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

First of all, let us recall the classic general definition of this type of ecosystem: a mire is damp terrain colonized by the vegetation that develops on soil that is poorly permeable, made up of peat, of a thickness of 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 certain ligneous plants) in an environment that is almost always humid, 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, or fossil or dead mires. One must also add at this point, that many mires are often described in France using the very vague term « marais » (marsh or bog). Until 1994 the mires in France 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 that was poorly understood and not clarified from the point of view of topology.).

BIOGEOGRAPHICAL AND FUNCTIONAL DIVERSITY OF THE MIRES IN FRANCE

French mires and peaty bogs represent less than 1% of the area of the country, which is very little compared with more northern countries (Canada, the British Isles, Fenno-Scandinavia and Russia), but the diversity is very great, as demonstrated by the number of habitats listed in **Table 2** (see later). This diversity arises for various reasons, which are summarized below (**Figure 1**):

• altitude, which varies from sea level up to 4800 m: indeed one still finds rare peaty systems above 2500 m. In this case it is the temperature which will determine the differentiation of diverse types of peaty systems;

• extremely wide climatic range, which induces large gradients over relatively short distances (of the order of a thousand kilometers). One can cite the Atlantic climates or influences, attenuated to a greater or lesser extent (the Atlantic front corresponds 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 depending on the altitude: one finds highland Atlantic climate in Limousin or the western Pyrenees, highland continental climate in the Hautes-Alpes or the Vanoise or even in the Jurassian chain, and highland Mediterranean climate in Corsica, in the eastern Pyrenees or the southern Alps. One must, of course, add to all that, all the intermediate climates possible between the most typical cases. The water balance, dependent both on the amount of precipitation and the temperatures, induces the existence of functional types which are quite different in different areas of France;

• great variety in the geological substrates, whether these are recent sediments or more ancient rocks (granites, basalts, shales, gneiss, sandstones or calcareous clay). This will have an influence on the chemistry and the pH of the various peats, from the most basic with the formation of tufa (pH = 8) to the most acidic and poorest in minerals with settlements of peat mosses (pH = 4 sometimes);

• and finally, great variety in the type of relief or the geomorphology. In France one finds back- littoral mires near the sea, marshes of the plain in large fluvial valleys or beside wide perialpine lakes, peaty moors and pools in the hercynian mountain range which have quite a soft relief, sloping marshes created by resurgences or acidic or basic oozings, and many peaty-lakes arising either from the action of quaternary glaciers (in almost all the mountains of the country, from the Vosges to the Pyrenees) or from volcanic geomorphology (Massif Central).

We note that the *Sphagnum* raised mires are less clearly linked to the geomorphology than the other

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 regions of France richest in typical raised mires are, in order of importance, the Jurassian chain, the Vosges, the Auvergne and the northern Alps (especially the Haute-Savoie).

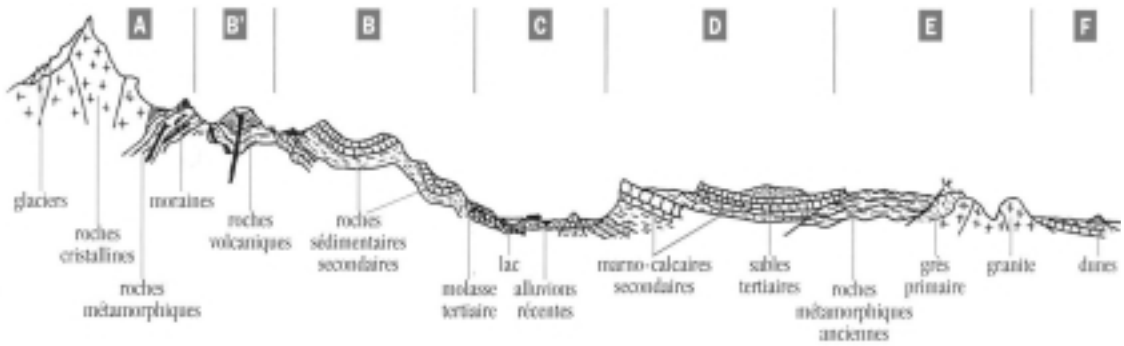

Figure 1. *The relationship between the geomorphology, the biogeography and the different types of mires in France (zones A to F) and in the Rhône-Alpes region (zones A to D) (see the section on the inventory of the Rhone-Alpes mires later in this article).*

MIRE SYSTEMS	ZONE A	ZONE B	ZONE C	ZONE D	ZONE E	ZONE F
pannes, back littoral marshes						●●
estuaries and deltas						●●
large valley marshes		●	●●	●●	●	●●
sides of wide lakes			●●			●
sloping mires	●●	●●	●●	●●	●●	
peaty moorland				●●	●●	●●
blanket bogs					●?	
forest peaty bogs			●	●●	●	●
peaty pools			●	●●	●●	●●
peaty lakes	●●	●●	●			●
raised mires		●●	●	●	●●	●
high mountains marshes,"pozzines"	●●					
peaty forests or wooded mires main types in different zones)	None or dwarf willow woodland	Spruce woodland Pine woodland Birch woodland	Alder woodland Willow woodland	Alder woodland Willow woodland Birch woodland	Birch woodland Alder woodland Pine woodland	Birch woodland Alder woodland Willow woodland

●● frequently found or ● seldom found

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

B = mountain, in the wider sense of the large mountain ranges subjected to quaternary glaciations (recent local volcanic activity)

C = lowlands of large inland fluvial valleys and of postglacial wide piémont lakes

D = slightly orogenic secondary basins, with cuestas, valleys and hummocks or glacis of sandy tertiary soils

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

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

As a result of various international efforts, the world classification of mires is currently tending to homogenize and clarify, 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, another called "ombrotrophic" – water arising from precipitation and therefore acidic and very poor, except, sometimes, close to the windswept coasts where there can be 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 certain raised mires, of saddle mires for example, and of blanket bogs) and are relatively independent of the geomorphology. The soligenous type corresponds to the mires that depend on springs, oozing, or streams, 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 – or sometimes 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 on the edges of a pond or 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.

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 stage, 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 one heads towards a system of peaty moorland. One must also distinguish the process of alluviation – movement from a stretch of water to a damp land system then possibly more dry, from those of paludification, in which the exogeneous arrival of waters makes aquatic or very damp peaty systems appear without an initial stretch of water.

To this first definition, which has the advantage of defining the functioning and 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 phosphour, the acidity, (basic mires to be contrasted with acidic mires) and the carbonate or calcium content which are often linked to it (Bridgham *et al.,* 1996). In addition, the vegetation is a good integrator of the conditions of the area and an indicator of the stage of evolution; one notes therefore that, in the absence of precise physico-chemical data, the observation of species and vegetable groupings in a mire often and rapidly permits one to estimate its characteristics and classify it; that is why the classification of the habitats is essentially based on the phytosociological study of the vegetation (CORINE-Biotopes, **table 2**).

One finds, in numerous regional or local forms, all the functional types cited above on French territory (figure 1), 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 one calls "blanket bogs" (tourbières de couverture). Naturally the boreal types of mire (aapa to be linked to the soligenous type and palsa mires to the topogenous type) are absent from France, but perhaps they existed in this country during the last ice ages ? These types occupy great surfaces in Sweden, Finland and Canada.

CLASSIFICATION OF FRENCH NOMENCLATURE OF PEATY HABITATS AND THE EQUIVALENT ENGLISH AND GERMAN TERMS

If confusion sometimes reigns in the scientific classification, this seems even worse for the terms usually used to describe these habitats in French. Besides the word tourbière (mire), one also often uses marais (marsh) 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 vague - marécage (marsh and swamp?) is even more vague!, only refers to those zones that are damp and rich in vegetation, but without reference to peat. It is true that certain types of mire do not produce peat (saltmarsh or salty marsh on the sea shore, marsh on a mineral substrate on the edges of certain lakes or ponds, marshes (or 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-tourbières- (by definition !)

In fact, to try to set up a coherent nomenclature, it is necessary to turn to the German literature, which is very prolific in mire terminology; the abundance and diversity of these systems in central and boreal Europe being the main reason. Table 1 gives all the different possible meanings of these terms together with their equivalents in German and English, allowing them to be linked to the more scientific classifications discussed above. The French generic term tourbière corresponds to Moor in German and mire in English.

Classically one distinguishes the raised mires (ombrogenous or ombrotrophic) from the other types (minerotrophic), which is shown well by the German and English terms: Hochmoor and bog for the former

Figure 1.
Peuil's mire on the Claix commune (Isère, France). This is a small site of 25 ha which constitute a mosaic of mire vegetation, bogs audics and alkaline fen.

and Niedermoor – Flachmoor and fen 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 peat mosses, *Sphagnum* and *Polytricum, 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 (bas-marais, Niedermoor) of average or poor productivity should be distinguished from the fens (marais plats, Flachmoor) of high productivity, but in the majority of cases these two types are mixed-up, or grouped together, using the term "bas-marais" (fen). For more details see Manneville, Vergne and Villepoux, 1999, and Wheeler and Proctor, 2000.

HABITATS AND PLANT OR ANIMAL SPECIES IN FRANCE 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 2, are either of European interest or of special interest, this concerns in particular, all the *Sphagnum* raised mires and numerous habitats at an early stage. 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 formations with reed and tall sedges of the great mires of the plains to the moors with *Ericaceae* and the complexes of hummocks and bog pools of the peaty Atlantic moors or the middle mountains raised mires in humid climates, passing via the sloping basic oozing mires.

TABLE I.
FRENCH NOMENCLATURE USED FOR PEATY HABITATS AND THE ENGLISH AND GERMAN EQUIVALENTS
Do not confuse moor (wild open land often covered in heather in English) with Moor (mire in German).

MARSH (in its broadest sense) Zone that is almost always wet and covered in dense or fairly dense vegetation				
MARSH, SWAMP, CARR = MARAIS, MARECAGE = RIED, SUMPF, BRUCH **in its limited meaning** (French) (German)			**RAISEDMIRES**	**MOORE-LAND, HEATHER MOOR**
mineotrophic *eutrophic*	*minero-ombrotrophic* *mesotrophic* *oligotrophic*		*ombrotrophic* *oligotrophic*	*minero-ombrotrophic, oligotrophic*
Plate marsh of high productivity **not peaty** or **peaty**	**Fen-sedge beds*** poorly productive (like the haut-marais)		**Raised mires***	
Saltmarsh, or mineral marsh		**transitional or intermediate mire = marais ou tourbière de transition** (French) **= Ubergangsmoor, Zwischenmoor** (German)		**= Lande tourbeuse** (French) = **Heidemoor, Moorheide** (German)
(French) (German)	**tfen(-land) tourbière plate Flachmoor, Ried**	**fen(-land) tourbière basse Niedermoor**	**bog, raised mire tourbière haute Hochmoor**	
MIRE, PEATLAND = **TOURBIERE (broad sense)** = MOOR Damp zone covered in vegetation and producing peat (French) (German)				
		Fen (strict meaning) Usually with peat mosses		
Reed marshes Marais à roseaux		*Sphagnum mires* Tourbières à sphaignes		
	Hypnaceae mires Tourbières à hypnacées			

Table 3 shows the plant and animal species cited in the annexes of this directive which more or less owe allegiance 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 aquatic and amphibious plants, the bog myrtle *Myrica gale* and other ligneous, *Gentiana pneumonanthe, Trientalis europaea* and, finally, diverse pteridophyles like *Lycopodiella inundata, Osmunda regalis* and *Dryopteris cristata,* etc... Between 35 and 40 species, depending on the broadness of the definition one gives to the notion 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 about a hundred species of bryophytes including nearly 30 *Sphagnum* (almost exclusive to these habitats), a great many fungi, of which certain 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 counted).

Concerning the fauna, the qualitative data are very vague, even if one knows that very many invertebrates (above all the arthropods) are tyrphophili; for the vertebrates, which have larger territories and move about more, species which depend strictly on peaty habitats are very rare, even if some of them are regularly found there. Let us cite the case of diverse species of rare butterfly 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* on the *Cyperaceae* and the purple moor-grass, the *Lycaena* s.l. on the *Polygonaceae*, among them *Polygonum bistorta*, and, finally, the *Maculinea* of which one species feeds on *Gentiana pneumonanthe* and two

TABLE 2.
PEATY, PARAPEATY OR PERIPEATY HABITATS
(forming peaty systems and peaty complexes) found in France, with their phytosociological properties, their CORINE code and their community status.

Codes CorineE 91		Habitats and phytosociologic names	
16.3 (see 37.4)	IC	Humid dune-slacks *p.p.*	*Caricion viridulae-trinervis Molinio-Holoschoenion romani*
22.11 X 22.3	IC	Lime-deficient oligotrophic water with amhibious communities vegetation *p.p*.	*Littorelletea uniflorae, Juncetea bufonii*
22.13	IC	Eutrophic waters with "hydrophytes" (pondweeds, water lilies) *p.p*.	*Potametea pectinati, Lemnetea minoris*
22.14	IC	Dystrophic waters	*Utricularion minoris ?*
31.11 and 31.12	P	P Northern and southern wet heaths	*Ericion tetralicis s.l.*
31.622	IC	Subarctic willow bushes *p.p*.	*Salicion lapponi-glaucosericeae*
36-372		Corsica pozzine mat-grasslands *p.p*.	*Nardion strictae p.p.*
37.1		Meadowsweet stands and related communities *p.p*.	*Filipendulion ulmariae*
37.2 and 37.32	IC	Eutrophic and ologotrophic humid grasslands *p.p*	*Juncion acutiflori Juncion squarrosi*
37.31	IC	Purple moorgrass meadows and related communities *p.p*.	*Molinion caeruleae*
37.4	IC	Mediterranean tall humid grassland *p.p*.	*Molinio-Holoschoenion romani*
37.7 and 37.8	IC	Humid tall herb fringes and subalpine and alpine herb communities	*Calystegion sepium Filipendulo-Cirsion rivularis*
42.213		Peatmoss subalpine spruce forest	**Sphagno-Piceetum abietis*
44.9	P	Alder, willow and bog-myrtle swamp wood	**Alnion glutinosae, Salicion cinereae, Frangulo alni-Salicion auritae, Osmundo-Myricion gale*
44 A	P	Birch and conifer swamp woods	**Betulion pubescentis, *Sphagno-Pinetum s.l.*
51.1	IC	Near natural raised bogs	**Oxycocco-Sphagnetea*
51.2	IC	Purple moorgrass bogs	**Oxycocco-Sphagnetea*
52.1 and 52.2	IC P	Lowland and upland blanket bogs	**Oxycocco-Sphagnetea et Caricetea nigrae*
53.1		Reed beds *p.p.*	*Phragmition australis s.l., Oenanthion aquaticae*
53.2	P	Large sedge communities *p.p*.	*Caricion elatae (= C. rostratae), Caricion acutae*
53.3	P	Fen-sedge beds *p.p*.	*Cladietum marisci (in Caricion elatae)*
54.11	IC	Soft water springs	*Montio fontanae-Cardaminetalia amarae*
54.12	P	Hard water springs	*Cratoneurion commutati, Cardamino amarae-Chrysosplenietalia oppositifolii*
54.2	IC	alkaline fens	*Caricion davallianae, Schoenion nigricantis*
54.3	P	Arcto-alpine riverine swards	*Caricion bicoloris-atrofuscae*
54.4 54.44		acidic fens and intricated sedge pozzines	*Caricion nigrae, Eriophorion scheuchzeri, Bellidio bernardii-Bellion nivalis*
54.5	IC	Transition mires	*Caricion lasiocarpae s.l. (Utricularion minoris)*
54.6	IC	White beak-sedge	*Rhynchosporion albae*

p.p., partially
Status: IC = of European Union interest
P = of priority

** 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).*

species feed on the *Sanguisorba officinalis*. Other groups of animals are equally remarkable and diverse: dragonflies, dipterans, spiders, amphibians, 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 area of these habitats in France has gone from more than 120 000 ha before 1945 to less than 60 000 ha today; one finds this phenomenon throughout Europe (Goodwillie, 1980). In this way, certain French mires or bogs of great extent have been practically erased from the map; one can cite the case of the marsh of Echets near Lyon, almost all of the Marais Poitevin and the marshes of Redon, the mire of Chauderolles in Auvergne, etc.

In 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 Hervio, 2001, to be published ; 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 clearly poses 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 to the mires of the plains or large valleys, because it required the soil to be drained and dug over, which completely disrupted [the functioning of] 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 hollows and therefore collect everything that flows down the slopes. Recently the ONF (French office for the forest) has taken steps to stop conifer plantations in marshy areas of land 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 mire ecosystems 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 plain, which have been overgrown with scrub and closed-in, leading to the disappearance of many colonizing habitats and numerous interesting animal or plant species.

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

TABLE 3.
PLANT AND ANIMAL SPECIES DEPENDING MORE OR LESS ON PEATY HABITATS IN FRANCE AND CITED IN THE EUROPEAN DIRECTIVE OF 1992.

FLORA	FAUNA	
Annexe II	**Annexe II :**	**Annexe IV :**
Aldrovanda vesiculosa	*Mustela lutreola*	*Mustela lutreola*
Apium repens	*Emys orbicularis*	*Emys orbicularis*
Caldesia parnassifolia	*Triturus cristatus*	*Triturus cristatus*
Ligularia sibirica	*Coenonympha oedippus*	*Triturus marmoratus*
Liparis loeselii	*Euphydryas aurinia*	*Rana arvalis*
Luronium natans	*Thersamolycaena dispar*	*Rana dalmatina*
Saxifraga hirculus	*Maculinea nausithous*	*Rana lessonaen*
Thorella verticillatinundata	*Maculinea teleius*	*Bufo calamita*
Drepanocladus vernicosus **Br**	*Leucorrhinia pectoralis*	*Bufo viridis*
Meesia longiseta **Br**	*Austropotamobius pallipes*	*Hyla arborea*
Sphagnum pylaesii **Br**	**Annexe V :**	*Hyla meridionalis*
Annexe IV :	*Mustela putorius*	*Coenonympha heroe*
Spiranthes aestivalis	*Rana esculenta*	*Coenonympha oedippus*
Annexe V :	*Rana ridibunda*	*Lycaena dispar*
Cladonia du groupe Cladina	*Rana temporaria*	*Maculinea nausithous*
Leucobryum glaucum **Br**	*Hirudo medicinalis*	*Maculinea teleius*
Genre Sphagnum **Br**	*Astacus astacus*	*Leucorrhinia caudalis*
Lycopodiaceae	*Austropotamobius pallipes*	*Leucorrhinia pectoralis*
		Leucorrhinia albifrons
		Dytiscus latissimus

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.

PROGRESS IN THE INVENTORY, THE CONSERVATION AND THE MANAGEMENT OF MIRE HABITATS IN FRANCE, MAINLY SINCE 1994

French mires have been the object, at this end of the century, of sustained interest by scientists (Bournérias and Sajaloli., 1994), by the protectors and managers of natural spaces (Hervio, 2001) or from the point of view of 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 function and dynamics), at preserving them better and at managing them in a sustainable fashion (land purchase, contracts, legal protection, summaries of management techniques and large-scale tests) and, also, to get them better known and recognised (Julve, 1996; Manneville *et al.*, 1999). The European programme L.I.F.E. "Tourbières de France" (see the inventory of peat lands of region Rhône-Alps article), associated with some others, was the origin of this action and the annual Forum des Gestionnaires d'Espaces Naturels, in Paris, was devoted to these ecosystems in March 1998 (Cf. Inventory of Rhône-Alps peat lands). Every year since 1986, the (French-

speaking) Groupe d'Etudes des Tourbières (G.E.T) has organised, with the help of regional management organisations, a field session in a French region or in a border country, so as to improve the knowledge and experience of its members. (the session in 2000 was held in Rhône-Alpes).

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, Midi-Pyrénées, Rhône-Alpes.

During the summer of 2001, this vast movement in support of French mires, scientists and conservationists should end up creating a National Resource Centre related to the mires, a centre answerable to the "Observatoire National des Zones Humides"; this will be a reference and documentation centre for everything concerning the practical understanding and management of peaty habitats.

We hope that this synthetic presentation, no doubt too abbreviated, will nevertheless allow the richness and diversity of French mires to be well demonstrated, particularly that of the Rhône-Alpes region, and equally, will clarify the ideas and unify the terminology for the future, in such a way that all the people concerned can understand each other and thus work more effectively for the conservation of these remarkable ecosystems. For more complete information on anything touched on here, you may consult the recent publication of Manneville, Vergne & Villepoux, (1999).

Figure 2. *Liparis loeselii*

BIBLIOGRAPHY

Bournérias M. & Sajaloli B., édit., (1994) - Les marais continentaux. C.R. du colloque de St Cloud 1993. *Bulletin de l'Association de Géographes Français,* n° spécial 94-3, 154 p.

Bridgham S.D., Pastor J., Janssens J.A., Chapin C. and Malterer T.J., (1996) - Multiple limiting gradients in peatlands : a call for a new paradigm.*Wetlands,* 16-1, 45-65.

Donadieu P., (1996) - Paysages de marais. Editions de Monza, Paris, 199 p.

Dupieux N., (1998) - La gestion conservatoire des tourbières de France : premiers éléments scientifiques et techniques. Espaces Naturels de France - Orléans, 244 p.

Goodwillie R., (1980) - Les tourbières en Europe. Conseil de l'Europe, *collection "Sauvegarde de la Nature",* 19, 82 p.

Hervio J.M., édit., (1996) - Comptes-rendus du Séminaire "Tourbières" de Parent - avril 1996. *Cahiers Scientifiques et Techniques "Tourbières de France",* ENF-Orléans, n°2, 36 p.

Hervio J.M., édit., (2001) - Comptes-rendus du 4° Forum des Gestionnaires consacré aux tourbières. Paris-1998. ENF-Orléans. *À paraître.*

Institut Européen d'Ecologie, (1981) - Inventaire des tourbières de France. Rapport pour le Ministère de l'Environnement - Direction de la Protection de la Nature (rapport de synthèse et un fascicule par région administrative).

Julve Ph., (1993) - Synopsis phytosociologique de la France. *Lejeunia,* N.S. 140, 160 p.

Julve Ph., (1996) - Les tourbières de France : écologie et valeur patrimoniale - La végétation des tourbières de France. *Cahiers Scientifiques et Techniques "Tourbières de France",* ENF-Orléans, n°1, 26 p.

Manneville O., Vergne V., Villepoux O. & le Groupe d'Etudes des Tourbières, (1999) - Le monde des tourbières et des marais - Belgique, France, Luxembourg, Suisse. Delachaux-Niestlé, Paris et Lausanne, 320 p.

Manneville O.,(2001) - Les tourbières de France ; causes de régression ; intérêts de leur conservation ; mise au point nomenclaturale. *Journal de Botanique,* Soc. Bot. France, 12: 73-82.

Wheeler B.D. and Proctor M.C.F., (2000) - Ecological gradients, subdivisions and terminology of north-west European mires. *Journal of Ecology,* 88, 187-203.

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