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#### Chapter

## Protecting Wetlands: Insights from the Northern Iberian Peninsula (Galicia, NW Spain)

Javier Ferreiro da Costa and Pablo Ramil-Rego

#### Abstract

Wetlands are a key tool for environment conservation policy. They harbour important biodiversity values such as priority habitats and fragile species, reduce the impacts of floods, improve water quality, absorb pollutants, and protect shores from climate change effects, also acting as carbon reservoirs in the medium and long term. From an international point of view, those sites containing representative, rare or unique wetlands, are designated under Ramsar Convention, which was signed in 1971, being added to the Convention's List of Wetlands of International Importance and become known as Ramsar sites. More than 50 years after the signing of Ramsar Convention, its degree of application is very uneven across the different territories. This paper analyses the situation from the Atlantic area of the Iberian Peninsula, and specifically from Galicia, a territory that has a large number of wetlands, both terrestrial, marine, underground and artificial, with sites of high value for biodiversity and natural heritage conservation, but where there is no adequate protection over them, documented by the presence of a large number of anthropic impacts that is leading to biodiversity deterioration, habitat destruction and species decline.

Keywords: wetlands, conservation, management, protection, Ramsar, biodiversity

#### 1. Introduction

During the last decades of the 20<sup>th</sup> century, a paradigm shift in the social assessment of wetlands happened, as key components of biodiversity and donors of ecosystem services, leading to the implementation of various mechanisms, instruments and agreements for their conservation. The most relevant example was the signing of an International Convention in 1971 in the Iranian city of Ramsar, for the conservation of wetlands of international importance as waterfowl habitats (known as 'Ramsar Convention'), which made wetlands the only large ecosystem subject to an international agreement aimed at promoting its protection and rational use [1].

The signing of the Ramsar Convention would serve as an impulse for the development of new initiatives from an international perspective, as well as at a national, regional, or local level. In this way the International Union for the Conservation of Nature (IUCN) applied, considering the conservation of wetlands



**Figure 1.** Distribution of Ramsar sites within EU Member states [2].

of vital importance, since they contribute to the conservation of biological diversity and cultural heritage, in addition to having an important role for human beings in terms of climate regulation, carbon sink, recharging aquifers, flood mitigation and other processes, as well as providing important provision services as they are an important source of directly exploitable resources. From the signing of the Ramsar Convention, wetlands would begin to be integrated into the legal framework of different countries. In 1990, after 15 years of the entry into force of the Ramsar Convention, the IV Conference of the Contracting Parties (COP4) of the Ramsar Convention was held in Montreux (Switzerland), bringing together 56 of the 59 signatory countries of the convention, approving the designation of 53 new wetlands of International Importance, which added to those declared since 1974, reached 533 designations (**Figure 1**).

In 1992, the United Nations Conference on Environment and Development (UNCED), also known as the 'Earth Summit', was held in Rio de Janeiro. At the Earth Summit, 5 highly relevant documents were approved that marked environmental policy in the following decades: Rio Declaration on the environment and development (which established the concept of sustainable development), Agenda 21 (which listed 2,500 recommendations relating to the implementation of the declaration's principles), the United Nations Framework Convention on Climate Change (which led to the signing in 1997 of the Kyoto Protocol), the Declaration of Principles on Forests, and finally the Convention on Biological Diversity (CBD).

The European Union played a relevant role in the Rio Earth Summit, and at the same time promoted new environmental regulations. Thus, the Birds Directive (Directive 79/409/EEC), aimed at the conservation of wild birds, was complemented by the promulgation of the Habitats Directive (Directive 92/43/EEC), relating to the conservation of natural habitats and wild fauna and flora, in which Natura 2000 was created. Subsequently, on 05/29/1995 the European Commission approved a communication from the Commission to the Council and the European Parliament "Wise use and conservation of wetlands (COM(95) 189 final)", where it was assumed that wetlands represent one of the most important, most threatened and most common habitats in all the countries of the European Union. All this European legal framework granted the consideration of habitats of community interest to the natural and seminatural wetlands within the framework of the European Union was completed through a third regulation, the Water Framework Directive (Directive 2000/60/EC).

In Spain, the new orientations of environmental policy regarding wetlands were embodied by the very first time in Law 4/1989, which in its article 25 it contemplated the creation of the Spanish Wetland Inventory (SWI), whose preparation corresponded to the Spanish regions. This new framework was continued by the Spanish Strategy for the Conservation and Sustainable Use of Biological Diversity [3], which established at the end of the 20<sup>th</sup> century the general framework of Spanish conservation policy, as an application of the Convention on Biological Diversity (Rio de Janeiro, 1992). The application of this Strategy was proposed through the development of Sectoral Action Plans, which in the framework of aquatic ecosystems led to the preparation of the Spanish Strategic Plan for the Conservation and Rational Use of Wetlands [4]. This plan was inspired by the First Strategic Plan of the Ramsar Convention 1997–2002 [5], as well as the postulates of the IUCN, thus contributing to compliance with the international commitments acquired by the Spanish government. However, the progress of the SWI set out in Law 4/1989 followed a slow development, as its regulation was not established until 15 years later, through Royal Decree 435/2004. Finally, Law 42/2007 came to recognize the Wetlands of the Ramsar Convention within the Spanish legislative framework as Areas Protected by International Instruments (APII), establishing additional protection measures for Spanish wetlands, mainly those included within one of the European or Spanish protection categories that were also established in the Law.

In application of Law 4/1989, the different Spanish regions started to take their first steps in terms of wetland protection. In Galicia, the regional legal framework in terms of protecting wetlands would take an important step with the promulgation of Law 9/2001, since it included a total of 9 categories of Protected Natural Areas (PNA), among which was the specific category of Protected Wetlands, setting an unparalleled example in Spain at that time. All these regulatory changes carried out in Galicia since the end of the 1980s were accompanied by different actions regarding the characterization and monitoring of waterfowl and the ecological restoration of wetlands [6], which showed a remarkable change of direction compared to the destructive policies on wetlands, developed under Franco's dictatorship and continued during the first stages of Spanish democracy.

In this paper, as one of the first planning and dissemination tasks developed by LIFE INSULAR project (LIFE20 NAT/ES/001007), we analyse the management, methods and processes on Protected Wetlands biodiversity in Galicia, assessing the future challenges and perspectives that arise for this protected area category.

The document assesses the progress in biodiversity conservation and management that has been made on Protected Wetlands over time, including the inventorying of wetlands, as well as their legal provisions and designations, the trends and changes of their limits because of several reasons, their improper use and management measures, as well as the consequences of all of these aspects which results in a loss of quality in the legal framework of Protected Wetlands.

#### 2. Study area

Galicia is a Spanish region that occupies an area of 3 million hectares and is located at the NW end of the Iberian Peninsula (Figure 2). Its Nomenclature of Territorial Units for Statistics code is ES11. It is a territory of strong biogeographical and landscape contrasts [7–10], mostly included in the Atlantic biogeographical region, but with a significant part of its territory in the Mediterranean region. It is bounded by the Cantabrian Sea on the North, by the Atlantic Ocean on the West, by the Spanish regions of Asturias and Castilla y León on the East, and by the Portuguese region of Regiao Norte on the South. The marine waters surround Galician extensive northern and western coastline, while eastern edge encompasses the western end of the Cantabrian Mountains, which are diluted across the different Galician mountain ranges that separate the Littoral Galicia from the Interior Galicia. The first one is configured by a succession of short river valleys separated from each other by small reliefs. The second one is represented by large sedimentary basins, which mean a landscape with large horizontal extensions, drained by the tributaries of Miño, Sil and Limia rivers. In some sections these pass throughout canyons, especially the main streams of Miño and Sil rivers.

This huge heterogeneity has determined a high level of biodiversity in the Galician territory [11–21], both from the point of view of the diversity of wild species present (an especially the protected and catalogued species), as well as from the wide range of habitat and ecosystem types.



**Figure 2.** *Geographic framework of Galicia in NW Iberian Peninsula. Created by the authors.* 

#### 3. The importance of wetland inventories

The Ramsar Convention recognized from the beginning the importance of national wetland inventories as essential instruments for shaping policies and other measures aimed at achieving the conservation and wise use of wetlands. Already at the first meeting of the Conference of the Contracting Parties (COP1, Cagliari, 1980), the Parties were convinced that national wetland policies should be based on a nation-wide inventory of wetlands and their resources (Recommendation 1.5). This recognition of the value of national wetland inventories has been periodically reiterated at subsequent COPs, inter alia in the Annex to Recommendation 2.3 (COP2, Groningen, 1984), Recommendation 4.6 (COP4, Montreux, 1990), Resolution 5.3 (COP5, Kushiro, 1993) and Resolution VI.12 (COP6, Brisbane, 1996). So national wetland inventories, in addition to being an essential basis for the formulation of national wetland policies, are also considered important, among other things, to detect sites that can be included in the List of Wetlands of International Importance (the Ramsar List); to quantify the world's wetland resources, in order to assess their status and patterns; to determine which wetlands need to be restored and to carry out risk and vulnerability assessments [22].

The first studies for the cataloguing of the Iberian wetlands were developed in the mid-20<sup>th</sup> century [23]. After the signing of the Ramsar Convention, the drafting of different studies was promoted, resulting in the first different provincial inventories of wetlands and some synthesis works [24–28]. Finally, the importance of carrying out an inventory of wetlands was included in the Spanish Strategic Plan for the Conservation and Rational Use of Wetlands [4], developing its technical aspects through Royal Decree 435/2004, regulating the SWI, which is based on the regional inventories and consequently on the regional lists of wetlands that are prepared from the available data. The number of Spanish regions that have carried out a proper inventory of their wetlands is very small, and in most cases these inventories have not been updated and published. So, the wetlands included in the SWI are limited, in most of the regions, to the Ramsar list, a fact that limits the effectiveness of the inventory to comply with the aspects set out in the Spanish regulations and in the agreements derived from the Ramsar Convention.

Although there is not a periodically updated list of wetlands in Spain, compilations made in 2003 [29] indicate that Spanish wetlands should exceed 5,000 sites, of which more than 2,027 sites would be located in the 7 regions of Northern Spain (**Figure 3**), which are Galicia, Asturias, Cantabria, Castilla y León, Euskadi, Navarra and La Rioja. No further works have been made estimating the Spanish wetlands, so nowadays there is no updated information about this. Moreover, the number of wetlands in Spain has not been adequately collected in the official inventories managed by the Spanish and regional governments. Thus, the SWI shows a very small number of wetlands in the Northern Iberian regions, as in many cases only includes wetlands that are part of the Spanish Ramsar List.

Both in the SWI and in the List of Ramsar Wetlands of Spain, the mountains of the Atlantic-Cantabrian area show a meagre representation, which in no case reflects the high diversity and richness that these territories possess [15–17, 20, 21, 30–35], where important representations of wetland types of high environmental singularity at an international level, such as peatlands that include different types of ecosystems (blanket bogs, raised bogs, fens, floating mires, bog woodlands, etc.), as well as



**Figure 3.** Number of wetlands identified in each Spanish region during the period 2001–2003, coinciding with the carrying out of GWI [29].

different types of scrublands, wet heaths and hygrophilous forests. The deficient content of the SWI reflects the inefficient inventorying and management of the biodiversity components which also has a negative impact on its conservation, even more so when these territories can be immersed in the evaluation of the effects that could derive from the implementation of new projects for power generation or from the promotion of intensive forestry and livestock farms [36, 37].

During the two last decades of the 20<sup>th</sup> century, an important work aimed at the legal protection and rational use of wetlands began in Northern Spain. A large number of wetlands were included in the first Natura 2000 proposals, which between 1997 and 2004 formed almost the entirety of its current delimitation. This contrasted with those designed within the framework of the SWI, where the number of wetlands registered to date is very small, leaving out wetlands that have environmental protection status derived from their inclusion in different figures of PNA or Natura 2000 areas, as well as wetlands that lack such protection. In this scenario, only Galicia would take a step towards the protection of wetlands through a new conservation and management regime for wetlands that was established by Law 9/2001, introducing the category of "Protected Wetlands" within the different types of PNA. This new category was reserved for those wetlands that fulfilled a function of international, national, or regional importance in the conservation of natural resources, and that were declared as such.

Derived from these previous developments in terms of the regional legal framework and protection of wetlands, and in application of Law 4/1989, it was considered necessary to carry out an inventory of them at Galician level, which would allow identifying their territorial representativeness, their conservation status, as well as the role they played in conservation of biodiversity and the functionality of ecosystems. In this way, the scope of action of the first Galician Wetlands Inventory (GWI) was established [29], which was carried out under a collaboration agreement signed

between the Galician government and the University of Santiago de Compostela over the years 2001 and 2003. The GWI scientific-technical aspects were later included in Decree 127/2008, whereby developed the legal regime of protected wetlands and created the Galician Wetlands Inventory (GWI).

#### 4. The Galician Wetlands Inventory (GWI)

Galician Wetlands Inventory (GWI) included those natural, semi-natural or artificial systems that could be attributed to one of the types established in the classification of Ramsar wetlands and whose environmental interest could be corroborated with any of the internationally approved systems (Ramsar Convention, Birds Directive, Habitat Directive, IUCN) for the characterization of biodiversity at the level of its biotic components and the eco-functions they perform in the system.

The typology of the GWI integrated the criteria of the Ramsar Wetlands Classification established in Recommendation IV.7 approved by COP4 Montreux-1990 and modified by Resolution VI.5 approved by COP6 Brisbane-1996 [1], and the criteria of the Eunis-Habitat classification [38, 39], as well as the categories of the Spanish Strategic Plan for the Conservation and Rational Use of Wetlands [4]. For some categories (lagoon environments), standardized delimitations for the characterization of the different units (lakes, lagoons, ponds, puddles) were fixed. The typology of wetlands thus showed an easy correspondence with the one used by the European Commission for the designation of the types of habitats of community interest present in Annex I of DC 92/43/EEC.

As a result of the inventory and identification work, the GWI included a total of 1,131 wetlands distributed mostly between the coastal sectors, the interior sedimentary depressions and the sub-littoral and central mountain areas. The rest of the Galician territory and specifically the eastern and southern mountainous areas present a smaller proportion of humid ecosystems, which are usually confined to areas with morphological characteristics favourable to the maintenance of seasonal water contributions (**Figure 4**). In total they cover more than 70,600 ha (**Table 1**), which represents 2.4% of the Galician continental territory [29].

Comparing the data obtained in the GWI [29], with the information available in the rest of Spanish regions for the same inventory period (2001–2003), Galicia would be the region with the largest number (**Figure 3**), and probably the largest area of wetlands, having more than 26% of the Spanish wetlands. According to the major types of wetlands established in the Inventory of Wetlands of Galicia (**Table 1**), the majority of the inventoried means correspond to the group of "continental wetlands" with a total of 659 wetlands (54.4% of the total) followed by the "artificial wetlands" with 312 wetlands (27.6%) and "marine-coastal" with 153 wetlands (13.3%), while the number of "subterranean wetlands" would be represented by 7 wetlands.

The littoral Galicia includes the largest average size wetlands, as they usually appear forming important coastal and marine complexes, including shallow marine waters, humid dune slacks, estuarine systems, coastal lagoons, humid meadows, and alluvial forests [15–17]. In the interior of Galicia, the sedimentary basins and the bottoms of the great Atlantic valleys host an important representation of peaty, hygrophilic, fluvial and lacustrine wetlands [6, 30]. Among the large sedimentary basins, upper Miño basin stands out for the biodiversity, natural heritage, and naturalness of its ecosystems, as the floodplain configured around the main channels of the upper Miño river and tributaries includes one of the best representations of the

#### New Insights into Protected Area Management and Conservation Biology



#### Figure 4.

Geographical distribution and typology of wetlands included in the GWI [29]. The symbols represent the centroid of the wetlands.

Mayor types of wetlands	ľ	lumber	Area					
	n	%	ha	%				
Coastal and marine wetlands	153	13.3%	20,268,2	28.7%				
Continental wetlands	659	54.4%	34,442.7	48.8%				
Underground wetlands	7	0.6%	0.6	<0.1%				
Artificial wetlands	312	27.6%	15,965.8	22.7%				
Total	1,131		70,677.3					

#### Table 1.

Major types of wetlands according to the classification established in the GWI [29].

Atlantic biogeographical region of alluvial forests, mixed with ponds, grasslands and wet scrub [34, 40].

The Galician mountains also include a significant number of wetlands. Their largest area is concentrated in bogs and wet heaths, standing out Serra do Xistral, where the most important blanket bog complex of Southern Europe is located [33]. On the contrary, the lakes located in the mountainous areas are very small, although numerous, and mostly originated in basins of glacial origin.

#### 5. Known vs. protected wetlands

As the Ramsar Convention establishes, wetland inventorying is the basic tool for planning and carrying out wetland management, protection and conservation activities. In Spain, the SWI would hypothetically take the data collected in regional lists or inventories, which should be carried out and updated by regional governments, with the participation of different specialists and research centres. The inclusion of a wetland in the SWI (Royal Decree 435/2004) does not give it a protection status, as the inventory contributes to knowing the evolution of wetlands and, where appropriate, indicating the protection measures that must be included in the basin hydrological plans. It is only possible to entering the inventory those natural, semi-natural or anthropic environments that meet morphological and/or ecological characteristics defined in accordance with those set by Ramsar, or those that have expressly attributed the status of wetland by virtue of a specific protection regulation. These same criteria are followed by the Spanish regions in their own legal framework. Thus, in Galicia (Decree 127/2008), the inclusion of a wetland in the inventory must meet a series of scientific-technical criteria, which apply both to those designed under a specific protection category and to those not. In the Galician regulations, the inclusion of a wetland in the inventory is carried out for statistical and research purposes and does not automatically imply the application of a protection status.

Regarding the wetland protection in Spain, this is established through its recognition under different categories linked to land or water planning and management, or through its designation under one of the different categories of PNA, which may be common to the used ones for other ecosystem types (National Parks, Natural Monuments, Protected Landscapes), or more rarely one of those specific to wetlands, as occurs in Galician regulations with the creation of the figure of "Protected wetland", established by Law 9/2001.

It is assumed that the number of known wetlands that appear compiled in the scientific-technical inventory documents that have been carried out in the different Spanish regions should be equal to or slightly less than the registered wetlands in the regional official catalogues as well as than the registered wetlands in the SWI. Currently, the SWI includes 715 wetlands, a value that represents 14.3% of Spanish known wetlands. This meagre representation is even more worrying when their territorial distribution is analysed, since 583 (11.66%) correspond to wetlands distributed in the Spanish southern regions which receive less rainfall, like Madrid (23 wetlands), Castilla - La Mancha (312 wetlands), Andalusia (147 wetlands), Murcia (53 wetlands), or Comunitat Valenciana (48 wetlands). While in the Spanish northern regions, that receive a higher rainfall which usually offers better conditions for the configuration and persistence of wetlands, only 132 wetlands (2.64%) have been recorded in the SWI with a very unequal distribution across the northern regions, like Galicia (0 wetlands), Asturias (53 wetlands), Cantabria (0 wetlands), Euskadi (30 wetlands), Navarra (0 wetlands), La Rioja (49 wetlands), or Castilla y León (0 wetlands). Consequently, the SWI has excluded 1,895 known wetlands in Northern Spain, which means 93% of them, and 38% of all the Spanish known wetlands [29].

Regarding the protection status, in recent years there has been a significant adaptation and improvement of both Spanish and regional environmental regulations, improving their convergence with the criteria established in other different countries. The application of regulations and monitoring mechanisms for their compliance continue to be a pending issue that has a significant impact on the conservation status of wetlands and on the authorization and sanction regime for different activities and uses. In the application of some sectoral regulations, such as those referring to water, the vision of wetlands continues to focus on reservoirs and lotic and lentic ecosystems, while hygrophilous or turfophilic wetlands are marginalized [37]. This unequal treatment is clearly seen in the basin plans, where the inventory, characterization, and proposal for the wetlands and specifically the hygrophilous and turfophilic ones is very deficient.

The environmental regulations in Spain establish three large groups of protected areas since Law 42/2007 [41, 42]: PNA (Reserves, Parks, Natural Monuments, Protected Landscapes, Marine Protected Areas), Natura 2000 protected areas (SCI, SAC, SPA), and APII (Ramsar Wetlands, Global Geoparks, World Heritage, Biosphere Reserves, etc.). Natura 2000 are the protected areas that include more sites and occupy the greater surface of wetlands, usually overlapping SAC and SPA and thus strengthening the level of protection on the same wetland, as well as establishing important synergies with other categories of protected areas. As an example, Natura 2000 areas support the core zones of the 20 Biosphere Reserves that have been designed in Northern Iberian Peninsula, which sum to a maritime-terrestrial area of 1.6 million hectares, including a notable representation of marine, coastal, interior and mountain wetlands [43]. However, during the creation process of Natura 2000,

Group A. Sites containing representation	ative, rare or unique wetland types					
Criterion 1	It contains a representative, rare, or unique example of a natural or n natural wetland type found within the appropriate biogeographic re					
Group B. Sites of international impo	rtance for conserving biological diversity					
Criteria based on species and ecolog	ical communities					
Criterion 2	It supports vulnerable, endangered, or critically endangered species or threatened ecological communities					
Criterion 3	It supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.					
Criterion 4	It supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.					
Specific criteria based on waterbirds						
Criterion 5	It regularly supports 20,000 or more waterbirds.					
Criterion 6	It regularly supports 1% of the individuals in a population of one species of subspecies of waterbird.					
Specific criteria based on fish						
Criterion 7	It supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.					
Criterion 8	It is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.					
Specific criteria based on other taxa						
Criterion 9	It regularly supports 1% of the individuals in a population of one species of subspecies of wetland-dependent non-avian animal species.					

Table 2.

The Ramsar Sites criteria for identifying Wetlands of International Importance [44].

the European Commission considered in 2004 that the network was incomplete in the Spanish Atlantic Region, as several wetland habitat types of community interest were covered insufficiently, such as wet heaths (Nat-2000 4040\*) raised bogs (Nat-2000 7110\*), and transition mires (Nat-2000 7140), so it would be necessary to revise the network, proposing new sites or enlarging some of the proposed at that time.

The rest of PNA like the Parks (National Parks, Natural Parks) and other categories (Reserves, Natural Monuments, etc.) occupy a lesser extent than Natura 2000. Regarding APII, their protection regime is determined by the corresponding international conventions and agreements, without prejudice to the validity of specific protection, planning and management regimes whose territorial scope coincides totally or partially with these protected areas, if they comply with the provisions of such international instruments.

As for the APII category directly related to wetland protection, the Ramsar sites, there are currently in Spain 76 wetlands (more than 316,000 ha) included in the Ramsar list, that accomplish different Ramsar criteria (**Table 2**): 31.70% wetlands meet criterion 2 (they support vulnerable, endangered or critically endangered species, or threatened ecological communities), while 26.8% meet criterion 3 (they support populations of plant and/or animal species important to maintain the biological diversity of a biogeographical region), 14.6% meet criterion 1 (they contain a representative, rare or unique example of a natural or near-natural wetland type within a biogeographical region), and 11.6% meet criterion 6 (they regularly support 1% of the individuals of a population of a species or subspecies of waterfowl). Compliance with the rest of the criteria is below 10% (**Figure 5**).

Among the Spanish Ramsar sites, 19 of them are spread across the Spanish northern regions (**Table 3**): Galicia (5 wetlands +1 shared one), Asturias (1 wetland +1



#### Ramsar criteria

Criteria met by Spanish wetlands included in the Ramsar List [44].

Figure 5.

Ramsar site	Date	Area (ha)	Region	Туре
Ría de Ortigueira y Ladrido	12/05/1989	2,600.58	Galicia	Littoral
Complexo intermareal Umia-Grove	12/05/1989	2,920.00	Galicia	Littoral
Lagunas de Villafafila	12/06/1989	2,714.00	Castilla y León	Lacustrine
Ría de Mundaka-Guernica	26/03/1993	945.00	Euskadi	Littoral
Lagoa e areal de Valdoviño	26/03/1993	485.23	Galicia	Littoral
Complexo de Corrubedo	26/03/1993	983.80	Galicia	Littoral
Ría de Ribadeo	04/10/1994	614.00	Galicia- Asturias	Littoral
Marismas de Santoña, Victoria y Yoyel	04/10/1994	6,907.00	Cantabria	Littoral
Lagunas de Laguardia	12/09/1996	45.00	Euskadi	Lacustrine
Embalse de las Cañas	18/11/1996	101.00	Navarra	Reservoir
Laguna de Pitillas	18/11/1996	216.00	Navarra	Lacustrine
Colas del Embalse de Ullibarri-Gamboa	24/10/2002	397.00	Euskadi	Reservoir
Lago de Caicedo-Yuso y salinas de Añana	24/10/2002	26.00	Euskadi	Lacustrine
Laguna de La Nava de Fuentes	24/10/2002	326.00	Castilla y León	Lacustrine
Salburua	24/10/2002	174.00	Euskadi	Lacustrine
Txingudi	24/10/2002	128.00	Euskadi	Littoral
Humedales de la Sierra del Urbion	19/02/2007	86.00	La Rioja	Mountain
Ría de Villaviciosa	07/01/2011	1,263.00	Asturias	Littoral
Galician Atlantic Islands	05/22/2021	8,542.62	Galicia	Littoral
Total		29,474.23		

#### Table 3.

Ramsar sites in the Spanish northern regions. Created by the authors from official Ramsar information.

shared one), Cantabria (1 wetland), Euskadi (6 wetlands), Navarra (2 wetlands), La Rioja (1 wetland) and Castilla León (2 wetlands). The only shared Ramsar wetland in this group, which is located between Galicia and Asturias regions, has been erroneously named as 'Ría del Eo' in the Ramsar list, but its right name should be 'Ría de Ribadeo', according to the most recent reports carried out by the Spanish Specialized Commission of Geographic Names (dependant from the Spanish Superior Geographical Council) and the Spanish Royal Geographic Society, following historical criteria. The rest of Ramsar wetlands in Northern Spain are framed in a single region each one. Ten of these Ramsar sites are located in the littoral area, with an unequal representation of littoral marine habitats and coastal habitats. The remaining 9 are in inland areas, 2 of them correspond to reservoirs, 6 to lacustrine environments and only 1 correspond to mountain wetlands (Sierra del Urbión Wetlands).

The Spanish environmental regulations allow the different Spanish regions to establish their own categories of PNA. In Galicia, the Protected Wetlands have been established as a proper regional PNA category since Law 9/2001 (setting an unparalleled example in Spain at that time), which was supposedly created to provide a specific regional protection regime for wetlands, promoting a better conservation of

these ecosystems, taking into account their special fragility and value from an environmental point of view, and specifically dedicated for those declared as International Importance according to the Ramsar Convention. This regional category has been maintained by Law 5/2019, which in addition has incorporated the Ramsar Wetlands of International Importance into the Galician legal framework, within the group category of APII, inheriting the model previously established for the Spanish territory by Law 42/2007. However, nowadays this regional category of PNA has only been applied to the first 5 Ramsar sites designed in Galicia (**Table 3**), as the last one designed (Galician Atlantic Islands) in 2021 [45] does not have received yet the designation as a Protected Wetland, nor has the procedure for such designation been initiated, nor has a preventive protection regime for the site been established.

#### 6. Conservation status of Spanish wetlands

The Iberian Peninsula is frequently considered as a territory of high biodiversity with a great diversity of habitats and species, considered endemic, rare or threatened with disappearance [35, 43, 46]. The Iberian high value of biodiversity contrasts with the unfavourable conservation status of many of the biodiversity components, which is caused by human action. In this scenario, wetlands are not an exception. Already in 1990, the Ramsar Convention established the "Montreux Registry", to include those Ramsar wetlands in which "modifications in ecological conditions have occurred, are occurring or may occur", so it should be necessary to carry out priority conservation actions. Among the worldwide 872 Ramsar sites, 62 are currently included in the Montreux Registry, and two of them are Spanish, having been included in this registry since 07/04/1990: Doñana (Andalucia) and Las Tablas de Daimiel (Castilla-La Mancha). Both wetlands are National Parks and have also been designed under other different categories of PNA, but they have registered numerous complaints filed in courts about their poor situation, as well as to the different international organizations that manage the different programs and categories of protected areas. Doñana was added to the Montreux Registry due to a situation generated by tourist pressure and intensive irrigation agriculture that are present in and around the wetland. Intensive irrigation agriculture is also the determining cause Las Tablas de Daimiel deterioration, as the groundwater intakes have caused a progressive drop in the water table, modifying the hydrological cycle that fed Guadiana River and Las Tablas de Daimiel wetland. Despite attempts to reverse the situation in both wetlands, their unfavourable situation determines that they continue to be included in the Montreux Registry.

The situation of other Spanish wetlands is equally worrying, despite not having been included in the Montreux Registry. Among them, Lagoa e Areal de Valdoviño (Galicia) Ramsar site accumulates many complaints [47] due to the change of its limits (**Figure 6**), to the alteration of the hydro-ecological cycle with rupture of the coastal barrier and alteration of the flooding regime, loss of area occupied by natural-semi-natural habitats, expansion of invasive alien species, irrational and unsustainable public use, etc. In other cases, human activities have led to the total destruction of the wetland, transforming the area into intensive agricultural crops or Eucalyptus plantations [37].

In recent works [37, 46, 48], the situation of Galician wetlands has been analysed for the last 20 years, comparing the situation at the starting of the works leading to the GWI (2001–2003), with the current situation. From them, it can be deduced that human action continues to have a very negative effect on the conservation of wetlands,



#### Figure 6.

Change of limits in Lagoa e Areal de Valdoviño Ramsar site, from its initial designation in 1992 and the subsequent modification of its boundaries in 2006, that has caused numerous complaints [47].

both in those cases in which they are protected under any category of protection, and more dramatically, in those wetlands that have not been designed as protected areas. Conservation status of Galician wetlands can be evaluated by applying the same methodology used for the Directive 92/43/EEC Article 17 reporting every six years for conservation status of habitats and species of community interest [49], focusing on the habitat types that are characteristic of the natural wetlands in Galicia [18, 20, 21, 29]. In each type of wetland were valued 4 factors: occupancy area, habitat structure, alterations on the hydrology, and conservation status of wetland characteristic species. For each one of them, different parameters were recorded (**Figure 7**).

The different impacts that negatively affect the conservation status of Galician wetlands were assessed following the systematization established in Spain [50], which follows the previous standardized list of the European Commission. Impacts are grouped in 4 classes (A.- Activities of the primary sector. B.- Construction activities. C.- Pollution. D.- Activities of public use), in which 4 types of actions are included. Among the 29 wetland types of the GWI that were evaluated (**Figure 7**), only 3 (10.35%) have a "Favourable" conservation status, which are underground habitats (3.1.1 and 3.2.1) and shallow marine waters (1.2.1). With a "Moderate" conservation status there is only one habitat (3.45%), that corresponds to estuaries (1.3.1). The wetlands in an "Inadequate" conservation status are 8 types (27.58%), including sandy coastal systems (1.2.3, 1.4.2), intertidal flats (1.2.4, 1.3.2), intertidal marshes (1.3.3),

		Wetland typology	CS A				R				ſ				D						
GWI	R	Denomination	1 2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3 4	-
1		Marine and coastal wetlands					_	-		_		-			_	-	-	_			
1.2.		Shallow marine waters																			
1.2.1	В	Permanent marine waters			+	+	-	-	-	-	•	-	-	+	٠	-	-	-	-		
1.2.3	Е	Coastal sandy systems	+ +	-	+	+	-		-	+	-	-	+		٠	-	ie.	•	-	. •	
1.2.4	G	Intertidal mud or sand	+ +	-	+	+	-		-	+	-	-	-	+	•	-	-	+	-	. •	
1.2.5	Н	Intertidal marshes	+ +	1.00	•	+	+	+	-	+	-	-	-	+	•	+	+	+	+	+ •	
1.3.		Estuaries and fluviomarine systems																			_
1.3.1	F	Estuarine waters	+ -	-	+	+	-	-	-	+	4	4	-	+	٠	+	-	+	-	. •	
1.3.2	G	Intertidal mud or sand	+ +	-	+	+	-	-	-	+	-	-	Ξ.	+	•	+	+	+	3	. •	
1.3.3	Н	Intertidal marshes	+ +	-	+	+	-	-	-	+	1	-	1	+	•	+	+	+	+	+  •	
1.4.		Coastal lagoons				_	_						_		_		_			_	_
1.4.2	E	Coastal sandy systems	+ +	-	+	+	-	-	-	-	-	-	+	-	•	+	•	•	-	•	
1.4.3	J	Coastal brackish/saline lagoons	• +	•	•	+	+	+	-	-	•	-	+	+	•	+	+	•	+	+ •	
1.4.4	K	Coastal freshwater lagoons	+ +	•	•	-	-	-	-		-	•	- <b>T</b>	•	•	-	-	•	-	•   •	
2.		Continental wetlands																			
2.1.		Freshwater ecosystems																•			
2.1.1	M	System of terrigenous Islands		-	T		+	+ +	-	+	-	-	-	+	•	-	•	•			_
2.1.2	M	Meanders temporarily unconnected	+ •	+			+		-			2	-		•	+			2		-
2.1.4	M	Waterfalls and wells.	+ +	+	-		+	-	-	-	-	-	-	+	•	-	-	•	3		
2.2.1		Continental lacustrine accoustoms																			-
2.2.	0	Permanent freshwater lakes			•		-	-					2	+	•	•	+	•	-		
2.2.1	Tn	Lagoons (surface 1 - 8 ha)	+ •	•	•		-	-	-			-	-	+	•	•	+	•	-	+ •	
2.2.3	Ts	Ponds (< 1ha)	+ •	•	•		•	+	-	+		-	-	+	•	•	+	•		+ •	
2.2.4	Ts	Temporary lagoons or ponds	• •	•	•		•	•	-	+			-	+	•	•	+	•	-	+ •	
2.2.5	Ts	Ponds and seasonal puddles	• •	•	+	-	•	•	-	+	-	-	-	+	•	•	+	•	2	+ •	
2.3		Non-forested peatlands																			_
2.3.1	U	Blanket bogs	• •	+	+		•	•	•	٠		•	•	-	-	•	•	-	-	+ -	
2.3.2	U	Raised bogs	• •	+	+	×	•	•	•	٠		٠	٠	+	٠	•	•	-	+	+ +	
2.4		Shrub-dominated wetlands																			
2.4.1	W	Wet heaths	• •	+	+		•	•	•	٠		•	•		٠	•	•		+	+ +	
2.4.2	W	Wet shrubland	- +	+	+	×.	-			-	-	-	-	-	2 <b>-</b> 2	٠	-	-	+	. +	
2.6.		Hygrophilic ecosystems																			
2.6.2.1	Xf	Freshwater tree-dominated wetlands	• •	+	•	Ξ.	•	•	+	•	-	-	-	+	•	+	+	-	-		
2.6.2.2	W	Shrub-dominated swamps/fens	• •	+	+	Ξ.	+	+	-	•	•	•	л.,	С. С	٠	+	+	96	+	+ +	
2.6.2.3	Тр	Permanent freshwater swamps/fens	- +	+	+	•	-	-	-	17		-		-	-	-	-	-	-		
2.6.2.4	Ts	Seasonal freshwater swamps/fens	+ •	+	+	1	+	+	-	٠	-	-	5	-	•	+	1				
3.		Underground water systems																			
3.1.		Marine underground wetlands		_			_		_	-			_				_			_	_
3.1.1.	Zk (a)	Marine/coastal subterranean systems	× *	1.00	+	+				983 1	1	•	-	*	•	-	1			•	
3.2.	·	Inland underground wetlands		_		_	_		_	_	_	_	_	_		_	_	_	_	_	_
3.2.1.	Zk (b)	Inland subterranean systems		-	+	+	-	-	-	-	8	5	1	+	•	-	-	1	-	• •	
[CS] - Conservation status indicators. [1] Occupancy area. [2] Structure. [3] Hydrology. [4] Species. Non-significant or non-																					
evaluabl	e conditio	on (-). Significant impact (+). Very signific	cant imp	pact	(•	). (	ons	erva	atio	n s	tatu	s of	we	etlai	nds	: Cr	itic	al: 4	4•	3•	
and $1+$ .	<b>Bad</b> : $\geq 20$	• $1 \bullet \text{ and } \ge 1 + 1 \bullet \text{ and } 3 +;$ Inadequa	te: 1 🛡	≥	3+	; M(	ode	rate	: ≥2	2+;	Fav	/ou	rab	ole:	Res	st of	t coi	nbi	natio	ons.	
Factors a	affecting	the conservation status and biodiversity	loss of	we	tlan	ds:	(A)	Act	ivit	ies	of t	he	prir	nar	y s	ecto	or. [	A1]	Fish	ning-	٦
seafood	activity. [	[A2] Agricultural-livestock activity. [A3] F	orestry	act	ivit	y. [4	A4]	Ext	ract	tive	act	ivit	y. (	B) (	Con	stru	ictio	on a	ctivi	ties:	
[B1] Roa	[B1] Roads and linear infrastructures. [B2] Industrial, commercial, or service areas. [B3] Renewable energy installations (wind																				
farms).	[B4] Buil	dings and isolated constructions. (C) P	ollution	n: [0	[1]	Pol	lluti	on	of 1	urb	an ·	· in	dus	stria	al c	orig	in.	[C2	] Di	fuse	
contamin	nation. [C	3 Use of lead ammunition in wetlands	anents	NOIS	se p	tal	itioi	n. (I	D) ]	Pub Ac		use	act	tivit	ties	: [L	hin	Pre	ssur	e on	
ecologica	any sensi	hreas of note (without loosh or murgh	a)	acci	uen	ital :	spre	au	01 17	10.	[03]	CII	cul	aut	- 11	pai	KIII	5 01	veill	cies.	

[GWI]: Galician Wetland Inventory typologies. [R]: Ramsar Convention types of wetlands.

#### Figure 7.

Conservation status of Galician wetlands, comparing between 2001 and 2022. Created by the authors from recent works assessing the situation of Galician wetlands [37, 46, 48].

waterfalls (2.1.4), humid shrubland (2.4.2), and permanent freshwater swamps/ fens (2.6.2.3). In a "Bad" conservation status there are 11 types of humidais (37.93%): Intertidal marshes (1.2.5), Coastal freshwater lagoons, (1.4.4), riverine tree and terrigenous islands (2.1.1, 2.1.2), temporarily disconnected meanders (2.1.3), permanent freshwater lakes (2.2.1), shrub-dominated and seasonal freshwater swamps/fens (2.6.2.2, 2.6.2.4), blanket and raised bogs (2.3.1, 2.3.2), and wet heaths (2.4.1). And finally, in a "Critical" conservation status, 6 types of wetlands are included (20.69%): coastal brackish/saline lagoons (1.4.3), permanent, temporary, and seasonal continental lagoons and ponds (2.2.2, 2.2.3, 2.2.4, 2.2.5), and freshwater tree-dominated wetlands (2.6.2.1).

Anthropogenic actions that have a very negative effect on the conservation status of wetlands are mostly linked to actions derived from construction activities, as well as those linked to the primary sector. Their execution usually leads to the partial loss of habitats that are characteristic of wetlands, but even sometimes they also generate the complete destruction of the wetland [37]. Thus, permanent ponds within Parga-Ladra-Támoga SAC (ES1120003) have been lost because of their transformation into intensive farmland, a situation that similarly happened in the coastal lagoon of Praia da Ermida (Costa da Morte SAC, ES1110005), where the wetland disappeared during the execution of supposedly environmental restoration works. In other cases, it is possible to identify large areas of wetlands that have been transformed by the afforestation with exotic species (*Eucalyptus, Pinus*) or by the creation of artificial pasturelands, as it can be documented in different areas of Serra do Xistral SAC (ES1120015), causing a high impact on peaty habitats like blanket bogs, raised bogs and wet heaths [33].

The installation of wind farms also had a very negative effect on mountain wetlands, causing significant losses [36] in wet heaths, peaty ecosystems (blanket bogs, raised bogs), as well as on lacustrine environments. Serra do Xistral SAC (ES1120015) also stands out regarding the impact of wind farms on natural ecosystems [51], but this can also be detected in other areas of Galician Natura 2000 network. The negative effects of the installation of wind farms on the mountain wetlands of Galicia were pointed out when this activity erupted with force during the late 1990s in the region [33, 52]. Years later, there is no doubt about the high impact that windfarm developments generate on mountain areas, especially considering that they are established on the areas of most fragility and highest ecological value of the territory, as different authors have highlighted both for Galicia and for other territories in Europe [53–60]. Other reasons of wetland loss join to the previous ones, caused by the exploitation of subterranean resources, highlighting the extraction of fine and coarse aggregates on different Galician wetlands, as well as the peat extraction in Montes do Buio (again in Serra do Xistral SAC, ES1120015), to be used as a substrate for gardening.

The physic-chemical and microbiological analysis carried out in numerous wetlands in Galicia highlight the treatment problems of both urban-industrial waste water and that derived from livestock farms [37, 46]. The recurring presence of *Escherichia coli* and other pathogens of stool origin in coastal and inland wetlands can hardly be assimilated to a favourable ecological status. Regarding other chemical pollutants (antibiotics, phytocides), there is no detailed information that allows us to assess their impact on Galician wetlands, but in any case, their impact on the biodiversity components, especially amphibian populations, should not be minimized. The presence of lead ammunition in the Galician wetlands is more frequent than expected, despite its possession and use in wetlands it is considered illegal by Spanish law, but it has been diluted in Galician regulations, avoiding spreading among hunters the ban that affects this ammunition made with a toxic element [37].

Finally, it is necessary to comment on the impacts derived from actions of public use and leisure activities developed with disrespectful behaviour towards the values of natural heritage and biodiversity, derived from the banalization of natural areas as a mere tourist attraction or as an amusement park. This conceptualization is often favoured by tourism campaigns promoted from public bodies (mostly regional and local governments). Irrational public use is the cause of the deterioration of habitats

and protected species populations, especially in the coastal wetlands, among which the most frequent actions are the usual presence of pets without leash and muzzle that freely roam into wildlife breeding or refuge areas of wetlands, the circulation and parking of vehicles on natural and semi-natural habitats, the collection of key components of the natural heritage and biodiversity, or the accidental spread of invasive alien species [37].

#### 7. Future challenges of protected wetlands

Safeguarding of wetlands in Northern Iberian Peninsula requires a change of attitude towards natural heritage and biodiversity, abandoning the usual reactive policies and actions inherited from the old pre-democratic regimes, and start to develop proactive actions, facing the future challenges that arise over their protection. The current worldwide and European framework on biodiversity constitutes an effective action framework to reformulate and ensure the conservation of natural heritage and biodiversity of wetlands, as well as to improve the benefits they provide for people. According to Aichi Biodiversity Targets [61], at least 17% of terrestrial and inland water, and 10% of marine areas, should be protected. The EU Biodiversity Strategy for 2030 [62] increases this percentage to 30%, both in the marine and terrestrial areas. Northern Iberian Peninsula is very far from the reference values contemplated at international and European level, and it is aggravated considering several regions such as Galicia, where the terrestrial PNA do not even reach 13% [41, 42].

So, it is appropriate to raise the urgent need to increase the representation of wetlands in the different categories of protected areas (PNA, Natura 2000, APII), proposing new sites or enlarging some of the existing ones that should ensure adequate representation and protection of those wetlands that have habitats and/or endemic, rare or threatened species, and that play a significant role as a medium or long-term carbon reservoir. These usually correspond in Northern Iberian Peninsula to the different types of peat bogs, wet heaths, lagoons, and marshes. Similarly, it is equally necessary to add certain wetlands to the Ramsar List, trying to cover the current existing huge gap in relation to this category in the Cantabrian-Atlantic mountainous areas, as well as in the wetlands located in inland areas, both in Galicia (Terra Chá) and in the Iberian Plateau. Anyway, all the proposals for enlargement or new designation of wetlands protection in Galicia should obviously be complemented with measures for their mandatory monitoring, restoration and surveillance, as well as with the effective application of the sanctioning and criminal regime for every activity, plan or project that could carry out actions on wetlands that negatively affect their ecological integrity, or the conservation status of habitats and species held in them, and therefore contradict the laws and other general provisions on nature or environment. This approach assumes:

1. Eliminate or reduce close to zero the negative effects that are currently occurring in protected areas on the conservation status of habitats and species that are characteristic of wetlands. This would force to increase surveillance with rangers and complement it with remote sensing monitoring. Changes in use, waste disposal, mechanical shredding vegetation, the use of lead ammunition, or even the use of fire and biocides, which occurs in many wetlands, are incompatible with the objective of ensuring a favourable ecological status of these ecosystems.

- 2. Among the Spanish wetlands, there is a group of them that have lost their naturalness due to human action and that should be the object of restoration and conservation measures, to reverse this situation fully or partially. This list usually includes very large wetlands that were altered during Franco's dictatorship regime (Antela or Cospeito in Galicia, Mar de Campos in Castilla y León). But those wetlands whose significant alteration has occurred in recent decades should be added to this group, as they will end up disappearing if effective measures are not taken to ensure their conservation (being possible to cite in Galicia several examples: Brañas do Deo, Brañas de Brins, Brañas de Alcaián, Brañas de Xestoso, Lagoa de Valdoviño, etc.).
- 3. Surveillance, control, and eradication of invasive alien species must be done, acting on the mechanisms that facilitate their expansion, and therefore significantly reducing the area occupied by them, especially on natural and semi-natural habitats, whose ecological restoration should be promoted. The future scenarios marked by climate change are very negative for the conservation of wetlands, especially in the Atlantic coastal and insular areas of the Northern Iberian Peninsula, where the predicted scenarios will be favourable for the invasive alien species already installed in the territory, as well as for others that may settle soon.
- 4. The rational and sustainable management of wetlands must be based on the best scientific-technical information available and on previous experiences. It is anomalous to propose management actions aimed at favouring livestock use in mountain wetlands with actions that involve a significant alteration of the structure and composition of the natural and semi-natural habitats held in these wetlands, as is occurring in certain mountainous enclaves, such as Serra do Xistral SAC (ES1120015), where the increasing livestock pressure and the adoption of inappropriate use measures are negatively affecting the conservation status of peat bogs and wet heaths.

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# Author details

Javier Ferreiro da Costa<sup>\*</sup> and Pablo Ramil-Rego GI-1934-TB, Institute of Agricultural Biodiversity and Rural Development (IBADER), University of Santiago de Compostela, Lugo, Spain

\*Address all correspondence to: javier.ferreiro.dacosta@gmail.com

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