

# Strategies for peatland conservation in France - a review of progress

F. Muller

Fédération des Conservatoires d'espaces naturels, Pôle-relais tourbières, Besançon, France

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## SUMMARY

Mires in France provide important natural habitats. Although efforts to protect individual sites began in the 1970s, the development of strategies for mire conservation at regional, national and international levels is more recent. Nowadays mires fall within the remit of the national strategic plan for wetlands as well as the international European Union Natura 2000 and LIFE programmes. On the other hand, local initiatives are particularly effective in reaching stakeholders. This article reviews the various plans, strategies, facilities, and actions that operate at different geographical scales to deliver beneficial management of mires in France. Despite these wide-ranging initiatives, there is still cause for concern about the effects on mires of water pumping, fertiliser drift and overgrazing. Care must also be taken to enable site managers to effectively implement all elements of mire protection strategies, especially by providing relevant scientific information to them in appropriate forms.

**KEY WORDS:** Action Plans, EU Habitats Directive, LIFE-Nature, mire conservation, wetland management

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## INTRODUCTION

Most natural mires in France (Figure 1) have been destroyed or damaged by a wide range of human activities. They cover more than 0.2 % (approximately 1,000 km<sup>2</sup>) of the European part of the country, but the current estimate of peatland area could reach 275,000–300,000 ha (Julve & Muller 2017) if surfaces covered by Histosols without mire-related vegetation were included. Although rare, French mires are of great natural importance. Twelve of their habitats are listed in Annex I of the European Union (EU) Habitats and Species Directive, and eight of these are classified as priority habitats. As in some other central and south European countries, especially those including mountains, specific types of mires covering small areas occur in mosaics with other habitats and provide refugia for plant and animal species with limited ranges.

Effective conservation measures for mires in France were not developed until the 1970s. The first inventories, published at around that time (*e.g.* Gehu *et al.* 1981), were incomplete. In the past, efforts to protect mires have not always constituted a real 'strategy', but have rather focused on individual sites and species and depended on the goodwill of individuals and organisations. It is only recently that more substantial strategies have been developed at a range of geographical scales with support from national government, the EU, water agencies and/or local government (regions, départements). These

organisations either implement the actions themselves or subsidise NGOs and other land managers working at local or wider scale. The government has also launched national action plans for wetlands, and legislation to support the protection of wetlands has been improved.

Despite all these efforts, certain key issues have still not been adequately addressed. These include the following:

- peat cutting continues to be allowed, although the scarcity of appropriate sites and the low value of peat on the international market now largely limit this activity to ten sites with significant extraction;
- pumped water abstraction from (or more often around) mires prevents them from receiving sufficient water of appropriate quality; and
- the application of fertilisers on agricultural land adjacent to peatlands often reduces the quality and naturalness of their habitats through fertiliser drift and downwash into sites.

At a time when yet more new threats are appearing, especially those linked to global climate change, it is essential to ensure that mires are as resilient as possible (Lindsay 2015). This article reviews the strategies that are in place to drive the protection of mires in France, as an example of a country in western Europe that operates within the legislative framework of the EU. At national level, actions have been developed to improve the state of wetlands; how these plans affect mires is examined. Furthermore, a network of protected mires is

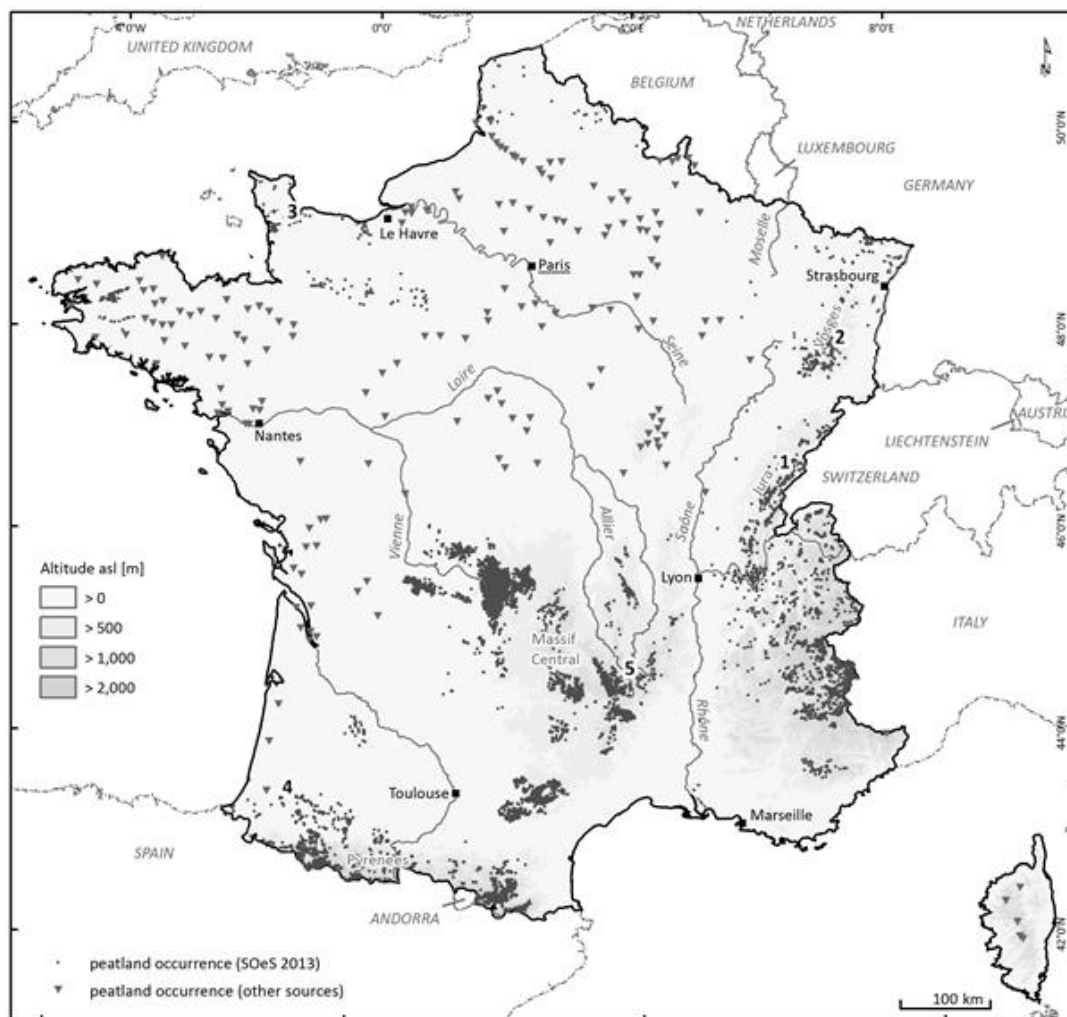


Figure 1. Map of current peatland distribution and locations of peatland areas of international importance in France. Dots indicate information from SOeS (2013). Triangles indicate information from various other sources compiled by Pôle-relais tourbières. In both cases, peatlands with characteristic vegetation are depicted, regardless of whether peat is currently being formed. Peatlands without characteristic vegetation (*e.g.* heavily drained peatlands) are included only for the following regions: 1=Druegon valley, 2=Tourbière du Tanet, 3=Tourbière de Baupte, 4=Les Mées, 5=Tourbière de Ribains. Significant mire areas in Guiana (Marais de Kaw) and the French Southern and Antarctic Territories (Ile d'Amsterdam, Iles Kerguelen, Iles Crozet) are not shown. This Figure is reproduced from Julve & Muller (2017).

currently being developed. National actions under the EU Natura 2000 programme (in which mires are widely represented) are included here, but it must be emphasised that these particular actions are being driven by two European directives. France also participates in international mire conservation partnerships, for example through EU “LIFE” programmes, which have a rather long-lasting boosting effect; and there are regional programmes which can involve the public, stakeholders and local operators working closely together. Finally, consideration is given to how these strategies can reach site managers, emphasising some possible challenges in knowledge communication and integration.

## ACTIONS AND STRATEGIES AT NATIONAL LEVEL

### National action plans for wetlands

In 1994, Prefect Paul Bernard noted in an assessment report (P. Bernard 1994) that French wetlands had been largely destroyed - two-thirds of the original wetland surface having disappeared within the last century - and those that remained were still under threat. He said that, until then, wetlands had “virtual protection without a real policy” and proposed that an action plan should now be formulated to address the situation. The first national strategic plan dedicated to wetlands was launched in 1995. This plan was not

formally published, but is summarised by Agence française pour la biodiversité (2017). The main objectives of the 1995 strategic plan were to address the drivers of wetland loss and degradation across all areas of agriculture and urbanism, to avoid laws with negative impacts, and to develop good practice. It aimed to:

- i) reinforce knowledge (including the development of inventories and evaluation tools);
- ii) improve the coherence of the different public policies affecting wetlands, thus improving the consideration of wetlands in all sectors;
- iii) support the preservation of wetlands, notably by improving their management; and
- iv) support awareness-raising by launching a programme of information involving all partners.

Although the situation has improved to some degree since 1995, especially with regard to the protection status of some wetlands through different designations (natural reserves, Natura 2000 sites, national parks, natural regional parks) and through land purchase (notably by Conservatoire du Littoral - the Seashore Conservancy), it was evident at the end of this first plan that efforts must be continued and reinforced. Thus, following assessment of the first plan, a second plan was launched for the period 2010–2013 (MEEDDM 2010), having been prepared and discussed with all the relevant stakeholders through a national group for wetlands which included representatives of the different ministries and departments, local authorities, NGOs, and the private sector. This second plan was more ambitious than the first plan, due to the ongoing need for urgent action, and benefitted from enhanced mobilisation of resources.

The evaluation of this second plan in 2013 was positive with regard to implementation, reporting strong efforts to protect the most important sites through different designations and through land acquisition. The involvement of water agencies reinforced the actions of Conservatoire du Littoral and NGOs, enhancing the success of restoration efforts. But the evaluation also pointed out that the trend of degradation in more than 50 % of wetlands that had been identified for the period 1990–2000 seemed, unfortunately, to be more or less unchanged during the period 2000–2010, with significant negative pressures from human activities - especially agriculture and urbanisation - detected for more than half of the important wetlands. Thus, any positive effect of the Plan and its implementation was not yet really measurable.

It was concluded, therefore, that despite some significant advances in wetland improvement, specific points still had to be addressed and a third

action plan was proposed for 2014–2018 (MEDDE 2014). Apart from one action concerning an EU-funded LIFE+ programme for the restoration of mires in Franche-Comté region, this third plan (like the previous ones) does not contain actions that specifically target mires. However, all except the first of its six headlines are clearly relevant:

- Line 2 aims for increased knowledge and use of strategic tools for the proper management of wetlands. It is guided by the need to know how to improve protection (through inventories and cartography, setting out where mires are located), identify trends (through monitoring), and understand which functions and services are offered by wetlands. This last aspect is of major importance in terms of placing value on the preservation of wetlands, not only for their environmental significance but also for social and economic benefits.
- Line 3 favours the use of some programmes (such as LIFE+) to achieve the objectives. It aims to intensify actions in biotope preservation that reconcile the different viewpoints relating to the quality of water bodies and the restoration of ecological continuities (this last item is encapsulated in France as the principle of ‘TVB’, Trame verte et bleue = Green and Blue Infrastructure). The actions are aimed at ensuring better consideration of wetlands in land planning and in large-scale programmes concerning whole water basins or regions, including work in overseas territories, as also stipulated by the EU Water Framework Directive.
- Lines 4 and 5 aim to achieve a better consideration of wetlands in areas of policy which have influenced widespread wetland loss, with notable focus on agriculture and grazing. The aim is to improve the way in which wetlands are taken into account within land planning policies including urbanisation, agriculture, water and flood management, and in some places including overseas territories, inter-tidal areas and estuaries. Concerning agriculture, Line 4 aims for better training of professionals in key topic areas, including the development of agro-ecology on wetlands and a realignment of farming practices towards conservation of these habitats and their functions, for example through extensification of grazing in overgrazed areas.
- Finally, Line 6 aims to enhance public awareness and develop educational tools which, as assumed by the Ramsar Convention, is a very important aspect of the efforts that are necessary to ensure long-lasting protection. Following on from the first “capacity building, education, participation

and awareness” (CEPA, CESP in French) strategy running since 2012, France launched a new strategy concerned with this topic in 2016. The resources centres described below are deeply involved in this line.

### National resource centres for wetlands

Five Resource Centres for wetlands were established under the First Action Plan. They receive financial support notably through the French Agency for Biodiversity (AFB). They focus, respectively, on:

- i) Atlantic marshes;
- ii) Mediterranean lagoons;
- iii) inland wetlands (lake shores, ponds, marshes and floodplains);
- iv) mangroves and wetlands of overseas territories;
- v) mires, wet heaths and upper river basin wetlands.

The general aims of these resource centres focus on four main items:

- i) identifying and developing tools for monitoring and assessing the measures taken in favour of wetlands;
- ii) promoting the coherence of public policies;
- iii) facilitating the restoration of wetlands;
- iv) identifying and developing appropriate information and raising environmental awareness.

Experience gained during the European Union funded Life-Nature programme "Peatlands of France" (1995–1999) (Dupieux 1998) enabled the Ministry of Ecology and Sustainable Development to commission the programme co-ordinator FCEN (Federation of the Conservancies of Natural Areas) to set up, manage and staff the French Mire Resource Centre. Its remit is the knowledge, the sustainable management and the assessment of mires within French territory. It has developed a documentation centre with over 7,000 references that can be found online<sup>1</sup> or viewed in its library located in Besançon. In addition to these so-called “pôles-relais”, a national resource centre that was completed and implemented during the First Programme for CESP (communication, education, awareness and participation of the public) 2012–2014 includes:

- the national portal for information on wetlands, operated by the newly created AFB (French Agency for Biodiversity)<sup>2</sup>;
- a newspaper, “Zones humides Infos”, dedicated to wetlands and written by a group of experts moderated by Société nationale de protection de la nature<sup>3</sup>; and

- the National Observatory for Wetlands, integrated into the National Observatory of Biodiversity, which develops and implements indicators to assess knowledge and to check the effects of specific works.

### National action plans for species

Action in favour of any type of biotope in France has often begun with measures for the protection of plant and animal species. This was also true for mires. More recently, as some species could not maintain their populations despite legal protection, better-integrated national action plans focusing on rare and threatened species have been launched. These are developed in order to ensure the best possible level of conservation for one or a group of species within the national territory. They seek to:

- i) identify the reasons for decline;
- ii) counteract these trends, involving all possible stakeholders; and
- iii) disseminate information about what has been done.

These action plans can have a regional focus. The following species of French peatlands have already benefitted from such plans: Marsh Saxifrage *Saxifraga hirculus*, Fen Orchid *Liparis loeselii*, Capercaillie *Tetrao urogallus*, Aquatic Warbler *Acrocephalus paludicola*, Large Blue Butterflies *Maculinea* spp., and several dragonflies which were grouped together in an action plan developed for *Odonata* species.

Considering the example of the Fen Orchid Action Plan (Valentin *et al.* 2010, G. Bernard 2014), it was shown that this plant had been historically known in 226 communes but that after 2000 it could be found in only 78. This orchid is threatened by loss of open habitat, mostly caused by the abandonment of traditional agricultural practices, by drying-out of wetlands, by the intensification of different farming practices combined with the use of fertilisers, and sometimes through colonisation by invasive plants such as *Solidago* sp. or *Cortaderia selloana*. The action plan includes the following key aims:

- i) to map the populations of this orchid, identify favourable management techniques and pursue biological studies concerning reproduction and the conservation of seeds;
- ii) to favourably manage habitats, to purchase sites of importance, and to address negative influences (*e.g.* drainage, pumping) on water table levels and water quality; and

<sup>1</sup> <http://pole-tourbieres-doc.org/dyn/portal/index.seam?page=home&fonds=2>

<sup>2</sup> <http://www.zones-humides.eaufrance.fr/>

<sup>3</sup> <http://www.snpn.com/spip.php?rubrique23>

iii) to present these actions to the public, stakeholders and local authorities, as well as to exchange scientific and technical data at national and international levels.

### Scientific aspects and programmes

In the First Action Plan for Wetlands, special attention was paid to research, which improves our knowledge about how mires function and supports decision-making about their appropriate management. The ‘Programme national de recherche sur les zones humides’ (PNRZH; Barnaud *et al.* 2004) mobilised different teams of scientists for research projects on wetlands. For mires, socio-economic changes leading to the transformation of mires from production areas to protection areas were studied by Canivé & Laplace-Dolonde (2004). Only minor parts of the Second and Third Action Plans focused on research, and they contained nothing specifically about mires.

RECIPE was a collaborative research project funded by the European Union Fifth Framework Programme. The programme involved three French laboratories (plus several from other countries), and ran from January 2003 to May 2006. RECIPE aimed to assist both conservationists and managers of peat extraction by providing information about options for re-establishing peat accumulation and carbon sequestration in peatlands that had been either abandoned or designated for restoration.

Some other initiatives are currently led by different universities or the National Centre for Scientific Research (CNRS). Thus, France is one of the leaders in research into palaeo-environments and the interactions between climate change and wetlands. French-Swiss teams are also active in the field of micro-organisms in mires.

In 2012, the French Mire Resource Centre organised a meeting of different research teams to discuss the scientific programmes about mires that had been completed, together with those in progress or in prospect. A report of this meeting is available (Pôle-relais tourbières 2013).

The National Monitoring Service for Mires (SNO Tourbières<sup>4</sup>) is a long-term infrastructure based on the observation and modelling of the functioning of temperate-zone mires as they are subjected to climatic and human disturbance. Its purpose is to congregate multiple scientific disciplines around four sites equipped for measurements, and create synergy between them so that carbon flows between the

atmosphere and the soil can be observed and modelled. The four sites are Bernadouze (Occitanie), Frasné (Burgundy-Franche-Comté), La Guette (Region Centre-Val de Loire), and Landemarais (Brittany). The SNO’s mission also includes the implementation and management of a database for carbon flows, and it is responsible for documenting the development of experiments where temperature and water table levels are modified. All these activities are intended to be developed within an international framework and similar experiments are being implemented along a south–north gradient, at Linje Mire (Poland) and Mukhrino Field Station (Western Siberia) (Lamentowicz *et al.* 2016).

Mention is also due to the research of Université de Saint-Etienne (Cubizolle *et al.* 2012, Cubizolle & Thebaud 2014) on ‘anthropogenic’ mires created since Neolithic, Roman or mediaeval times, following the construction of dams or other devices. These cases show how human activity can sometimes trigger the initiation of mires, although such sites are generally rather small.

### Protected areas

Several peatlands are strongly protected by law on account of their inclusion in National Parks (whereas Regional Parks do not have a strong level of protection) or Nature Reserves. The Natura 2000 network, initiated by the European Union, also includes a large complement of French mires.

#### National Parks

Among the ten French National Parks (including three located overseas), some have no or nearly no mires; these include Port-Cros, Calanques and Parc amazonien de Guyane (Guiana). Mires are rather widespread in the Cévennes National Park and present in the Pyrénées and Ecrins National Parks, although they are rare and located at high altitudes in the last two. Vanoise National Park (Northern French Alps) protects only 5 ha of bog and 110 ha of fen in its core area. A further 83 ha of bog and 850 ha of fen are located in the Optimal Adhesion Area (AOA), which is a form of buffer zone for the park (Vanoise NP, personal communication 2015). Mercantour National Park (Southern Alps) has only 1 ha of active bog and 66 ha of alkaline fen, with 46 ha of pioneer formations of *Caricion bicoloris-atrofuscae* (habitat #7240 of the European Habitats Directive) (Mercantour NP, personal communication 2015). Guadeloupe National Park (West Indies) includes

<sup>4</sup> SNO is operated by OSUC (scientific coordinator: F. Laggoun-Défarage) in association with other University centres: [THETA](#) in Besançon (D. Gilbert), [OSUR](#) in Rennes (A.-J. Francez) and [OHM Pyrénées Haut Vicdessos](#) (GEODE, INEE, D. Galop): <http://www.univ-orleans.fr/en/osuc/service-dobservations-so-tourbieres>.



flooded coastal areas (extent as yet unspecified), of which two-thirds are accumulating peat. These deposits can reach 10 m depth west of Rivière Salée. In the mountains of Guadeloupe National Park, mires are more local. Here, *Sphagnum* peat occurs in very humid summit areas but tends to be shallow because of frequent disturbance by eruptions and rock avalanches, although up to 12 m of forest peat has been recorded in depressions such as Val Kanaers (Guadeloupe NP, personal communication 2015). Réunion National Park (covering the whole core of this Indian Ocean island) also includes some peatlands at rather high altitude (Manneville 2005). Thus, the National Park network contributes to the peatland protection strategy, although peatlands in National Parks need little restoration work.

#### Nature Reserves

Today, the French Nature Reserves network includes 167 national reserves ‘RNN’ (2,751,498 ha), 167 regional reserves ‘RNR’ (39,020 ha) and 6 Corsican reserves (83,426 ha). Of these, 30 RNN and 26 RNR have at least 1 ha of mire habitat. Altogether, these designations protect, respectively, 1,511 and 2,273 ha of mire (not including overseas départements and territories such as Kaw RNN in Guiana and the huge Southern and Antarctic Territory Reserve). This is

only a tiny fraction of the >100,000 ha total area of mires in the European part of France, so this calculation clearly highlights a need to promote the creation of new nature reserves containing mire habitat (Darinet & Muller 2016).

When evaluating the success of Nature Reserves in terms of protection of biodiversity, it appears that they have positive effects at least for habitats and flora. Indeed, the Heritage Monitoring System of Réserves Naturelles de France shows that all ten peatland habitats of importance for the EU are represented in Nature Reserves (Fiers 2008). Nevertheless, the absence of Nature Reserves from some major peatland areas is an issue which deserves consideration and action (Darinet & Muller 2016).

#### Natura 2000 network

The database<sup>5</sup> of the National Museum of Natural History (MNHN) gives information about all the peatland habitats included in the European Natura 2000 network; for each site, each region or each habitat of the European Directive. The French state is engaged in the management of a significant part of this peatland area, with work to maintain the sites in good condition or to restore them being partially subsidised by the European Union. Table 1 provides a summary.

Table 1. Numbers of sites and areas of mires and fens in France corresponding to habitats listed in Annex I of the European Habitats Directive (National Museum of Natural History (MNHN) personal communication 2016, with a caveat that total areas may be over-estimated).

Type of mire: Annex I code and name	Number of sites	Corrected areas (in hectares)*
Bogs and transition mires	291	38148
7110 Active raised bogs	214	12144
7120 Degraded raised bogs still capable of natural regeneration	110	5819
7130 Blanket bogs	1	4
7140 Transition mires and quaking bogs	180	9127
7150 Depressions on peat substrates of the <i>Rhynchosporion</i>	110	11054
Fens	284	21297
7210 Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	111	8237
7230 Alkaline fens	229	12007
7240 Alpine pioneer formations of the <i>Caricion bicoloris-atrofuscae</i>	24	1053
Totals	447	59446

<sup>5</sup> <https://inpn.mnhn.fr/accueil/recherche-de-donnees/natura2000?lg=en>

## ACTIONS AT INTERNATIONAL LEVEL

France contributes to a range of international schemes relating to mire protection, as a result of having signed international conventions and in fulfilment of legal obligations arising from membership of the European Union.

### Mires in the Ramsar network

The Convention on Wetlands, signed in Ramsar (Iran) in 1971, was ratified by France in 1986. So far (December 2017), 48 sites have been designated in France (including overseas territories). Fourteen of these sites include mires. Until recently, no more than average attention was focused on the protection and management of Ramsar sites. In the last few years, action on Ramsar sites in France has been boosted by the creation of an NGO specifically for Ramsar site managers and renewed interest from the Ministry of the Environment; but the proportion of peatland sites in this network is still rather small (Figure 2). However, it is encouraging that the most recently designated sites ('Marais Vernier', 'Marais de Sacy' and 'Vallées de la Somme et de l'Arve') include some of the largest French peatlands.

### Actions supported by the European Union

Several key projects have been supported by the European Union (although mostly co-financed by the French Government and local authorities) under 'LIFE Nature' programmes. Most of these projects involve peatland management or restoration works. In 1992–2001, early in the lifetime of this fund, eight projects were focused on mires at local, regional or national level (Table 2). The only national programme, "Tourbières de France", had a long-lasting effect on different aspects, as observed by Raeymaekers (2015), "Altogether, the French LIFE mires projects covered a great diversity of habitat types, ranging from extensive wetlands dominated by lakes over typical fens and bogs to unique mire sites such as the 'pozzines' in the mountains of Corsica. The land use issues (agriculture, forestry, recreation, hunting,...) were equally diverse and resulted in the involvement of a wide range of local authorities and stakeholders. This in turn enabled demonstrative restoration actions, such as the restoration of the former river beds in the valley of the Drugeon in the Jura (eastern France), to take place." After 'LIFE', the sites have continued to be managed, often by the same operators, with grazing and mowing regimes frequently being established to maintain the biotopes on such 'marginal farmlands'.

More recently there have been local or regional programmes, with more focus than before on the

functional rehabilitation of mires. National actions continue meantime, through other means such as Action Plans. The recent LIFE+ programme "Mires in the Jura mountains of Franche-Comté", awarded 8 M € and continuing for six years from 2014, appears to be the largest LIFE Nature programme that has ever been conducted in France. It aims to achieve functional restoration of 60 mires in the Jura and is co-ordinated by Conservatoire d'espaces Naturels de Franche-Comté.

Other European programmes have been supported by ERDF (the European Regional Development Fund, FEDER in French), such as the project conducted in Picardy (1998–2000) which incorporates a socio-ecological approach. Also of significance are the projects that are now being prepared by several Natural Regional Parks and Conservancies of Natural Areas (CEN) to protect and restore mires in various parts of the Massif Central, with an emphasis on reinstating the hydrological balance of mires.

## ACTIONS CO-ORDINATED AT REGIONAL LEVEL

### Role of private and public bodies in supporting or initiating measures

Ever since their creation, mostly in the 1980s, the regional conservancies (Conservatoires d'espaces naturels = private NGOs forming a nationwide network) have been active in mire conservation. In addition to leading LIFE programmes and running the French Mire Resource Centre, they have purchased and rented several thousand hectares of mires, which they manage according to management plans prepared for each site. They also operate different nature reserves, promote Natura 2000 actions, and lead many regional or local programmes. Many other NGOs also have some field actions on mires, including public education programmes. Several Regional Natural Parks (such as Volcans d'Auvergne, Pilat and Millevaches en Limousin in the Massif Central, Marais du Cotentin et du Bessin in Normandy, Haut-Jura and Morvan in Burgundy-Franche-Comté, Caps et marais d'Opale in Hauts-de-France) are very active on the ground, as well as proposing protection measures and being in direct contact with local authorities and stakeholders.

In addition to the support of Regional and Département councils (many of the latter also have their own purchasing policy for 'Espaces naturels sensibles'), the role of the water agencies (Agences de l'eau) is critical. Six water agencies cover the whole national territory and their activities help to

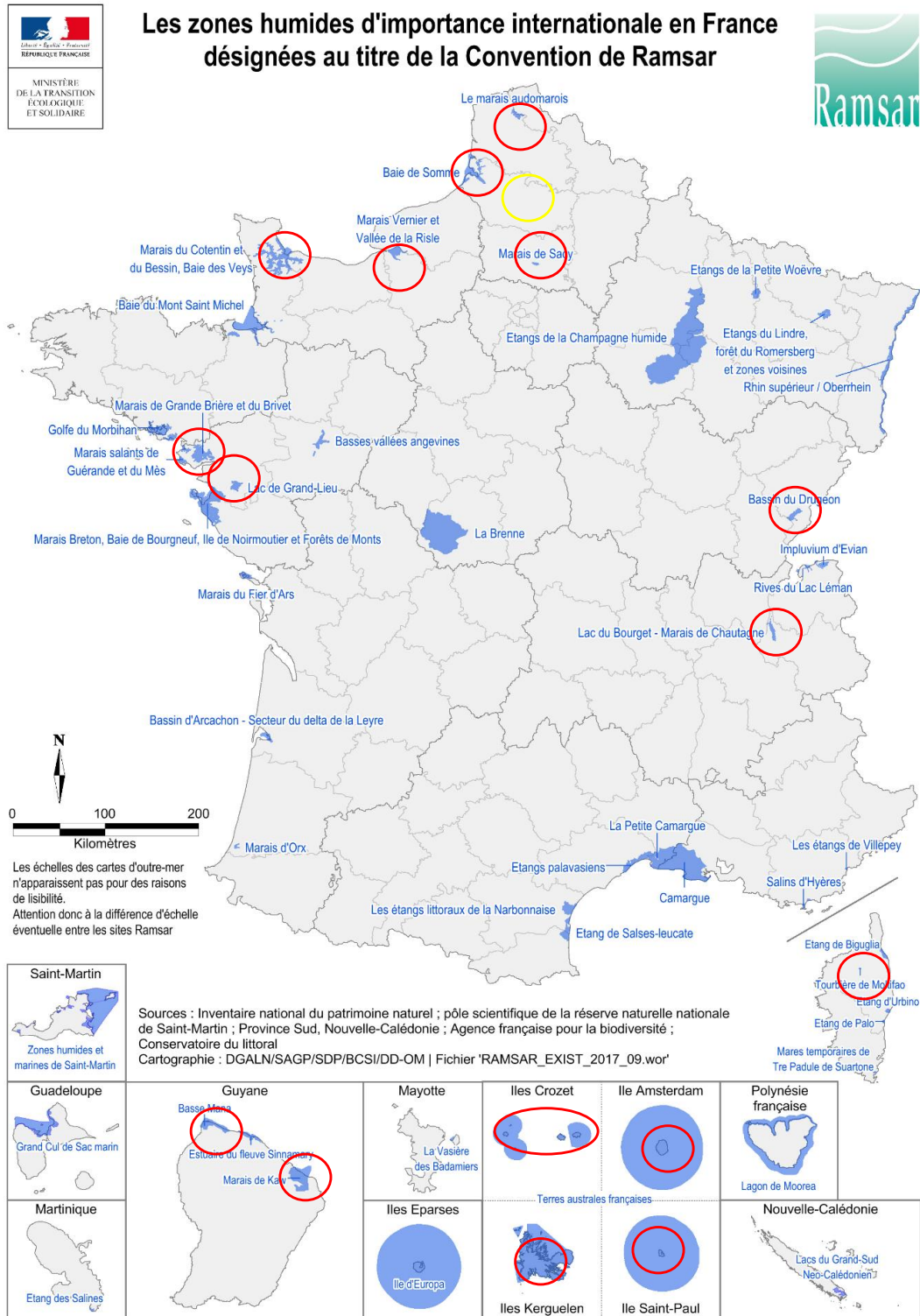


Figure 2. Translation of the title: French Wetlands of international significance designated according to the Ramsar Convention. Sites indicated by red circles (○) have significant areas of mire, and are listed below. Continental France: Marais audomarois; Marais du Cotentin et du Bessin; Marais de Grande Brière et du Brivet; Lac de Grandlieu; Bassin du Drugeon; Lac du Bourget, marais de Chautagne; Marais Vernier et vallée de la Risle; Marais de Sacy (note that “Vallées de la Somme et de l’Arve” in Northern France (yellow circle) was added to the Ramsar List in December 2017 and does not appear on the map). Corsica: Tourbière de Moltifao. Overseas Départements and Territories: *Guiana*: Basse Mana; Marais de Kaw. *French Southern Territories*: îles Crozet, Amsterdam, St-Paul & Kerguelen. The scales for Overseas Territories sites vary, but are not shown for reasons of legibility.



Table 2. Former LIFE programmes (1992–2001), classified according to their geographical range of influence.

LOCAL	REGIONAL	NATIONAL
Druegon Basin (Franche-Comté)	Conserving bogs in Midi-Pyrénées	Tourbières de France
The Vézère Plateau Millevaches (Limousin)		
Wetlands of Cotentin (Normandy)	Natural habitats and plant species in Corsica	
Pays de Gavot (Rhône-Alpes)		
Lac de Grandlieu (Pays de la Loire)		

achieve good water quality, not only by purifying it in wastewater treatment plants, but also through subsidies for the maintenance or restoration of wetlands. Adour-Garonne Water Agency (personal communication 2015) especially mentions two sites that could be protected: Pédestarrès, a 40 ha bog managed by the commune of Louvie-Juzon (Landes), where restoration works will be challenging because of the deep trenches left by peat excavation; and the Passeben peatland, managed by the Communes community of Seignanx (60 ha). The Seine-Normandie Water Agency (personal communication 2015) is involved in ground clearing and grazing on several peatlands in different parts of the river basin, and has subsidised both mire studies and land purchase. Loire-Bretagne Water Agency has also significantly supported research, management, restoration and purchase actions in its area.

### Regional strategies for mires

Strategies for mires have been developed in several French regions, often with the support of Regional and Departmental Councils. For example, regional action plans for mires have been implemented in Franche-Comté, Limousin, Auvergne and other regions. These various plans were launched after precise analysis of the work required, and they include different types of measures ranging from the purchase or leasing of land to the installation of access boardwalks and other educational features. New action plans are also in prospect, for example in Pays de la Loire. Some examples of the aims and achievements of regional strategies are given below.

#### *Franche-Comté*

A systematic inventory conducted in the 1990s identified more than 400 mires in this former region of eastern France. The main goal of the first regional programme for mires (2002–2011) was to achieve

long-lasting conservation of the top-priority sites. To this end, mires have been purchased or leased and some supporting formal protection measures have been applied. The programme also enabled communes and private landowners to receive assistance with land management, to test different types of management, to develop fundamental or applied scientific research, and to consider opening up some mires for tourist or educational use. A new action plan, co-ordinated by Conservatoire d'espaces naturels de Franche-Comté, was launched in 2016 and will run for ten years. So far, some 25 % of the mires of Franche-Comté have been included in some form of conservation measure.

#### *Limousin*

An action plan initiated in 2000 encompassed both heaths and mires, as the level of threat to heaths was comparable to that for mires and the management requirements were often similar. Within this plan, several land purchases were made and a special team devoted to providing free advice for landowners was highly successful. Professional training was also provided, with the result that the mire resource of this former region is now much better understood. In total, 637 ha of peatland comprising 64 sites is managed by the Limousin conservancy (Conservatoire d'espaces naturels du Limousin 2012), and all of the main mires are at least partly protected. In the future, knowledge will be updated and the restoration of degraded peatlands will continue.

#### *Pays de la Loire*

The peatlands of this region comprise large fen systems (on the estuary of the River Loire) which have been damaged by agricultural activities and peat extraction, together with much smaller peatlands scattered across the remainder of the territory. A

vision for a future regional action programme for mires, proposed by Conservatoire des Espaces naturels des Pays de la Loire, aims to:

- 1) diagnose the state of the region's peatlands and catalogue actions that have already been completed;
- 2) determine which means and methods are needed to implement an appropriate action plan; and
- 3) propose conservation measures on a site-by-site basis.

#### *French Overseas Départements and Territories*

Mires are often rare or absent on the French tropical islands (including Guadeloupe, Martinique, Réunion, French Polynesia and New Caledonia). Their extent in French Guiana has previously been underestimated, and a recent assessment gives a possible peatland area of 917 km<sup>2</sup> (Cubizolle *et al.* 2013). In St-Pierre-et-Miquelon (close to Newfoundland, Canada), mires are abundant and include many blanket bogs, but the archipelago is small (Etcheberry *et al.* 2004). Except for some nature reserves in Guiana and the above-mentioned national parks in Guadeloupe and La Réunion, the only extensive area of protected mires in overseas France is located in the Southern Territories (including Kerguelen, Amsterdam and St-Paul Islands). All of these mires lie within both a Nature Reserve (the largest in France; its terrestrial part covers more than 7,000 km<sup>2</sup>) and a Ramsar site, but knowledge of these mires is incomplete and a strategy for their conservation should be further developed (Flatberg *et al.* 2011).

## **BRINGING THE STRATEGIES TO SITE MANAGERS**

In order to ensure that all the elements of protection strategies function well, it is essential that people who are directly involved in the field should have access to all the means they need to apply such strategies. There are still some gaps in knowledge or know-how that may prevent measures from being fully effective. The following elements are extracted from the conclusions of two seminars organised by Pôle-relais tourbières in 2012.

### **Concerning research and knowledge**

Scientific studies on peatlands in France generally have a practical purpose, namely the immediate need for management. Few scientists are ready to undertake syntheses; and official research, with its tendency to build 'research silos' rather than encourage interdisciplinary research, does little to

help address this problem. Few mires can be adopted as reference sites like Bois-des-Bel in Québec (Canada), where Université Laval has gathered - and continues to gather - a huge archive of data. Funding of the Canadian programme includes contributions from the peat industry. This is less readily achieved in France. For example, an attempt to interest the French peat industry in developing a monitoring network in Baupré (Normandy) during the programme 'Recréer la nature' ('re-create nature') was not successful (A.-J. Francez, personal communication). In the future, 'SNO Tourbières' (see above) may partially fill this gap.

Appropriate indicators are urgently required to determine the current condition of mires, their ongoing change and/or recovery, and identifiable target states. These indicators must especially be:

- reliable and accurate in describing site condition;
- reproducible;
- rather easy to implement; and
- responsive to any change in the biotope condition (natural, degradation, restoration).

Not only do we need to know that knowledge exists; we also need it to reach site managers, and for them to find time to absorb and integrate it. Reading, participating in meetings, fieldwork and discussion are all important. The usefulness of exchanges between site managers and scientists (even from distant regions or countries) is emphasised.

### **Concerning appropriate hydrological management**

Some workers consider that there is a general lack of knowledge regarding management of hydrological regimes, or that such knowledge is not adapted to the uses that site managers can make of it. Often, even basic knowledge is scarce for a given site, yet it may be difficult to find private consultancies or universities to undertake new investigations. The manager needs to have the right questions, adapted to the problem, to get the right answers.

### **Studies of species, and functional models**

Autecological research on French mire species is currently at a low ebb, and yet urgently required. For example, studies on the fauna of French mires are now almost confined to monitoring, with few zoologists at the National Scientific Research Centre (CNRS) or in universities engaged in research on the autecology of mire species. This is regrettable because plant and animal species can be good indicators, and are of obvious intrinsic interest.

Functional models for mires are lacking, particularly for fens and wooded mires, and need to be established through further scientific research. Key questions include: What is the 'normal'

vegetation of a bog in each successional or zonal stage? Is afforestation normal? Management should be based on such models, which influence the very perception of a mire (G. Gayet, personal communication 2015).

### How to integrate the recent past of mires into present management

Site managers are actively aware of the need to take the past into consideration because they are compelled by the Nature Reserve protocol to include this information in their management plans. However, in most cases, few resources can be devoted to this aspect. Looking at traditional uses presents an opportunity to discuss sites with local people, but it may not be beneficial to restore any ancient use. A key question to consider is whether the present biodiversity is a result of good management that has been maintained up to the present time.

### CONCLUSIONS

Mires are relatively scarce in France and have received significant attention from nature conservationists. Peatland conservation has benefited from specific national and European Union measures, including the designation of many mire habitats under the EU Habitats Directive. Nevertheless, mires are still under-represented in the networks of protected areas. Even within some protected areas, they are subject to unfavourable effects from water pumping, agricultural fertilisers, or even localised overgrazing. The effects of climate change are also a concern (Pôle-relais tourbières 2015). The state of mires in France dictates that all groups, organisations and public bodies should remain engaged in implementing co-ordinated action plans and, when necessary, applying measures including rehabilitation of the hydrological regimes of mires and their immediate surroundings.

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Author for correspondence:

Francis Muller, Fédération des Conservatoires d'espaces naturels, Pôle-relais tourbières (French Mire Resource Centre), MEFC, 7 rue Voirin, F-25000 Besançon, France. E-mail: [francis.muller@reseau-cen.org](mailto:francis.muller@reseau-cen.org)