m above the ground; general and local orientation SE.

F - Zone of rows of lime trees at Mortain (11/07/2008)
54: on the 0.4 m diameter trunk of the approximately 15 m high second lime of the roadside line of trees going in the direction of Mortain; general orientation SSE and local SE.
55: same as sample 54, sampled at 0.5 metres, but NW local orientation.
56: same line of trees as samples 54 and 55 but on the trunk of the sixth lime tree; general orientation SSE and local SE.

G - Zone of the White Virgin (11/07/2008)
57: on the pedestal of the White Virgin; general orientation SSW and local W.
58: on the pedestal of the cross and a block nearby, general orientation SSW and local SW.
59: on the 0.5 cm diameter trunk of an approximately 5 metre walnut tree located on the road to the White Virgin, sampled 1 m above the ground, general and local orientation W.
60: on the 0.5 cm diameter trunk of an approximately 5 metre walnut tree located on the road to the White Virgin, sampled 1 m above the ground, general orientation SSW and local NW.

H - Zone of rows of ash and hornbeam (11/07/2008)
61: on twigs of ash and base of trunks.
62: rows of hornbeam (trunk diameter of 0.4 m and height of approximately 5 metres) on the road to the little chapel of Mortain (Rue de la Petite Chapelle).

Results

I - Overview of the lichen vegetation

A - Saxicolous groupings

Two types of media were studied: bedrock floodable by waters of rivers or large runoff after rain (aquatic groupings) and non flooding bedrock (non-aquatic groupings).

Only calcifuge and saxicolous lichens were studied because of the absence of limestone bedrock in the areas of exploration.

1 - Aquatic saxicolous groupings

Aquatic saxicolous groupings are classified into two categories: hydrophilic groupings located on rocks at times of flooding by the waters of streams and ékréophilic groupings located on the rocks at runoff during and after prolonged rain.

a - Hydrophilic saxicolous groupings

The hydrophilic groupings can be classified into three groups (Coste et al., 2009) according to the duration of contact with water. Hyperhydrophilic groupings are located in the low flow channel of the river where water is concentrated in summer. Mésohydrophilic groupings are located on the substrates located in the lower part of the riverbed; they undergo moderate periods of flooding. Subhydrophilic groupings experiencing short periods of flooding are located on the substrates in the upper part of the riverbed. Groupings of

substrates located in the floodplain should not be considered as aquatic groupings because their periods of flooding are very short and negligible.

The most abundant groupings in the domain are pioneering and impoverished groupings. One sees mostly cyanobacteria and a few thalli of *Verrucaria hydrela.* This grouping corresponds to the phytosociological class of hydrophilic and saxicolous lichens present in the three flood zones.

Hyperhydrophilic groupings

Locally (samples 8, 11 and 38 for example) one can observe characteristics of *Verrucarion funckii* Wirth 1972 with: *Verrucaria funckii, V. pachyderma* and *V. aquatilis* as well as *Verrucaria margacea* and *Hydropunctelia rheitrophila* typical of the upper units.

Mésohydrophilic groupings

These groupings colonize rocks at times of moderate flooding but also substrates experiencing significant runoff during and after rain but whose drying rate is particularly slow.

Thus these groupings may be exceptionally observed on vertical walls subject to large flows in sites well protected from sunlight and wind. This is the case of site 1, where we observed *Dermatocarpon luridum* that can flourish due to a stronger desiccation of *Verrucaria aethiobola* characteristic of substrates with a short duration of flooding and rapid rate of drying.

On the banks of the Cance and Cançon (samples 9 and 35 for example) *Dermatocarpon luridum, Rhizocarpon lavatum* and *Ionaspis lacustris* are abundant. *Porpidia hydrophila* characteristic of *Porpidietum hydrophilae* Ullrich 1962 emend. Drehwald 1993 was not observed in the domain.

Subhydrophilic groupings

The substrates submerged for a short time are mainly colonized by (eg sample 46) *Aspicilia aquatica, Rinodina oxydata, Verrucaria aethiobola* and *Bacidina inundata.* To this grouping should be added (eg sample 45) the abundance of *Collema flaccidum,* which is not strictly a hydrophilic species but hygrophilic and substratohygrophilic which in this case penetrate strictly subhydrophilic groupings.

One notes in this grouping the presence of *Caloplaca diphyodes* characteristic of the interim association of *Caloplaco diphyodis-Caloplacetum submergendae* C. Coste 2009, which has its optimum in the south of France. The presence of *C. diphyodes* is normal because it is the kind of association which tolerates a greater contact time with water than other characteristics of the association such as *Caloplaca submergenda* , which was not observed.

b - Ekréophilic saxicolous groupings

Two ékréophilic groupings were observed:

A first grouping (Sample 45) usually corticolous: *Hypocenomycetum scalaris* Hill. 1925 represented by *Hypocenomyces scalaris* forming large stands in very shady sites and associated with *Placynthium flabellosum* and *Collema flaccidum.*

The second, more photophilic, monospecific to *Pyrenopsis subareolata* was observed (sample 57) more or less enriched by non ékréophilic species which will be discussed in the next chapter.

2 - Non-aquatic saxicolous groupings

Non-aquatic calcifuge saxicolous groupings may be: astégophilic when not protected by overhangs or stégophilic when they are located on overhanging walls protected from direct rain or runoff.

a - Astégophilic groupings

From the ecological perspective astégophilic groupings are different depending on the stability of support.

On unstable substrates

Unstable substrates (small recently crumbled walls, stones and small boulders on the ground, sample 29 for example) in microclimatically unstable areas, are colonized by *Porpidietum crustulatae* Klement 1950 belonging to *Porpidion tuberculosae* Wirth 1972 nom. mut. (= *Lecideion tumidae),* characterised from an ecological perspective by significant microclimatic changes and frequent and abundant deposits of dew, and from a flora point of view notably by *Porpidia crustulata, P. tuberculosa, Buellia aethalea, Rhizocarpon reductum, Trapelia coarctata, T. glebulosa* parasitized by *Roselliniella microthelia* (Coste and Montavont, 2007).

On stable substrates

The nature of lichen groupings on stable substrates depends on their exposure to sunlight, brightness or temperature.

On sunny surfaces

The substrates of sample 2 for example, are mainly colonized by species of the class *Rhizocarpetea geographici* Wirth 1972 such as: *Acarospora fuscata, Lecanora polytropic, Tephromela atra* mainly, to which must be added species of the order *Aspicilietalia gibbossae* Wirth 1972 such as *Lecidea fuscoatra, Aspicilia caesiocinerea, Rinodina aspersa* f. *atrocinerea.*

In this phytosociological unit, there were two characteristic groupings belonging to the alliance of *Umbillicarion hirsutae* Cern. and Hadac 1944: *Lasalietum pustulatae* Hill 1925 located on damp vertical walls and *Umbillicarietum griseae* (Massé 1964) Wirth 1972 on dry vertical walls.

On shaded vertical walls

In site D (sample 28), we observe very impoverished *Pertusarietum leucosoro-flavicantis* Wirth 1972 with very deteriorated *Pertusaria flavicans* as the sole representative of the association and accompanied by *Pertusaria leucosora* characteristic of *Pertusarion leucosorae* Egea and Llimona 1987. This grouping colonizes shaded vertical walls.

On sufficiently sunny and warm surfaces

These surfaces are colonized by stands characterized by the dominance of *Xanthoparmelia: Xanthoparmelia stenophylla, X. pulla, X. verruculifera* principally. This grouping is classified in the alliance of *Xanthoparmelion conspersae* Cern. and Hadac 1944, a more or less nitrophilic community (eg sample 58).

b - Stégophilic groupings

In all sites prospected no stégophilic or photophilic lichen groupings were encountered. The communities listed below are all sciaphilic.

Sciaphilic, very aerohygrophilic: *Cystocoleion ebenei*

An association was observed relating to the alliance of *Cystocoleion ebenei* Wirth 1972, sciaphilic and non nitrophilic: *Enterographeto zonatae-Opegraphetum gyrocarpae* Wirth 1969 (samples 6, 12 for example), little substratohygrophilic.

Probably in that phytosociological unit should be included an as yet undescribed but already proposed association (Coste, 1994) in which *Bacidia viridifarinosa* is associated with *Bacidia trachona* and *Enterographa hustchinsiae* (samples 1, 6 and 34 for example).

Sciaphilic, moderately aerohygrophilic: *Chrysotricion chlorinae*

Three associations of *Chrysotricion chlorinae* marda and Hadac 1944 were observed: *Chrysotricetum chlorinae* Schade 1934 ex Wirth 1972, a monospecific association,

Lecanoretum orostheae Hilitzer 1927, characterized by *Lecanora orosthea* (sample 26 for example) and finally *Psilolechietum lucidae* Schade 1934 (samples 12, 25), just as monospecific a community as the previous two.

B - Corticolous Groupings

The majority of groupings observed in the domain are sciaphilic, and to a lesser extent photophilic groupings.

1 - Sciaphilic corticolous groupings

a - groupings of the class *Opegraphetae vulgatae*

Most corticolous groupings are linked to the class of sciaphilic corticolous lichen communities of the class *Opegrapheteae vulgatae* Bricaud 1996, whose main representatives are *Opegrapha vulgata*, *Porina aenea* and *Opegrapha varia.*

On smooth bark

The following three associations are included in the alliance of *Graphidion scriptae* Oschner 1928 represented by: *Arthonia cinnabarina* and *A. didyma,* belonging to the order of *Arthonietalia radiatae* Barkm. 1958 of which *Arthonia radiata* is the closest representative.

Graphidetum scriptae (Hil. 1925) Oschner 1928 is the most prevalent association in the areas explored, it colonizes smooth substrates located in wet sites little sheltered from rainfall (samples 22, 48 for example): *Graphis scripta* parasitized by *Stigmidium microspilum* and also by *Arthonia graphidicola*, *Phaeographis dendritica* and *Pyrenula nitida* and are the main representatives.

In the damper sites and probably more sheltered from rain (eg sample 22) there appears *Pyrenuletum chlorospilae* Giralt 1991 represented by *Pyrenula chlorospila* and *Enterographa eleborata.* This community is rare in the domain (sample 48).

Also noted was (sample 19) *Opegraphetum rufescent* Almb. 1948 ex Klement 1955 which readily colonizes the base of tree trunks and is mainly represented by *Opegrapha rufescens* which forms monospecific stands.

Less substratohygrophilic than the previous alliance (samples 40 and 48 for example), the characteristics of the order *Schismatommetalia decolorantis* Bricaud 1996 are represented by *Schismatomma decolorans* as well as the alliance named *Bactrosporion patelleroidis* Crespo represented by *Bactrospora patellarioides.* In this alliance *Zamenhofietum coralloides* Roux and Bricaud 1991 is well represented, in which *Enterographa crassa* is the closest representative on less fissured bark.

On rough bark

On rough damp bark are found species (samples 24, 48 for example)of the alliance named *Agonimion octosporae* Bricaud 1996 represented by *Agonimia octospora*, *Bacidia rubella,* as well as a non lichenised fungus *Navicella pileata* (Coste and Rey, 1993). This alliance is classified in the order *Bacidietalia phacodis* Bricaud 1996, of which there are no representatives; this is certainly due to inadequate surveys. *Bacidia phacodes, Bacidia fraxini* for example should be sought in the domain.

Two characteristic associations belonging to this alliance were observed.

In warmer and probably drier but equally shady sites (sample 19), one notes the association: *Ramonio-Striguletum mediterraneae* Bricaud and Roux 1994 represented by *Ramonia subsphaeroides* and *strigula ziziphy.*

Certainly less demanding in terms of warmth, *Acrocordietum gemmatae* colonizes the base of tree trunks (samples 55, 59 for example): *Acrocordia gemmata* can form monocultures associated with *Anisomeridium biform* and more frequent in the domain, non lichenised fungi such as *Hysterium pulicaris, H. angustatum* (Coste and Rey, 1993).

b - Groupings of uncertain syntaxonomic position

The lichen communities that follow cannot be attached to the previous phytosociological class because of the absence of higher unit features, while still being frankly sciaphilic.

Phlyctidetum argenae Oschner 1928 colonizes bark located in sufficiently moist sites. *Phlyctis argena* and *P. agelaea* are the closest representatives (samples 16 and 22).

Arthonietum pruinatae Almb. 1948 settle on the rough bark of older phorophytes; this syntaxon is represented in the domain (sample 47) by *Lecanographa amylacea* and rarer *Arthonia pruinata.*

Opegraphetum vermicelliferae Almb. 1948 colonizes rough bark in sites that are very shaded and protected from direct rainfall (sample 24). It forms stands monospecific to *Opegrapha vermicellifera.*

c - Bryolichenic corticolous grouping

An association of a *Frullania dilatata* liverwort and a small squamulous lichen *Normandina pulchella* is common in the domain; it is *Normandino-Frullanietum dilatatae* Delzenne, Gehu and Watts 1975 (sample 62 for example).

2 - Photophilic corticolous groupings

In sunlit sites with isolated trees and little human activity, lichen groupings composed of foliose lichens (samples 54, 55 and 56 for example) are numerous. These groupings belong to the class of photophilic corticolous lichens of *Hypogymnietea physodes* Folmer. 1974 and more particularly of the order *Hypogymnietalia physodo-tubulosae* Barkman 1958. The most representative species are *Hypogymnia physodes, Evernia punastri, Parmelia sulcata ...*

Flavoparmelietum caperato-perlatae Delzenne and Géhu 1977, common on trunks and larger branches, is characterized by the association of *Flavoparmelia caperata* with *Parmotrema perlatum* to which must be added locally *Parmelina pastillifera.*

Among the foliose lichens, we can see in "sub-stratum" several species of crustacean thallus lichen, for example *Lecidella elaeochroma, Lecanora carpinea, L. chlarotera, L. albella ...* but also *Buellia griseovirens.*

Flavoparmelietum caperato-revolutae (Barkman 1958) Delzenne and Géhu 1977, more hygrophilic and less heliophilic that the previous association, is well represented on tree trunks. *Flavoparmelia caperata, Hypotrachyna revoluta, Parmotrema crinitum, Punctelia Reddenda* as well as a fruticose lichen *Usnea lapponica* are the closest representatives.

In human activity sites the species observed are to be related to the alliance of *Xanthorion parietinae* Oschner 1928 belonging to the order *Physcietalia adscendentis* Hadac em 1944. Barkm. 1958, groupings located on rough bark, and *Lecanorion conizeoidis* belonging to the order *Lecanoretalia Variae* Barkman 1958 located on smooth bark. These different groupings are difficult to distinguish because they are mixed in the domain. Some representative species widespread in France were noted: *Xanthoria parietina, X. Candellaria, Lecanora conizeoides, Physcia adscendens ...*

C - Lignicolous, Terricolous and Muscicolous Groupings

They have been very little studied so it is impossible to link specific species to specific phytosociological units. Only characteristic species of these environments will be cited, without specifying in which syntaxons it would be possible to include them.

1 - Lignicolous groupings

Bare wood or old stumps (samples 4, 13 for example) are colonized by: *Trapeliopsis flexuosa, T. granulosa, T. viridescens,* C. *fimbriata* and many indeterminate *Lepraria* (see methodology).

2 - Terricolous and muscicolous groupings

In only one site was there a sampling of a terricolous grouping (sample 3), the species observed are: C*ladonia mitis, Cl. pocillum,Cl. portentosa, Cl pyxidata, Cl. ramulosla, Cl rangiferina,* Cl. *squamosa* var. *squamosa, Cl Strepsils* mainly.

Sample 49 allowed the observation of stands at *Peltigera canina, P. praetextata, P. Collins, P. horizontalis* mainly.

II - Overview of the lichen flora

A - List of species observed

All species identified in the laboratory are shown in the following list. Lichens are followed by ***[L],*** non lichenised lichenicolous fungi by ***[cl]*** and finally non lichenised non lichenicolous fungi by ***[F].*** All species are followed by the number of the sample in which the species has been harvested.

This list is not an exhaustive sectoral mapping list but a reasoned inventory. Indeed, a mapping of species per area was obviously not possible, thus some species listed in a site can be observed in another site without being mentioned in the list of species. This reasoned inventory method aims to evaluate the wealth of a particular site and identify species of a heritage nature.

1. *Abrothallus microspermus* Tul. [***cl***] : 62
2. *Acarospora fuscata* (Schrad.) Th. Fr. [***L***] : 2 57 58
3. *Acrocordia gemmata* (Ach.) Massal. [***L***] : 55 59
4. *Agonimia octospora* Coppins et P. James [***L***] : 24
5. *Algues vertes* [***A***] : 8 21
6. *Amandinea punctata* (Hoffm.) Coppins et Scheidegger [***L***] : 1 24 56
7. *Anisomeridium biforme* (Borrer) R. C. Harris [***L***] : 40 55
8. *Anisomeridium polypori* (Ellis et Hevert.) M. E. Barr [***L***] : 55
9. *Arctomia incurva* (Pers.) Hale [***L***] :
10. *Arthonia cinereopruinosa* Shaerer [***L***] : 24
11. *Arthonia cinnabarina* (DC.) Wallr. [***L***] : 5 22 42 48
12. *Arthonia didyma* Körber [***L***] : 5 40
13. *Arthonia graphidicola* Coppins [***L***] : 20
14. *Arthonia pruinata* (Pers.) Steud. ex A. L. Sm. [***L***] : 47
15. *Arthonia radiata* (Pers.) Ach. [***L***] : 40 48 52
16. *Arthopyrenia cinereopruinosa* (Shaerer) Massal. [***L***] : 52 61
17. *Arthothelium ruanum* (Massal.) Körb. [***L***] : 20
18. *Ascodichaenea rugosa* Butin [***F***] : 16
19. *Aspicilia aquatica* Körber [***L***] : 46
20. *Aspicilia caesiocinerea* (Nyl. ex Malbr.) Arnold [***L***] : 26 57
21. *Aspicilia contorta* (Hoffm.) Krempelh. [***L***] : 57
22. *Aspicilia intermutans* (Nyl.) Arnold [***L***] : 57
23. *Bacidia laurocerasi* (Delise ex Duby) Zahlbr. [***L***] : 60
24. *Bacidia polychroa* (Th. Fr.) Körb. [***L***] : 22 61
25. *Bacidia rubella* (Hoffm.) Massal. [***L***] : 48 59
26. *Bacidia subacerina* Vainio [***L***] : 22
27. *Bacidia trachona* (Ach.) Lett. [***L***] : 1 6 34
28. *Bacidia viridifarinosa* Coppins et James [***L***] : 6 24 34 60
29. *Bacidina inundata* (Fr.) Vezda [***L***] : 9 21 43 44 51
30. *Bactrospora patellarioides* (Nyl.) Almq. [***L***] : 40 48
31. *Buellia aethalea* (Ach.) Th. Fr. [***L***] : 58
32. *Buellia disciformis* (Fr.) Mudd [***L***] : 52
33. *Buellia griseovirens* (Turner et Borrer ex Sm.) Almb. [***L***] : 55

34. *Buellia schaereri* De Not. [***L***] : 56
35. *Buellia sp. (?)* [***L***] : 26
36. *Calicium viride* Pers. [***L***] : 4
37. *Caloplaca arenaria* (Pers.) Müll. Arg. [***L***] : 58
38. *Caloplaca cerina* (Ehrh. ex Hedw.) Th. Fr. [***L***] : 61
39. *Caloplaca crenularia* (With.) Laundon [***L***] : 57
40. *Caloplaca diphyodes* (Nyl.) Jatta [***L***] : 46
41. *Caloplaca ferruginea* (Hudson) Th. Fr. [***L***] : 59
42. *Caloplaca flavescens* (Hudson) Laundon [***L***] : 57
43. *Caloplaca haematites* (Schaub. ex St. Amans) Zw. [***L***] : 52
44. *Caloplaca pyracea* (Ach.) Th. Fr. [***L***] : 52
45. *Caloplaca velana* (Massal.) Du Rietz [***L***] : 57
46. *Candelaria concolor* (Dickson) B. Stein [***L***] : 23 54 62
47. *Candelariella reflexa* (Nyl.) Lettau [***L***] : 62
48. *Candelariella vitellina* (Hoffm.) Müll. Arg. [***L***] : 57
49. *Candelariella xanthostigma* (Ach.) Lettau [***L***] : 52 57
50. *Catillaria chalybeia* (Borrer) Massal. [***L***] : 1 7 10 26
51. *Catillaria nigroclavata* (Nyl.) Schuler [***L***] : 24 56
52. *Catinaria atropurpurea* (Schaer.) Vezda et Poelt [***L***] : 33
53. *Chaenotheca ferruginea* (Turner ex Sm.) Mig. [***L***] : 4
54. *Chaenotheca phaeocephala* (Turner) Th. Fr. [***L***] : 4
55. *Chrysothryx chlorina* (Ach.) Laundon [***L***] : 12 25
56. *Cladonia chlorophaea* (Flörke ex Sommerf.) Sprengel [***L***] : 3
57. *Cladonia coniocraea* (Flörke) Spreng. [***L***] : 3
58. *Cladonia fimbriata* (L.) Fr. [***L***] : 4 13 53 61
59. *Cladonia furcata* (Huds.) Schrad. subsp. *furcata* [***L***] : 3
60. *Cladonia gracilis* (L.) Willd. [***L***] : 3
61. *Cladonia macilenta* Hoffm. subsp. *floerkeana var. floerkeana* (Fr.) Wirth [***L***] : 13
62. *Cladonia macilenta* Hoffm. subsp. *macilenta var. macilenta* [***L***] : 13
63. *Cladonia macrophylla* (Schaerer) Stenh. [***L***] : 13
64. *Cladonia mitis* Sandst. [***L***] : 3
65. *Cladonia pocillum* (Ach.) O. J. Rich. [***L***] : 3
66. *Cladonia portentosa* (Dufour) Coem. [***L***] : 3
67. *Cladonia pyxidata* (L.) Hoffm. [***L***] : 61
68. *Cladonia ramulosa* (With.) Laundon [***L***] : 3
69. *Cladonia rangiferina* (L.) Wigg. [***L***] : 3
70. *Cladonia squamosa* (Scop.) Hoffm. var. *squamosa* [***L***] : 4
71. *Cladonia strepsilis* (Ach.) Grognot [***L***] : 3
72. *Cladonia subulata* (L.) Weber ex F. H. Wigg. [***L***] : 49
73. *Cladonia uncialis* (L.) Weber ex F. H. Wigg. subsp. *uncialis* [***L***] : 2
74. *Coenogonium pineti* (Ach.) Lücking et Lumbsch [***L***] : 5 24 48
75. *Collema flaccidum* (Ach.) Ach. [***L***] : 38 43 45
76. *Collema furfuraceum* (Arnold) Du Rietz [***L***] : 53 56
77. *Collema fuscovirens* (With) Laundon [***L***] : 45
78. *Collema nigrescens* (Hudson) DC. [***L***] : 56
79. *Cresponea premnea* (Ach.) Egea et Torrente var. *premnea* [***L***] : 15 19
80. *Dermatocarpon luridum* (With) Laund. var. *luridum* [***L***] : 1 8 11 35 36 43 4546
81. *Diploicia canescens* (Dikson) Massal. [***L***] : 60
82. *Diploschistes muscorum* (Scop.) R. Sant. [***L***] : 3
83. *Diploschistes scruposus* (Schreb.) Norm. subsp. *scruposus* [***L***] : 2
84. *Enterographa crassa* (DC.) Fée [***L***] : 13 15 20 22 33 37 40 41 48 53
85. *Enterographa elaborata* (Lyell ex Leight.) Coppins et P. James [***L***] : 48
86. *Enterographa hutchinsiae* (Leighton) Massal. [***L***] : 1 6 34
87. *Enterographa zonata* (Körber) Kallsten [***L***] : 6 12
88. *Evernia prunastri* (L.) Ach. [***L***] : 52 56 62

89. *Flavoparmelia caperata* (L.) Halle [***L***] : 2 4 23 53 54 55 56
90. *Fuscidea cyathoides* (Ach.) V. Wirth et Vezda var. *corticola* (Fr.) Kalb. [***L***] : 40
91. *Graphis elegans* (Borrer ex Sm.) Ach. [***L***] : 5 14 33 40 53
92. *Graphis scripta* (L.) Ach. var. *scripta* [***L***] : 14 16 20 22 33 37 40 42 48 53 54
93. *Hydropunctaria rheitrophila* (Zsch.) Keller, Gueidan et Thüs [***L***] : 8
94. *Hyperphyscia adgluttinata* (Flörke) M. Mayrhofer et Poelt [***L***] : 23
95. *Hyphomycètes sp. ? Sur Entergrapha crassa* [***cl***] : 41
96. *Hypocenomyce scalaris* (Ach.) M. Choisy [***L***] : 45
97. *Hypogymnia physodes* (L.) Nyl. [***L***] : 4 23 54
98. *Hypotrachyna revoluta* (Flörke) Hale [***L***] : 54 55 56 62
99. *Hysterium angustatum* (Albertini et Schweinitz) Merat [***F***] : 14 53
100. *Hysterium pulicare* Pers. : Merat [***F***] : 14 19 41 48 59
101. *Hysterographium fraxini* (Pers.) De Not. [***F***] : 61
102. *Illosporiopsis christiansenii* (B. L. Brady & D. Hawksw.) D. Hawksw. (sur Physcia adscendens) [***cl***] : 23
103. *Imshaugia aleurites* (Ach.) Fricke et Meyer [***L***] : 15
104. *Incrustations noires à cyanobactéries* [***A***] : 8 18 21 35 38 39 44 51
105. *Ionaspis lacustris* (With) Lutzoni [***L***] : 9 11 35 36 44 46
106. *Lasallia pustulata* (L.) Mérat [***L***] : 2
107. *Lecania hyalina* (Fr.) R. Sant. [***L***] : 40
108. *Lecania inundata* (Hepp ex Körb.) M. Mayrhofer [***L***] : 21 51
109. *Lecanographa amylacea* (Ehrh. ex Pers.) Egea et Torrente [***L***] : 47
110. *Lecanora albella* (Pers.) Ach. [***L***] : 54
111. *Lecanora argentata* (Ach.) Malme [***L***] : 14
112. *Lecanora campestris* (Schaer.) Hue [***L***] : 57
113. *Lecanora carpinea* (L.) Vain. [***L***] : 54 60
114. *Lecanora chlarotera* Nyl. f. *chlarotera* [***L***] : 14 19 52 53 54 59 60
115. *Lecanora conizaeoides* Nyl. ex Cromb. [***L***] : 54
116. *Lecanora dispersa* (Pers.) Sommerf. [***L***] : 57
117. *Lecanora expallens* Ach. [***L***] : 54 60
118. *Lecanora impudens* Degel. [***L***] : 19
119. *Lecanora jamesii* J. R. Laundon [***L***] : 20
120. *Lecanora orosthea* (Ach.) Ach. [***L***] : 1 2 26 58
121. *Lecanora polytropa* (Ehrht. ex Hoffm.) Rabenh. var. *polytropa* [***L***] : 2 29
122. *Lecanora rupicola* (L.) Zahlbr. subsp. *rupicola* [***L***] :
123. *Lecanora saligna* (Schrad.) Zahlbr. var. *saligna* [***L***] : 54
124. *Lecanora sambuci* (Pers.) Nyl. [***L***] : 19
125. *Lecanora strobilina* (Spreng.) Kieffer [***L***] : 54
126. *Lecanora symmicta* (Ach.) Ach. (Nyl.) Zahlbr. [***L***] : 13
127. *Lecidea fuscoatra* (L.) Ach. var. *fuscoatra* [***L***] : 2 26 58
128. *Lecidella carpathica* Körb. [***L***] : 57
129. *Lecidella elaeochroma* (Ach.) Choisy var. *elaeochroma* [***L***] : 19 52 59 60 61 62
130. *Lecidella stigmatea* (Ach.) Hertel et Leuk. [***L***] : 12
131. *Lepraria blanc* [***L***] : 1 6 28 41
132. *Lepraria gris bleu* [***L***] : 4 13
133. *Lepraria incana* (L.) Ach. [***L***] : 5
134. *Lepraria vert* [***L***] : 2 5
135. *Lepraria membranacea* (Dicks.) Vain. [***L***] : 2 25 32
136. *Leprocaulon microscopicum* (Vill.) Gams [***L***] : 1 25 28
137. *Leptogium cyanescens* (Rabenh.) Körb. [***L***] : 49
138. *Leptogium lichenoides* (L.) Zahlbr. [***L***] :
139. *Lichenoconium lecanorae* (Jaap.) Hawksw. (sur les apothécies de *Lecanora chlarotera*) [***cl***] : 60
140. *Lichenostigma sp.* (sur Ionaspis lacustris) [***cl***] : 9
141. *Lichenostigma sp.* (sur Tephromella atra) [***cl***] : 57

142. *Melanelia infumata* (Nyl.) Essl. subsp. *elegantula* [***L***] : 5
143. *Melanelixia fuliginosa* (Fr. ex Duby) O. Blanco, A.Crespo, Divakar, Essl., D. Hawksw. et Lumbsch subsp. *fuliginosa* (Fr. ex. Duby) Laundon [***L***] : 26 56
144. *Melanelixia fuliginosa* (Fr. ex Duby) O. Blanco, A.Crespo, Divakar, Essl., D. Hawksw. et Lumbsch subsp. *glabratula* (Lamy) J. R. Laundon [***L***] : 54
145. *Melanelixia subargentifera* (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. et Lumbsch [***L***] : 4 23 52 54
146. *Micarea denigrata* (Fr.) Hedl. [***L***] : 4
147. *Micarea lignaria* (Ach.) Hedl. [***L***] : 49
148. *Micarea peliocarpa* (Anzi) Coppins et R. Sant. [***L***] : 13
149. *Muellerella pygmaea* (Körb.) D. Hawksw. var. *pygmaea* (Sur le thalle de *Porpidia rugosa*) [***cl***] : 30
150. *Mycoblastus caesius* (Coppins et P. James) Tønsberg [***L***] : 14
151. *Mycomicrothelia confusa* D. Hawksw. [***F***] : 55
152. *Navicella pileata* (Tode) Fabre [***F***] : 19 41 48
153. *Normandina pulchella* (Borr.) Nyl. [***L***] : 4 5 24 41 48 56 62
154. *Ochrolechia pallescens* (L.) Massal. subsp. *pallescens* [***L***] : 53
155. *Opegrapha atra* Pers. [***L***] : 5 15 59 60 61
156. *Opegrapha gyrocarpa* Flotow [***L***] : 6 12
157. *Opegrapha lichenoides* Pers. [***L***] : 5 15 42 59
158. *Opegrapha lithyrga* Ach. [***L***] : 6
159. *Opegrapha niveoatra* (Borr.) Laund. [***L***] : 19 59
160. *Opegrapha ochrocheila* Nyl. [***L***] : 59
161. *Opegrapha rufescens* Pers. [***L***] : 19
162. *Opegrapha varia* Pers. [***L***] : 59 60 61
163. *Opegrapha vermicellifera* (Kunze) Laundon [***L***] : 24
164. *Opegrapha vulgata* Ach. [***L***] : 5 14 15 19 22 42
165. *Pachyphiale fagicola* (Hepp ex Arnold) Zwackh [***L***] : 42
166. *Parmelia saxatilis* (L.) Ach. [***L***] : 55
167. *Parmelia sulcata* Taylor [***L***] : 23 54
168. *Parmelina pastillifera* (Harm.) Hale [***L***] : 54
169. *Parmotrema crinitum* (Ach.) Choisy [***L***] : 23
170. *Parmotrema perlatum* (Huds.) M. Choisy [***L***] : 23 53 54 56 62
171. *Peltigera canina* (L.) Willd. [***L***] : 49
172. *Peltigera collina* (Ach.) Schrad. [***L***] : 49
173. *Peltigera horizontalis* (Huds.) Baumg. [***L***] : 17 46 49
174. *Peltigera membranacea* (Ach.) Nyl. [***L***] : 49
175. *Peltigera neckeri* Hepp ex Müll. Arg. [***L***] : 49
176. *Peltigera praetextata* (Flörk. ex Somm.) Zopf. [***L***] : 17 49
177. *Pertusaria albescens* (Huds.) Choisy et Werner var. *albescens* [***L***] : 4 16 54 56
178. *Pertusaria amara* (Ach.) Nyl. var. *amara* [***L***] : 22
179. *Pertusaria flavicans* Lamy subsp. *flavicans* [***L***] : 28
180. *Pertusaria hymenea* (Ach.) Schaerer [***L***] : 22
181. *Pertusaria lactea* (L.) Arnold [***L***] : 58
182. *Pertusaria leioplaca* DC. [***L***] : 48
183. *Pertusaria leucosora* Nyl. [***L***] : 28
184. *Pertusaria pertusa* (Weigel) Tuck. [***L***] : 14 53 54 60
185. *Phaeographis dendritica* (Ach.) Müll. Arg. [***L***] : 14 40 42 53 55
186. *Phlyctis agelaea* (Ach.) Flot. [***L***] : 16 22
187. *Phlyctis argena* (Spreng.) Flot. [***L***] : 16 22 54 62
188. *Physcia adscendens* (Fr.) Oliv. [***L***] : 23 52 54 56
189. *Physcia aipolia* (Ehrh. ex Humb.) Fürnr. subsp. *aipolia* [***L***] : 52
190. *Physcia clementei* (Turner) Lynge [***L***] : 4
191. *Physcia stellaris* (L.) Nyl. subsp. *stellaris* [***L***] : 52
192. *Physcia tenella* (Scop.) DC. subsp. *tenella* [***L***] : 23

193. *Placynthium flabellosum* (Tuck.) Zahlbr. [***L***] : 45
194. *Platismatia glauca* (L.) W. Culb. et C. Culb. [***L***] : 23
195. *Pleurosticta acetabulum* (Neck.) Elix et Lumbsch var. *acetabulum* [***L***] : 52
196. *Polysporina simplex* (Dav.) Vezda [***L***] : 57
197. *Porina aenea* (Wallr.) Zahlbr. [***L***] : 5 19 22 42 53
198. *Porina ahlesiana* (Körb.) Zahlbr. [***L***] : 50
199. *Porina borreri* (Trev.) Hawksw. et James [***L***] : 14
200. *Porina chlorotica* (Ach.) Müll. Arg. [***L***] : 1 6 9 10 11 17 28 31 34 44 50 58
201. *Porina guentheri* (Flot.) Zahlbr. [***L***] : 44
202. *Porina lectissima* (Fr.) Zahlbr. [***L***] : 6 9 34 50
203. *Porpidia cinereoatra* (Ach.) Hertel et Knoph [***L***] : 29
204. *Porpidia crustulata* (Ach.) Hertel et Knoph [***L***] : 26 30 58
205. *Porpidia macrocarpa* (DC.) Hertel et Schwab [***L***] : 2
206. *Porpidia musiva* (Körb.) Hertel et Knoph [***L***] : 3
207. *Porpidia rugosa* (Taylor) Coppins et Fryday [***L***] : 9 30 50
208. *Porpidia tuberculosa* (Sm.) Hertel et Knoph [***L***] : 26 28 29 57
209. *Pronectria oligospora* Lowen et Rogerson subsp. *octospora* (Etayo) Cl. Roux (sur le thalle de *P. subrudecta*) [***cl***] : 23
210. *Psilolechia lucida* (Ach.) Choisy [***L***] : 12 25
211. *Punctelia borreri* (Sm.) Krog [***L***] : 54 62
212. *Punctelia reddenda* (Stirt.) Krog [***L***] : 54 55
213. *Punctelia subrudecta* (Nyl.) Krog [***L***] : 23 54
214. *Pycnothelia papillaria* (Ehrh.) Duf. [***L***] : 2
215. *Pyrenopsis subareolata* Nyl. [***L***] : 57
216. *Pyrenula chlorospila* (Nyl.) Arnold [***L***] : 22 48
217. *Pyrenula macrospora* (Degel.) Coppins et James [***L***] : 20 22
218. *Pyrenula nitida* (Weigel) Ach. [***L***] : 15 20 22
219. *Pyrrhospora cinnabarina* (Sommerf.) Choisy [***L***] : 37
220. *Pyrrhospora quernea* (Dickson) Körber [***L***] : 22
221. *Ramalina calicaris* (L.) Fr. [***L***] : 47
222. *Ramalina farinacea* (L.) Ach. var. *farinacea* [***L***] : 62
223. *Ramalina fastigiata* (Pers.) Ach. var. *fastigiata* [***L***] : 47
224. *Ramalina pollinaria* (Westr.) Ach. [***L***] : 26
225. *Ramonia subsphaeroides* (Tav.) Vezda [***L***] : 19
226. *Rhizocarpon geographicum* (L.) DC. subsp. *geographicum* [***L***] : 2 58
227. *Rhizocarpon lavatum* (Fr.) Hazsl. [***L***] : 30
228. *Rhizocarpon reductum* Th. Fr. [***L***] : 26 29 57 58
229. *Rinodina aspersa* (Hook) Cl. Roux f. *atrocinerea* [***L***] : 2 26 27 28
230. *Rinodina oxydata* (Massal.) Massal. [***L***] : 46
231. *Rinodina teichophila* (Nyl.) Arnold [***L***] : 17
232. *Roselliniella microthelia* (Wallr.) Nik. Hoffm. et Hafellner [***L***] : 1 27
233. *Sarcogyne privigna* (Ach.) Massal. [***L***] : 2
234. *Schismatomma decolorans* (Turner et Borrer ex Sm.) Clauz. et Vezda [***L***] : 14 40 48 55
235. *Schismatomma niveum* D. Hawksw. et P. James [***L***] : 41
236. *Scoliciosporum umbrinum* (Ach.) Arnold var. *umbrinum* [***L***] : 9
237. *Stereocaulon evolutum* Graewe [***L***] : 29
238. *Stigmidium microspilum* (Körb.) D. Hawksw. [***cl***] : 37 42
239. *Strigula ziziphi* (A. Massal.) Cl. Roux et Sérus [***L***] : 19
240. *Tephromella atra* (Huds.) Haffel. var. *atra* [***L***] : 57
241. *Trapelia coarctata* (Sm.) Choisy [***L***] : 1 6 26 29 31
242. *Trapelia glebulosa* (Sm.) J. R. Laundon [***L***] : 2 27 58
243. *Trapeliopsis flexuosa* (Fr.) Coppins et James [***L***] : 3 4 58
244. *Trapeliopsis granulosa* (Hoffm.) Lumbsch. [***L***] : 2
245. *Trapeliopsis viridescens* (Schrad.) Coppins et P. James [***L***] : 3
246. *Umbilicaria grisea* Hoffm. [***L***] : 2

247. *Usnea lapponica* Vain. [***L***] : 56
248. *Verrucaria aethiobola* Wahlenb. [***L***] : 1 7 43 44 46
249. *Verrucaria aquatilis* Mudd [***L***] : 38 43
250. *Verrucaria funckii* (Spreng.) Zahlbr. [***L***] : 11 46 51
251. *Verrucaria hydrela* Ach. (sl) [***L***] : 7 8 10 11 17 18 21 35 36 38 39 43 44 51
252. *Verrucaria margacea* (Wahlenb.) Wahlenb. [***L***] : 38
253. *Verrucaria muralis* Ach. [***L***] : 27 57
254. *Verrucaria pachyderma* Arnold [***L***] : 7 38
255. *Vouauxiomyces truncatus* (B. de Lesd.) Dyko et Hawksw. [***cl***] : 53 55
256. *Xanthoparmelia verruculifera* (Nyl.) O. Blanco, A. Crespo, Elix, D. Hawksw. et Lumbsch [***L***] : 12
257. *Xanthoparmelia loxodes* O. Blanco, A. Crespo, Elix, D. Hawksw. et Lumbsch [***L***] : 26
258. *Xanthoparmelia mougeotii* (Schaer. ex Dietr.) Hale [***L***] : 29
259. *Xanthoparmelia pulla* (Ach.) O. Blanco, A. Crespo, Elix, D. Hawksw. et Lumbsch subsp. *pulla* var. pulla [***L***] : 2 12 26 57
260. *Xanthoparmelia stenophylla* (Ach.) Ahti et D. Hawksw. [***L***] : 2 12 58
261. *Xanthoria fallax* (Hepp) Arnold [***L***] : 52
262. *Xanthoria parietina* (L.) Th. Fr. [***L***] : 23 52 54 61 62
263. *Zamenhofia coralloidea* (P. James) Clauzade et Cl. Roux [***L***] : 22 40 48

B - List of interesting species

It is particularly difficult to develop a list of lichens of heritage interest. Indeed lichenologists are few, so that the distribution of many species is so far unknown. However, *the Catalog of Lichens of France* (Roux, 2009) can present some uncommon species recorded in France so far. ***Anisomeridium biforme*** (Borrer) RC Harris (not a very common species in France), ***Arctomia incurva*** (Pers.) Hale (fairly rare species in France**), *Arthonia graphidicola*** Coppins **(**fifth French site), ***Arthothelium ruanum*** (Massal.) Körb. (rare in France), ***Bactrospora patellarioides*** (Nyl .) Almq. (rare in France), ***Buellia griseovirens*** (Turner and Borrer ex Sm.) Almb. (fairly common in the mountains), ***Chaenotheca phaeocephala*** (Turner) Th Fr (rare at hill level), ***Crespo premna*** (Ach.) Egea and Torrente var. ***premna*** (not very common in France), ***Enterographa elaborate*** (Lyell ex Leight.) Coppins & P. James (rare in France), ***Enterographa hutchinsiae*** (Leighton) Massal. (rare in France), ***Hydropunctaria rheitrophila*** (Zsch.) Keller, and Gueidan Thus (fairly rare), ***Lecania hyalina*** (Fr.) R. Sant. (not very common in France), ***Lecanora jamesii*** JR Laundon (rare in France), ***Mycoblastus caesius*** (Coppins & P. James) Tønsberg (known only in Lower Normandy), ***Opegrapha ochrocheila*** Nyl. (known in three French departments), ***Placynthium flabellosum*** (Tuck.) Zahlbr. (distribution in France very poorly understood because of confusion with *Placynthium rosulans* (Th Fr) **Zahlbr.)** ***Porin ahlesiana*** (Körb.) Zahlbr. (very rare in France), ***Porin guentheri*** (Flot.) Zahlbr. (rare in France), ***Punctelia Reddenda*** (Stirt.) Krog (very rare in France), ***Pycnothelia papillaria*** (Ehrh.) Duf. (not common in France), ***Pyrenula chlorospila*** (Nyl.) Arnold (fairly rare), ***Pyrrhospora cinnabarina*** (Sommerf.) Choisy (known in four French departments), ***Ramonia subsphaeroides*** (Tav.) Vezda (rare, new to northern France), ***Strigula ziziphi*** (A. Massal.) Cl Roux and Serusi. (new to northern France).

Discussion - conclusion

The study of lichens is unique in providing guidance on the stage of development in the environments studied, the importance of human impact and possible relationships between ecosystems.

Though lichens have a long life, they grow very slowly. Generally, colonization of virgin surfaces in aquatic environments (Keller, 2005) starts with algae (cyanobacteria and algae),

aquatic fungi and finally lichens. Black incrustations of cyanobacteria on rocks of streams are frequent and prominent in the domain. On the other hand, the first species to colonize the substrates are lichens considered common and of wide ecological spread in relation to the duration of flooding (Keller, 2005). *Verrucaria hydrela* sl characteristic of the phytosociological class of saxicolous lichens, and aquatic calcifuges are very common in the study area. Lichens typical of the various areas of immersion and characteristic of lower phytosociological units (order, alliance or association), are present but poorly represented. This low representation is not the result of severe pollution, which would have a significant deleterious impact on the ecosystem, since *Verrucaria funckii* (a species particularly sensitive to water pollution; Perreira, 1992) was observed repeatedly. These aquatic communities are characteristic of upper hill and mountain levels. The presence of *Placynthium flabellosum* confirms this view. Therefore, it does not seem unusual that a plain isolated in the north and, in fact, quite far from the Massif Central and even Brittany shows impoverished mycoflora.

For saxicolous and non aquatic ecosystems, the lichen communities observed are also fragmented compared to typical groupings in large mountain ranges: the associations are incomplete and the majority are monospecific communities common in France. The bio-geographic isolation of the site vis-à-vis the closest mountains (Massif Central, Monts d'Arrée) probably explains much of the loss of these mycoflora. Nevertheless, in a plain, these groups are rare and have a strong heritage interest.

In forest environments, if we calculate the index of ecological continuity (Coppins and Coppins, 2002) we get an index of 19. An index of 20 is regarded as assuring the protection of the site. The forests studied at Mortain present a forest continuity marked with a strong natural dynamic. Unlike saxicolous associations, the site, in a hypothetical distant past, presented a bio-geographical continuity with the habitat characteristics of old natural forests.

Therefore, these lichen populations are to be regarded as remarkable relic communities. The old postcard below shows that the site was much more open in the early twentieth century.

We can objectively consider the ecological continuity of forest areas where we see the degree of openness reflected in these old documents! However, these images provide a remarkable but partial view of the site, which does not exclude the persistence of forest patches that served as havens for the species characteristic of old forests.

The list presented in this work includes 263 species; this relatively modest number is certainly due to the preliminary aspect of this work, the low number of sites studied and the partial sampling method applied. However the site seems of remarkable lichenological

interest for a department in a lowland area, both qualitatively and quantitatively, as 24 species of interest were observed which are little collected in France (see previous chapter).

This heritage appears to be particularly sensitive to human disturbance, such as mechanical or physico-chemical damage. For saxicolous groupings, aquatic or terrestrial, mechanical disturbances are mainly related to surface stripping by intensive trampling and rubbing and repeated landslides or changing the position of rocks. This can be particularly disastrous for lichen communities whose recovery will be difficult, at best very slow, and sometimes impossible when it involves rare species with low dispersal ability.

The corticolous groupings are currently relatively little exposed to felling operations on the site because of its marked topography, which allowed them to retain, at least locally, their relic character typical of old forests today. However, in the context of the opening to the public of this site, felling for security reasons was made of old oaks during our study. Moreover, old alluvial phorophyte groupings and riverine islands seem particularly vulnerable to security operations or maintenance of rivers.

Physico-chemical damage is generated by various types of pollution related to human activity that is not always identifiable on the sites (remote air pollution, water pollution upstream of the site ...). In fact all aggressive damage to lichens inevitably induces damage to terrestrial lichen communities.

In conclusion, the site of Mortain "seems particularly remarkable" for a plain, for its geography, its climate, its wealth of lichens and the dynamic of its environment. The observed lichen stands, both saxicolous and corticolous, show marked mountain characteristics and naturalness. The mycoflora of these groupings, although impoverished their counterparts located in major mountain ranges, show a strong heritage interest at departmental and regional level.

The conservation of this heritage requires above all "non-management" to minimize human disturbance, mechanical or chemical, and to maintain the ecological continuity the site has enjoyed so far. However, only active management will contain the development of invasive species, extensive on the site (conifers, rhododendrons, laurel palm).

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