

The diversity of French mires and the account taken of them in conservation policy

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Résumé : La diversité fonctionnelle et écologique des tourbières de France est présentée et expliquée par les importants gradients écologiques du pays (climats, reliefs, substrats géologiques). Une clarification typologique et nomenclaturale (avec l'équivalence français-anglais-allemand) est résumée ; elle peut s'appliquer à de nombreux pays d'Europe. La liste des habitats présents dans et près des tourbières françaises est donnée, parmi lesquels de nombreux habitats prioritaires ou d'intérêt communautaire (Directive européenne "Habitats" de 1992) ; les espèces animales et végétales citées dans cette directive et présentes en France sont indiquées. Le bilan de la régression, et de ses causes, des tourbières françaises est présenté (plus de la moitié a disparu en moins d'un siècle) et, enfin, on aborde la prise de conscience et les mesures prises nationalement ou régionalement pour une conservation et une gestion efficaces, depuis 1994.

Mots-clés : France, tourbières, diversité, nomenclature typologique, causes de régression, politique de conservation, CORINE-Biotopes.

Introduction

First of all, let us recall the classic general definition of this type of ecosystem: a mire is a damp system colonized by the vegetation that develops on soil that is poorly permeable, made up of peat ; the thickness of peat is 30 to 40 cm or more. The peat consists of a minimum of 20 to 30% poorly degraded organic material and this content can reach 97%. This organic material comes from the accumulation over a long time (of the order of centuries or thousands of years) of the remains of plants (bryophytes and higher plants, like the *Cyperaceae* or various ligneous plants) in an environment that is almost always very wet, or even actually aquatic; the water balance must be equilibrate or a little in excess. This permanent presence of water, stagnant or more rarely flowing, impoverished in oxygen, brings about anaerobiosis, the result of which is the slowing down of the degradation of the plant debris to form the peat.

This definition only concerns the living or active mires, in which the vegetation is still turfigenous (peat producing); there are also peat beds in fossil or dead mires. One must also add that many mires are often described in France using the very vague word *marais* (marsh or bog).

In France, until 1994, the mires were recognized lands and appreciated for their biological richness, but they were only studied in a very partial way (incomplete or inadequate inventories, hydrology and ecology poorly understood and lack of clarification from the point of view of typology and terminology).

Biogeographical and functional diversity of the French mires

French mires represent less than 1% of the area of the country, which is very little compared with more northern countries (Canada, British Isles, Fenno-Scandinavia and Russia), but their diversity is very great, as demonstrated by the number of habitats listed in Table III (see later). This diversity arises for various reasons, which are summarized below (Table I):

- altitude, which varies from sea level up to 4800 m; indeed one still finds rare mires above 2500m. In this case, it is the temperature which determine the differentiation of various types of mire systems;
- extremely wide climatic range, which induces large gradients over relatively short distances (of the order of a thousand kilometers). One can cite the oceanic climates or influences (the oceanic front corresponds nearly to the western half of the country), the continental climates and influences (of which the most extreme are situated in the intern Alps and Alsace) and the Mediterranean climates and influences (in the south-east of the country). In addition, there are the highland or alpine climates and influences, more or less marked : one finds highland oceanic climate in Limousin or in the western Pyrénées, highland continental climate in the Hautes-Alpes or in Vanoise or even in the Jurassic range, and highland mediterranean climate in Corsica, in the eastern Pyrénées or in the southern Alps. One must, of course, add to all that, all the intermediate climates possible between the most typical cases. The water balance, dependant both on the amount of precipitation and the temperatures, induces the existence of functional types which are quite different in different geographical areas of France;
- great variety in the geological substrates, whether these are recent sediments or more ancient rocks (granite, basalt, shale, gneiss, sandstone or calcareous clay). This will have an influence on the chemistry and the pH of the various types of peat, from the most alkaline one with the formation of tufa (pH 8) to the most acidic and poorest in minerals with settlement of peat-mosses (pH 4);
- and finally, great variety in the types of relief or the geomorphology. In France, one finds back-littoral mires near the sea, great marshes in large floodplains and fluvial valleys or beside wide perialpine lakes, peaty moors and ponds in the hercynian mountain ranges which have quite a soft relief, sloping mires created by acidic or alkaline resurgences and oozings, and many mire-lake complexes arising either from the action of quaternary glaciers (in almost

all the high mountains of the country, from the Vosges to the Pyrénées) or from volcanic geomorphology (in Massif Central).

We can note that the *Sphagnum* raised mires (bogs) are less clearly linked to the geomorphology than the others types and it is the presence of a cool and damp climate that is essential for their existence; in addition, as in other countries, they can appear evolving from other types, due to the phenomenon of ombrotrophization. The French regions richest in typical bogs are, in order of importance, the Jurassic range, the Vosges, the Auvergne and the northern Alps (especially Haute-Savoie).

As a result of various international efforts, the world classification of mires is currently tending to be homogenized and clarified, putting the emphasis on the origin of the mire and on its type of water supply (Julve, 1996; Manneville et al., 1999). One can, first of all, distinguish one origin of water minerotrophic or geotrophic – water circulating in the soil and subsoil and more or less rich in minerals, from another one called ombrotrophic – water arising from precipitation and therefore acidic and very poor, except, sometimes, when close to the windswept coasts where there can be an enrichment by salty spray.

Diverse functional types can be distinguished as a function of the circulation of the water at the origin of the mire. The ombrogenous type concerns the mires which are almost uniquely, from their origin, under the influence of meteoric waters (rain and snow), with a poor ion content; they are found in constantly very humid climates (this is the case of raised mires, of saddle mires and of blanket bogs) and are relatively independent of the geomorphology. The soligenous type corresponds to the mires that depend on springs and oozing, on moderate or gently slopes, or on percolation below the surface of the ground.

The three types that follow are more difficult to separate and have sometimes been grouped together: topogenous means that there is a stagnant sheet of water on the surface in a topographical depression, fluviogenous – sometimes called telmatogenous – indicates that periodic floods, silt loaded, come from an alluvial sheet of water or a water course, and finally, the limnogenous type is born by the alluviation or terrestrialization on the edges of a pond or a lake from floating mats of vegetation or from plants rooted in the depths of the water. Often, a mire complex can be attributed to two, or even three, types at once.

Table I - The relationships between the geomorphology, the biogeography and the different types of mires in France :

A = alpine and upper subalpine levels of high mountains, under severe climate; glaciers still present sometimes

B = medium mountain level, of the great mountain ranges subjected to quaternary glaciations (recent local volcanic activity locally)

C = lowlands of large inland alluvial floodplains and of postglacial great piémont lakes

D = slightly orogenic secondary basins, with cuestas, valleys and sandy tertiary deposits (hills or glaciais)

E = leveled or rejuvenated old ranges, under oceanic climate influence, sometimes having been subjected to periglacial phenomena

F = littoral areas, maritime plains, low coastlands and subsidence zones

MIRE SYSTEMS	ZONES					
	A	B	C	D	E	F
dune-slacks, back littoral marshes						XX
estuaries and deltas fens						XX
large valley marshes		X	XX	XX	X	XX
sides of large lakes (fens)			XX			X
sloping mires	XX	XX	XX	XX	XX	
peaty moorlands				XX	XX	XX
blanket bogs (very rare)					X ?	
woodland peaty pools			X	XX	X	X
peaty pools or ponds			X	XX	XX	XX
mire-lake complexes	XX	XX	X			X
raised mires		XX	X	X	XX	X
high mountains mires, <i>pozzines</i>	XX					
peaty forests or wooded mires (main types in different zones)	none or dwarf willows	spruce pines birch	alder willows	alder willows birch	birch alder pine	birch alder willows

XX frequently found or X seldom found

If the ombrogenous mires are always ombrotrophic, the four other types can, progressively and under certain conditions, evolve from the minerotrophic stage to the ombrotrophic one, when the accumulation of peat makes the

system breakout and become acted upon by neighbouring telluric waters. Also, if there should be transitory drying, the peat starts to decompose and release diverse minerals, and the system can become a peaty moorland. One must also distinguish the process of terrestrialization – movement from a stretch of water to a damp land system then possibly more dry, from those of paludification, in which the exogenous arrival of waters makes aquatic or very damp peaty systems appear without an initial stretch of water.

To this first definitions, which have the advantage of describing the functioning and the evolution of the mires, one can add various subdivisions based on the biogeographical and climatic characteristics (oceanic types, boreal, alpine, etc), the trophic level linked to the amount of assimilated nitrogen and phosphor, the acidity (alkaline and basic mires to be contrasted with acidic ones) and the carbonate or calcium contents which are often linked to the acidity (Bridgham et al.,1996). In addition, the vegetation is a good integrator of the conditions of the area and, also, an indicator of the stage of evolution of the mires ; one notes therefore that, in the absence of precise physico-chemical data, the observation of plant species and vegetation groupings in a mire often and rapidly permits to estimate its characteristics and to classify it; that is why the classification of the habitats is essentially based on the phytosociological study of the vegetation (CORINE-Biotopes, table III).

It is nearly possible to find on French territory, in numerous regional or local forms, all the functional types cited above (table I), even if one can still question whether the ombrogenous type is well characterized in our country; this type is abundantly represented in the British Isles and in Norway by what is called blanket bogs. Naturally, the boreal types of mire (aapa to be linked to the soligenous type and palsa mires to the topogenous one) are absent from France, but perhaps they existed in this country during the last ice ages? These last types occupy large surfaces in Sweden, Finland, Siberia and Canada.

Clarification of French nomenclature of mires systems and its equivalence in English and in German

Table II – French nomenclature about peaty or unpeaty marshes and mires and its equivalence in English and German : (*french*, english, german terms)

Do not confuse the english moor (land often covered in heather) with the german Moor (mire).

<i>MARAIS</i> , in a very broad meaning area nearly wet in permanence and covered by a dense or fairly dense vegetation			
<i>MARAIS, MARECAGE</i> = MARSH, SWAMP, CARR = <u>RIED, SUMPF, BRUCH</u> (in a more restricted meaning)		<i>TOURBIERE</i> <i>BOMBEE</i>	<i>LANDE</i> <i>TOURBEUSE</i>
minerotrophic eutrophic		minero-ombrotrophic oligotrophic	ombrotrophic oligotrophic
<i>marais plat</i> , of high productivity unpeaty or peaty		<i>marais bas, bas-marais</i> less productive, as the raised mire	<i>marais bombé,</i> <i>haut-marais</i>
<i>marais salé,</i> <i>saumâtre ou minéral</i> saltmarsh or mineral marsh <u>Salzteich, Ried</u>		<i>marais ou tourbière de transition</i> transitional or intermediate mire <u>Übergangsmoor, Zwischenmoor</u>	moor(-land), heather moor <u>Heidemoor,</u> <u>Moorheide</u>
<i>tourbière plate</i> fen(-land) <u>Flachmoor, Ried</u>		<i>tourbière basse</i> fen(-land) <u>Niedermoor</u>	<i>tourbière haute</i> bog, raised mire <u>Hochmoor</u>
<i>TOURBIERE</i> , in a broad meaning = MIRE, PEATLAND = <u>MOOR</u> wetland covered with vegetation and producing peat			
		<i>TOURBIERE</i> , in a strict meaning, usually with peat-mosses (<i>Sphagnum</i>)	
<i>marais à roseaux</i> reed-marshes		<i>tourbières à sphaignes</i> peat-mosses mires	
		<i>tourbières à hypnacées</i> Hypnaceae mires	

If confusion sometimes reigns in the scientific classification, this seems even worse for the terms usually used to describe these systems and habitats in French. Besides the word *tourbière* (mire) which is coming from *tourbe* (peat), one also often uses *marais* (marsh in general) and, sometimes, *étang* (pond) or *lac* (lake) when referring to a stretch of water invaded by a mire. For some people, the term *tourbière* only corresponds to acidic habitats containing *Sphagnum* (therefore equivalent to bog) and, for many, the term *marais*, which incidentally is very imprecise - *marécage* (marsh and swamp) is even more imprecise!, only refers to those areas that are damp and rich in vegetation, but without obligatory reference to peat. It is true that some types of marshes do not produce peat (for examples, saltmarshes or

salty marshes on the seashore, marshes on mineral substrates on the edges of lakes or ponds, marshes and wet meadows with summer drying along rivers like the Loire or the Saône), but very many marshes are peat-producing and therefore must be classified as mires (by definition !).

In fact, to try to set up a coherent nomenclature, it seems necessary to turn to the German mire scientific literature, which is very prolific in mire terminology; the abundance and diversity of these systems in central and boreal Europe is the main reason of that. Table II gives the main different possible meanings of these French terms together with their equivalents in English and German, allowing them to be linked to the more scientific and precise classifications discussed above. The French generic term *tourbière* corresponds to mire in English and Moor in German.

Classically, it is possible to distinguish the raised mires (ombrogenous or ombrotrophic) from the other types (minerotrophic), which is shown well by the English and German terms: bog and Hochmoor for the former, fen and Niedermoor-Flachmoor for the latter. In French, the distinction is still true, but less perfect, with the use of *tourbière* (in its narrowest definition) in the first case and *marais* in the second. From the point of view of flora, raised mires correspond to poorly productive ecosystems dominated by *Sphagnum* and *Polytrichum*, many *Cyperaceae* and various *Ericaceae*, whereas the other types are covered by reeds, rushes, other *Cyperaceae* and a great variety of other plants. In addition, the fens of average or poor productivity (*bas-marais*, Niedermoor) should be distinguished from the fens of high productivity (*marais plats*, Flachmoor), but, in the majority of cases, these two types are mixed-up, or grouped together, using only the term *bas-marais* (fen) (for more details, see Manneville, Vergne and Villepoux, 1999, and Wheeler and Proctor, 2000).

Mires habitats and plant or animal species present in France and of great interest to European heritage

Peaty habitats are the refuge of groups of plants and numerous remarkable species, often rare and threatened, which is why they were taken account of in the 1992 European Habitats Directive; the majority of peaty or parapeaty habitats, characterized by their vegetation and their phytosociological equivalence and presented in Table III, are either of European interest or of special interest and priority. This concerns, in particular, all the *Sphagnum* raised mires and numerous habitats of the early (pioneer) stages. The variety is great, from the aquatic or very open phases to the peaty thickets and woods, from the back-littoral mires to the mires and *pozzines* of the high mountains, from the communities with reed and tall sedges of the floodplains to the moorlands with *Ericaceae* and the complexes of hummocks and bog pools of the peaty oceanic moors or of the mountains raised mires in humid climates, passing via the sloping basic oozing mires.

Table III – Peaty, parapeaty and peripeaty habitats (forming peaty systems and mires complexes) found in France, with their phytosociological equivalence, their CORINE code and their European union status :

* So as not to too disorient the reader, the classic syntaxons are indicated; they are likely to be radically restructured (see JULVE, 1993 et 1996).

CORINE codes 1991		Habitats names and phytosociological equivalents p.p., partially - status: IC = of European Union interest, P = of priority status	
16.3 (see 37.4)	IC	Humid dune-slacks p.p.	<i>Caricion viridulae-trinervis</i> <i>Molinio-Holoschoenion romani</i>
22.11 X 22.3	IC	Oligotrophic wet soils with amphibious communities vegetation p.p.	<i>Littorelletea uniflorae</i> , <i>Juncetea bufonii</i>
22.13	IC	Eutrophic waters with aquatic weeds (pondweeds, water lilies) p.p.	<i>Potametea pectinati</i> , <i>Lemnetea minoris</i>
22.14	IC	Dystrophic acidic waters	<i>Utricularion minoris</i> ?
31.11 and 31.12	P	Northern and southern wet heathlands, sometimes with peat-mosses	<i>Ericion tetralicis</i> s.l.
31.622	IC	Subarctic willow bushes p.p.	<i>Salicion lapponi-glaucosericeae</i>
36-372		Corsica pozzine mat grasslands p.p.	<i>Nardion strictae</i> p.p.
37.1		Meadow sweet stands and related communities	<i>Filipendulion ulmariae</i>
37.2 and 37.32		Eutrophic and oligotrophic humid rushes communities p.p.	<i>Juncion acutiflori</i> <i>Juncion squarrosi</i>
37.31	IC	Purple moorgrass meadows and related communities p.p.	<i>Molinion caeruleae</i>
37.4	IC	Mediterranean wet dunes communities p.p.	<i>Molinio-Holoschoenion romani</i>
37.7 and 37.8	IC	Humid tall herb fringes in plains or lower mountains p.p.	<i>Calystegion sepium</i> <i>Filipendulo-Cirsion rivularis</i>
42.213	IC	Peatmoss subalpine spruce forests	* <i>Sphagno-Piceetum abietis</i>

44.9		Alder, willows and bog-myrtle swamp woodlands	* <i>Alnion glutinosae</i> , <i>Salicion cinereae</i> , <i>Frangulo alni-Salicion auritae</i> , <i>Osmundo-Myricion gale</i>
44 A	P	Birch and conifers wooded bogs	* <i>Betulion pubescentis</i> , * <i>Sphagno-Pinetum s.l.</i>
51.1	P	Near natural raised bogs	* <i>Oxycocco-Sphagneteta</i>
51.2	IC	Purple moorgrass bogs	* <i>Oxycocco-Sphagneteta</i>
52.1 and 52.2	IC P	Blanket bogs (very rare in France)	* <i>Oxycocco-Sphagneteta</i> , <i>Caricetea nigrae</i>
53.1		Reed beds p.p. (various types)	<i>Phragmition australis s.l.</i> , <i>Oenanthion aquaticae</i>
53.2		Large sedges communities p.p.	<i>Caricion elatae</i> (= <i>C. rostratae</i>), <i>Caricion acutae</i>
53.3	P	Fen-sedge alkaline communities p.p.	<i>Cladietum marisci</i> (in <i>Caricion elatae</i>)
54.11		Soft water acidic springs p.p.	<i>Montio fontanae-Cardaminetalia amarae</i>
54.12	P	Hard water alkaline springs p.p. (sometimes producing tufa)	* <i>Cratoneurion commutati</i> , <i>Cardamino amarae-Chryso-splenietalia oppositifolii</i>
54.2	IC	Alkaline fens	<i>Caricion davallianae</i> , <i>Schoenion nigricantis</i>
54.3	P	Arcto-alpine riverine swards	<i>Caricion bicoloris-atrofuscae</i>
54.4, 54.44		Acidic fens and intricated sedge pozzines	<i>Caricion nigrae</i> , <i>Eriophorion scheuchzeri</i> , <i>Bellidio bernardii-Bellion nivalis</i>
54.5	IC	Transition mires and quaking mats	<i>Caricion lasiocarpae s.l.</i> , (<i>Utricularion minoris</i>)
54.6	IC	White beak-sedge communities on peat	<i>Rhynchosporion albae</i>

TABLE IV – Plant and animal species depending more or less on peaty habitats in France and cited in the annexes of the European Directive of 1992 :

annexe II species of European Union interest requiring special conservation zones

annexe IV species of European Union interest requiring strict protection

annexe V species of European Union interest whose sampling or exploitation may be managed.

FLORA (Br = bryophyte)	FAUNA	FAUNA
Annexe II : <i>Aldrovanda vesiculosa</i> <i>Apium repens</i> <i>Caldesia parnassifolia</i> <i>Ligularia sibirica</i> <i>Liparis loeselii</i> <i>Luronium natans</i> <i>Saxifraga hirculus</i> <i>Thorella verticillatinundata</i> <i>Drepanocladus vernicosus</i> Br <i>Meesia longisetata</i> Br <i>Sphagnum pylaesii</i> Br	Annexe II : <i>Mustela lutreola</i> <i>Emys orbicularis</i> <i>Triturus cristatus</i> <i>Coenonympha oedippus</i> <i>Euphydrys aurinia</i> <i>Thersamolycaena dispar</i> <i>Maculinea nausithous</i> <i>Maculinea teleius</i> <i>Leucorrhinia pectoralis</i> <i>Austropotamobius pallipes</i>	Annexe IV : <i>Mustela lutreola</i> <i>Emys orbicularis</i> <i>Triturus cristatus</i> <i>Triturus marmoratus</i> <i>Rana arvalis</i> <i>Rana dalmatina</i> <i>Rana lessonaen</i> <i>Bufo calamita</i> <i>Bufo viridis</i> <i>Hyla arborea</i> <i>Hyla meridionalis</i> <i>Coenonympha heroe</i> <i>Coenonympha oedippus</i> <i>Lycycaena dispar</i> <i>Maculinea nausithous</i> <i>Maculinea teleius</i> <i>Leucorrhinia caudalis</i> <i>Leucorrhinia pectoralis</i> <i>Leucorrhinia albifrons</i> <i>Dytiscus latissimus</i>
Annexe IV : <i>Spiranthes aestivalis</i>	Annexe V : <i>Mustela putorius</i> <i>Rana esculenta</i> <i>Rana ridibunda</i> <i>Rana temporaria</i> <i>Hirudo medicinalis</i> <i>Astacus astacus</i> <i>Austropotamobius pallipes</i>	
Annexe V : <i>Cladonia</i> of group <i>Cladina</i> <i>Leucobryum glaucum</i> Br Genus <i>Sphagnum</i> Br <i>Lycopodiaceae</i>		

Table IV shows the plant and animal species cited in the annexes of this Directive which are more or less linked to peaty habitats and their surroundings. This short list does not really account for the presence, in these habitats, of more than 350 vascular plants, among them the carnivorous plants (*Drosera*, *Pinguicula* and *Utricularia*), numerous species of *Cyperaceae*, rushes, orchids and *Ericaceae*, of many aquatic and amphibious plants, the bog myrtle *Myrica gale* and other ligneous, *Gentiana pneumonanthe*, *Trientalis europaea* and, finally, diverse ferns and related groups like *Lycopodiella inundata*, *Osmunda regalis* and *Dryopteris cristata*, etc. Between 35 and 40 plant species, depending on the broadness of the definition of peaty biotopes, are protected at national level and more than 150 are protected in at least one French region (lists in Manneville et al., 1999). To this, one must add more than hundred species of bryophytes, including nearly 30 *Sphagnum* species - almost exclusive to these habitats, a lot of fungi, of which many

live in symbiosis with the roots of higher plants, and diverse groups of algae, above all microscopic, like the diatoms and the desmids (hundreds of species have been recensé).

Concerning the fauna, the qualitative data are very uncertain, even if one knows that very many invertebrates (above all the arthropods) are tyrphophilous; for the vertebrates, which have larger territories and move about more, species which depend strictly on mires habitats are very rare, even if some of them are regularly found there. Let us cite the case of several species of rare butterflies found only in mires because their host-plants live there: the species or genus *Boloria aquilonaris*, *Colias palaeno* whose caterpillar feeds mainly on *Vaccinium uliginosum*, *Eurodryas aurinia*, *Coenonympha* ssp. whose host-plants are the *Cyperaceae* and *Molinia*, *Lycaena* s.l. on the *Polygonaceae*, among them *Polygonum bistorta*, and, finally, the *Maculinea* of which one species feeds on *Gentiana pneumonanthe* and two species feed on *Sanguisorba officinalis*. Other groups of animals are equally remarkable and diversified: dragonflies, dipterans, spiders, batrachians, etc (Manneville, Vergne & Villepoux, 1999).

Assessment of the decline of mires in France

The decline in surface area and biological quality of French mires is especially marked since the beginning of the 19th century, and technical progress and the desire to convert rural or natural land has only exacerbated this. It is estimated that the surface of these habitats in France has gone from more than 120,000 ha before 1945 to nearly 60,000 ha today; one finds this phenomenon throughout Europe (Goodwillie, 1980). In this way, many French mires of great extent have been practically erased from the map; one can cite the cases of the Le marais des Echets near Lyon, almost all of the Marais Poitevin and the marshes of Redon, the mire of Chauderolles in Auvergne, etc.

During the last century, it has been possible to observe large changes in the relative importance of the various causes of regression. Here we tackle succinctly some of these (for more details, see Goodwillie, 1980 ; Manneville et al., 1999 ; Manneville, 2001).

The extraction of peat, for heating, up until around 1950, and subsequently for horticultural use in cultivation substrates, is today in full expansion. In 1995, France consumed around 900,000 tonnes, of which 500,000 tonnes were imported, compared with respectively 250,000 and 85,000 in 1975 ; so, despite the large increase in imports, the national production has been multiplied by nearly 2 in 20 years. This fact clearly sets the problem of regeneration of this resource or the search to alternative products.

Intensive agriculture or forestry, above all for maize or poplar, have been very destructive for the mires of the floodplains or large valleys, because it required the soil to be drained and dug over, which completely disrupted their hydrology. In addition, the indirect effects of intensive agriculture or farming nearby have often caused their degradation by eutrophication (addition of fertilizer, liquid manure leakage); many mires are in basins and therefore collect everything that flows down the slopes. Recently, the ONF (French office for the forests) has taken steps to stop conifers plantations in marshy areas of lands managed for forestry and more general consideration is currently being taken to slow forestry plantations on private land. On the other hand, traditional extensive agriculture (wood-cutting, mowing, seasonal pasturing, light cutting of the superficial ground layer) have often been very beneficial to the functioning of mires and a source of countryside or biological diversity. Their progressive abandonment since 1950 has been a major cause of the degradation of the mires of the lowlands; these marshes have been invaded by scrubs and closed-in, leading to the disappearance of many pioneer communities and numerous interesting animal or plant species.

Quite recently, one can observe an alarming increasing in the transformation of mires and marshes into lakes or ponds, either by drowning to create reservoirs, or by digging for fishing or water sports.

Progress in the inventories, the conservation and the management of mires habitats in France

French mires have been the object, at the end of the 20th century and the beginning of the 21st, of sustained interest by scientists (Bournérias and Sajaloli., 1994; Laplace-Dolonde et al., 2001), by the protectors and managers of natural areas (Dupieux, 1998; Hervio, 1996) and by people interested in water resources. Since 1994, in the framework of the *Plan National d'Action pour les Zones Humides*, French mires have therefore benefited from numerous measures aimed at knowing them better (regional inventories and fundamental research into their diversity, their hydrological functioning and their dynamics), at preserving them better and at managing them in a sustainable fashion (land purchases or contracts, legal protection, synthesis of management techniques and large-scale tests) and, also, to get them better known and recognized (Julve, 1996; Manneville et al., 1999). The European project L.I.F.E. *Tourbières de France*, associated with some others regional projects, was the origin of this action and the annual *Forum des Gestionnaires d'Espaces Naturels*, held in Paris in March 1998, was devoted to these ecosystems.

Every year since 1986, the (French-speaking) *Groupe d'Etudes des Tourbières* (G.E.T) has organized, with the help of regional nature conservation organizations, a field session in a French region or in a border country, so as to improve and exchange the knowledge and experience of its members.

Apart from the summaries and an overall national policy, various French regions have finished or are currently finishing their inventories and setting up of strategies for protecting mires : Auvergne, Bretagne, Franche-Comté, Limousin, Midi-Pyrénées, Picardie, Rhône-Alpes. During the summer of 2001, this vast movement in support of French mires, leaded by scientists and conservationists, ended up by the creation of a National Resource Center related to the

mires and settled in Besançon; this is a reference and documentation center for everything concerning the practical understanding and management of peaty habitats and mires ecosystems.

We hope that this synthetic presentation, no doubt too short and incomplete, will nevertheless allow the richness and the diversity of French mires to be well demonstrated and, equally, will clarify the concepts and unify the terminology for the future, in such a way that all the people concerned by mires can understand each other and thus work more effectively for the conservation of these remarkable ecosystems. For more complete information on anything presented here about French mires, you may consult the book of Manneville, Vergne & Villepoux, (1999).

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