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# Biological Conservation and Nature Protection Strategies in Spanish Atlantic Region

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## Abstract

Despite the fact that the loss of biodiversity continues to be an unresolved problem at a global level, it is possible to identify new alternatives and initiatives in biodiversity conservation. From the environmental strategic framework created worldwide, an important World Network of Biosphere Reserves has been implemented under UNESCO's Man and the Biosphere (MAB) Programme, which in the European Union in general, and in Spain in particular, is strongly interrelated with Natura 2000 network that is created under Directive 92/43/EEC. In the present work, the importance of the Spanish Atlantic region for biodiversity is assessed, contextualizing the networks of protected areas created in this territory and valuing the created synergies that have favored the start-up of projects and agreements aimed at reducing the loss of biodiversity and achieving sustainability.

**Keywords:** biodiversity conservation, habitats, species, Natura 2000 network, Biosphere Reserves, Atlantic biogeographical region, LIFE Programme

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## 1. Introduction

After the declaration of the first protected areas in the mid-nineteenth century [1], the American model of national parks and monuments moved progressively to other continents and countries [2] until reaching an important development and covering important milestones in the conservation of world biodiversity and natural heritage. However, the model of protected areas generated frequent problems with the local population, especially at the time of reconciling the conservation objectives with the exploitation of the resources that had been carried out in the territory or that are incorporated after the protected area's declaration. This determined that during the mid-twentieth century the increase of protected areas stopped in many countries and even worldwide [3]. This situation changed during the 1970s through the

incorporation of two new protected figures: the Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, Iran, 02/02/1971) and the Biosphere Reserves created by the UNESCO in 1974 within the Man and the Biosphere (MAB) Programme.

In 1992 during the United Nations Conference on Environment and Development (Rio de Janeiro, Brazil), known as the “Earth Summit,” the Convention on Biological Diversity (CBD) was signed. Months before, the Council of European Communities promulgated Directive 92/43/EEC, creating Natura 2000 network and establishing a new nature conservation policy in the European Economic Community. CBD endorsed a really ambitious goal when the parties approved “to achieve by 2010 a significant reduction in the current loss rate of biological diversity, globally, regionally and nationally, as a contribution to the mitigation of poverty and for the benefit of all forms of life on earth” [4].

Despite world and European efforts, it was not possible to stop the loss of biodiversity before 2010. This failure led to the elaboration and adoption by the CBD of the “Strategic Plan for Biodiversity,” for the 2011–2020 period, which includes 20 operational targets (known as the Aichi Biodiversity Targets) in terms of conservation and sustainable use of biodiversity [5] to be met at the end of the programming period. Notable efforts have been made since then. The European Union has been one of the organizations, which has promoted the most activity from its competences, with the promulgation of different environmental regulations, the creation of an extensive network of protected areas, Natura 2000 network, and the adoption in 2011 of a new Biodiversity Strategy to protect and improve the state of biodiversity during the next decade [6].

## 2. Two different and complementary models of protected areas

Two models of networks of protected areas, the Biosphere Reserves Network and the Natura 2000 network, currently coexist in the territory of the European Union. Although they have a clearly different configuration, organization, and functioning, since their inception, the two models have shared common objectives oriented to biodiversity conservation and sustainable development. This coincidence determines that in many cases there is a strong complementarity between both figures, resulting in greater effectiveness of their objectives and especially in a greater interrelation of environmental policies with the society that lives in these territories.

The Biosphere Reserves have been consolidated as a long-term conservation model, with 45 years of experience. The Earth Summit of Rio, the Convention on Biological Diversity, and the European Biodiversity Strategy have had a wide impact on the evolution of the Man and Biosphere Programme, reflected in its Seville Strategy (worldwide strategy of working and sustainable development) and the approval of the Statutory Framework of the World Network of Biosphere Reserves in 1995 [7]. Biosphere Reserves have become a successful example of adaptive management, incorporating the latest trends and the best available scientific-technical knowledge through the implementation of the successive Action Plans for the World Network of Biosphere Reserves until the last one approved recently in Lima [8].

In 1992, the European environmental policy was reinforced with the approval of the Directive 92/43/EEC and the creation of Natura 2000 network, made up of various types of protected areas (including Sites of Community Importance and Special Areas of Conservation and

incorporating Special Protected Areas according to Directive 79/409/EEC, now replaced by Directive 2009/147/EC), and destined to the conservation of biodiversity. Up to now, Natura 2000 network has been established as the largest ecological network worldwide [9, 10], with a total area of 1,147,956 km<sup>2</sup>, which represents 18.12% of the European Union territory. Therefore, Natura 2000 network accomplishes and surpasses the 11th target established in the Strategic Plan for Biodiversity for the 2011–2020 period [5]. In addition, Natura 2000 areas are estimated to provide ecosystem services valued between 223,000 and 314,000 million euros a year; to retain 35,000 million tons of carbon dioxide (CO<sub>2</sub>); and to generate about 12 million jobs every year in the European Union [11].

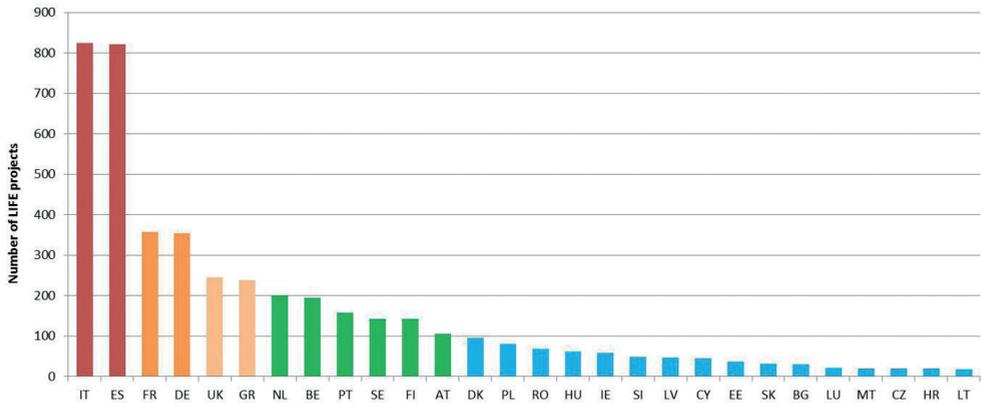
Both in the model of Biosphere Reserves Network and Natura 2000 network, the protected areas must meet a set of environmental criteria, evaluated in the context of a biogeographical sectorization with an impact on the organization and management of the sites.

Designated Biosphere Reserves must be able to fulfill three basic functions: conservation of natural resources, economic and social development according to sustainability principles, and creation and participation in networks [7]. To achieve this, a zoning model is established, which includes one or several separate core areas within the Biosphere Reserve, aimed to ensure the biodiversity conservation function. On the contrary, Natura 2000 network areas (SCI, SAC, SPA) have been designed by adjusting their morphology to the spatial distribution of certain types of habitats or species, so they are identified with areas destined primarily for conservation. These are comparable with the core areas of the Biosphere Reserves but lacking a clear designation of buffer and transition zones. This absence generates serious problems when Natura 2000 areas are designated into the member states, but it is being addressed with the brand new Green Infrastructure Strategy [12].

Natura 2000 network has an important level of regulatory development, supported by both Directives 92/43/CEE and 2009/147/CE. This regulatory complexity of Natura 2000 network clash against the maintenance of an unsustainable use generating a widespread rejection among sectors that maintain the hopes of achieving a profit based on an irrational exploitation.

Biosphere Reserves lack specific regulations, or rather, do not generate their own regulations, although their establishment and development implies the incorporation of European Union regulations, including reference to the Natura 2000 network. Without these protected areas, it would be impossible to comply the objectives established by the Man and Biosphere Programme.

The model management shows important differences between Biosphere Reserves and Natura 2000. The ordinary management of Biosphere Reserves is carried out from the own territory, through a set of management bodies, including a manager, as well as public participation and advisory bodies. Regarding to Natura 2000 network, the national or regional authorities directly manage the protected areas, but there are no participation bodies, and it's not possible to identify the manager of each of them into the territory. Therefore, Natura 2000 management is more detached from the territory, which in many cases supposes malfunctioning of participation channels and the lack of collaboration with local society and entities during the implementation of specific plans or programs or the search for the simple implication of citizenship. At this point, the Biosphere Reserves have demonstrated a greater capacity for management and involvement with real problems.



**Figure 1.** Number of LIFE projects led by the EU member states (prepared from [13]).

Funding is another key aspect in both models of protected areas. The MAB Programme does not provide any kind of financial aid or credit to the Biosphere Reserves or to the countries that have designated them. On the contrary, the countries are responsible to bear the expenses of the UNESCO and United Nations. Even in most European countries, there is also no specific financial program for Biosphere Reserves.

The European Union financing for environment is carried out globally through the ERDF, ESF, and ECF funds. In addition, the EU maintains a successful program for support environmental conservation and restoration activities, the LIFE Programme (acronyms that come from the French *l'instrument financier pour l'environnement*). This program, mainly focused on the Natura 2000 network, has cofinanced more than 4,600 projects dedicated exclusively to the environment and climate change [13] across the European Union and beyond (**Figure 1**).

### 3. Natura 2000 network and diversity of habitats in Spain

Undoubtedly, the most relevant tool in the promotion of biodiversity conservation in Spain has been the approval of the Directive 92/43/CEE (Habitats Directive) and the implementation of the Natura 2000 network. In fact, Spain has been one of the EU member states that has put more efforts on this figure, since it is the country that holds the largest area occupied by Natura 2000 sites (**Figure 2**), with a total amount of 222,276 km<sup>2</sup> and 27.3% of its continental area (**Figure 3**). Natura 2000 network in Spain meets, therefore, the 11th Aichi Biodiversity Targets [5].

Currently, the Spanish Natura 2000 network includes a set of 1,863 sites, consisting of 1,467 SCI/SAC and 644 SPA, which are distributed among the biogeographical regions represented in Spain, i.e., Atlantic, Alpine, Mediterranean, and Macaronesian (**Figure 4**). 85.7% of the Spanish continental area is included in the Mediterranean region, divided between the Iberian Peninsula, the Balearic Islands, Ceuta, and Melilla. The following region by occupation order is the Atlantic region, with 11.0% of the total, present in the NW Spanish mainland. Finally,

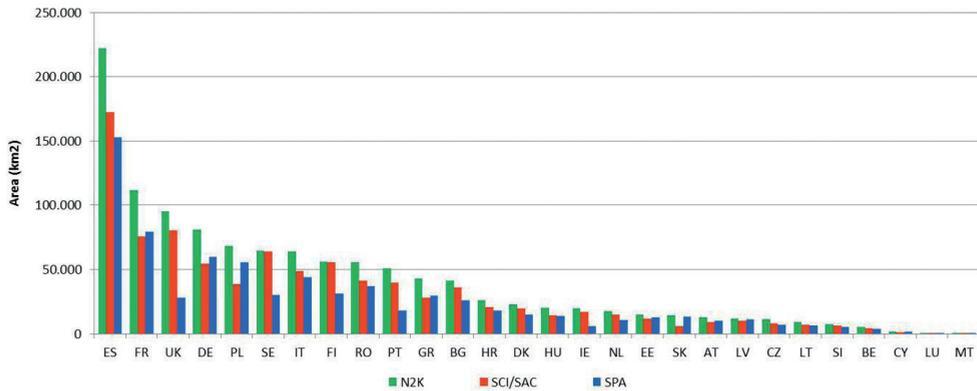


Figure 2. Total area occupied by Natura 2000 sites in the EU member states (prepared from [14]).

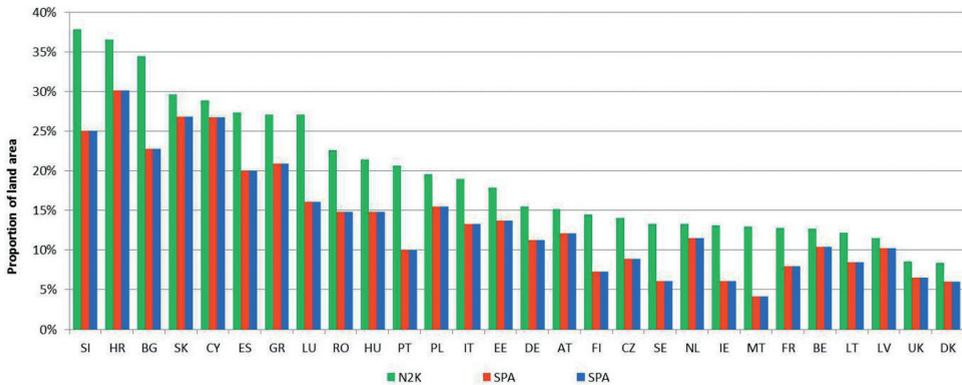


Figure 3. Proportion of the terrestrial and inland water areas occupied by Natura 2000 sites in the EU member states (prepared from [14]).

it should be noted that 1.9% of Spain is included in the Alpine region, delimited around the Pyrenees mountain range, while the remaining 1.4% corresponds to the Macaronesian region represented in the Canary Islands.

According to distribution analysis of habitat types in the Iberian Peninsula [17], the areas of the highest diversity are concentrated in the Atlantic portion (Figure 5). The 10×10 km<sup>2</sup> UTM grids with a higher number of habitats are placed mainly in the northern third of the peninsula, highlighting those that host the maximum (more than 25 types) in the NW coastal area (Galician region) and along the mountain foothills of the Cantabrian Mountains.

The Spanish Atlantic biogeographical region includes the most diverse areas in Spain and even several of the most diverse habitat areas of the whole Atlantic biogeographical region or of the entire European Union, according to reports on conservation status and trends of habitat types and species, which are developed every 6 years under Article 17 of Directive 92/43/EEC and Article 12 of Directive 2009/147/EC. The report regarding the last evaluation period

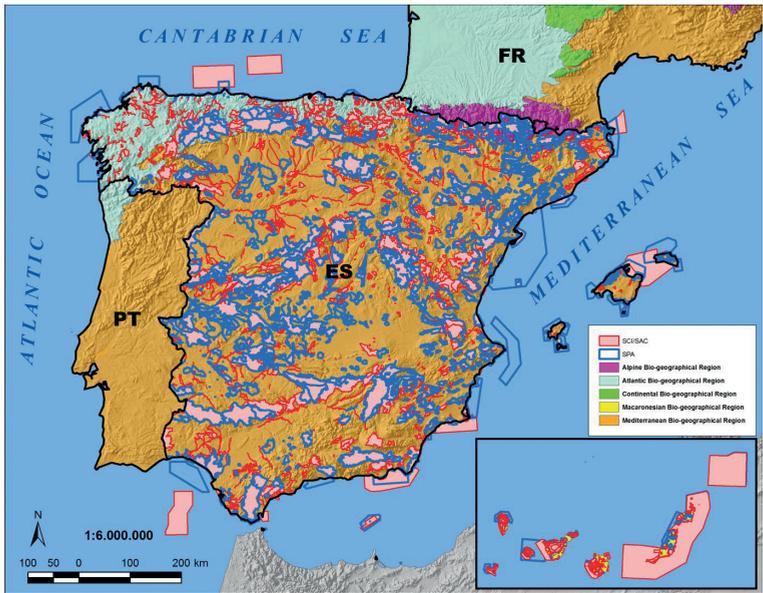


Figure 4. Distribution by biogeographic regions of Spanish Natura 2000 network (prepared from [15, 16]).

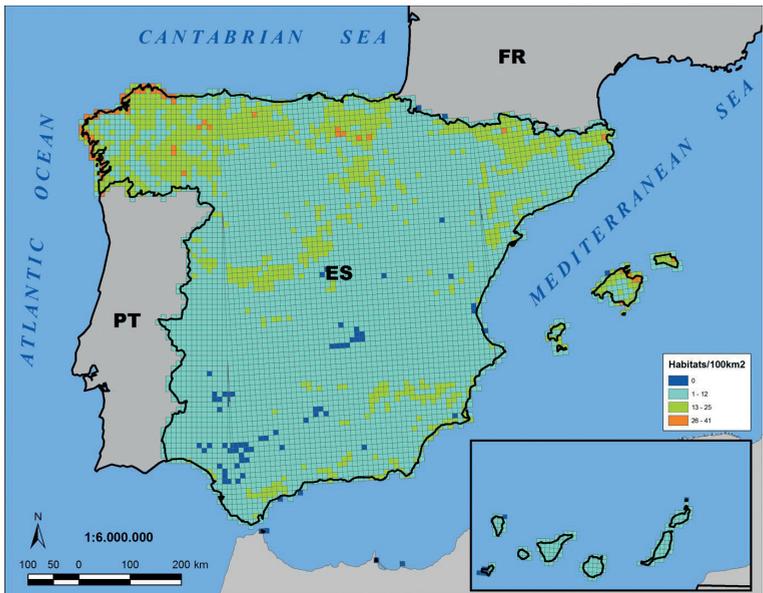


Figure 5. Number of habitats per 10 × 10 km<sup>2</sup> UTM grid in Spain (prepared from [17]).

available [18] includes the information collected for the 2007–2012 period. The list of habitats provided in this report [19] for the Atlantic region includes a total of 121 types, and 30 of them are considered as priority types (those whose conservation supposes a special responsibility for the member states of European Union) in Annex I of Directive 92/43/EEC. In the Spanish Atlantic region, a total of 89 habitat types are considered present, of which 19 are considered priority types [19]. So, Spanish Atlantic biogeographical region plays an important role in biodiversity conservation, since it houses 72% of the variety of habitat types and 63% of the priority types present in the Atlantic biogeographical region (**Table 1**).

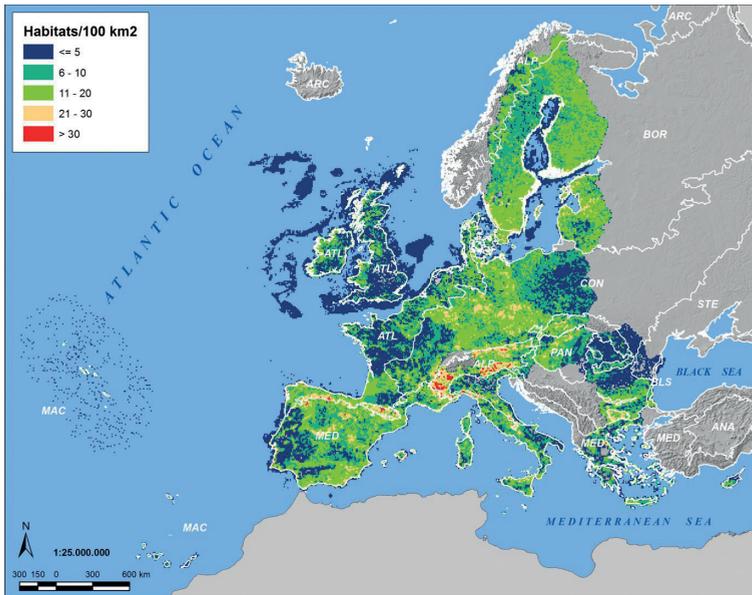
The analysis of digital cartographic information housed in web servers of [20] and classified in LAEA grids 10×10 km<sup>2</sup> allows to assess the territorial distribution of habitat types in different intervals by the number of habitat types (**Figure 6**). The Atlantic region of the Iberian Peninsula concentrates a greater proportion of the top three intervals of the number of habitat types by LAEA grids 10×10 km<sup>2</sup> with respect to the rest of the Atlantic region or even from the European Union. On the contrary, grids with the lowest number of habitats show a scarcer representation into the Spanish Atlantic region than in the other areas (**Table 2**). The levels of biodiversity of habitats recorded in the grids included into the Spanish Atlantic region are comparable to those that can be identified in the Pyrenees or the Alpine Range (Alpine region), in the Balearic Islands (Mediterranean region), or in small points of the Scandinavian coast (Boreal region). These results are consistent with those obtained by analysis made for the period 2001–2006 [21].

Regarding to the species across the territory, the number of taxa present in the Iberian Peninsula is estimated to amount to a value above 80,000 [22]. In this way, Spain is attributed to be the member state of the European Union responsible for the conservation of the highest species diversity of the continent [23], with more than 60,000 animal and 22,000 plant species. In some of these groups, Spain hosts 80–90% of the total taxa found in the European Union. Within this framework, the portion of the Iberian Peninsula located in the Atlantic biogeographical region plays a key role in the conservation of the main components of biodiversity, since it meets the optimum conditions for a significant diversity of different taxon groups [24–28].

The high Spanish biodiversity explains the relevant territorial representation that Natura 2000 sites have achieved within the Spanish national territory. This large area occupied by Spanish Natura 2000 network has allowed the improvement of biodiversity conservation policies and environmental measures at different levels. Inventorying of habitat types and species of community interest

	Habitat number		
	Total	Priority	Non-priority
European Atlantic region	121	30	91
Spanish Atlantic region	89	19	70

**Table 1.** Comparison of the number of habitats (priority and non-priority) of Annex I of the DC 92/43/EEC present in the European and Spanish Atlantic regions (taken from [19]).



**Figure 6.** Number of habitats per LAEA grid  $10 \times 10 \text{ km}^2$  in the European Union, with respect to biogeographical regions (prepared from [15, 20]).

N° hab	European Union		European Atlantic region		Spanish Atlantic region		Spanish Atlantic Biosphere Reserves	
	N LAEA	%	N LAEA	%	N LAEA	%	N UTM	%
≤5	17.376	32.5	8.223	59.6	113	15.4	1	0.4
6–10	15.004	28.1	2.803	20.3	106	14.4	24	10.6
11–20	18.093	33.8	2.445	17.7	338	46.1	155	68.3
21–30	2.764	5.2	299	2.2	150	20.4	43	18.9
>30	207	0.4	35	0.2	27	3.7	4	1.8

**Table 2.** Comparison of the number of habitats per grid  $10 \times 10 \text{ km}^2$  and percentages in the European Union, the Atlantic region, the Spanish Atlantic portion, and the Spanish Atlantic Biosphere Reserves (prepared from [15, 16, 20]).

and delimitation of the Natura 2000 areas have allowed increasing the knowledge on Spanish interesting areas for biodiversity conservation, strengthening, and consolidating the national and regional networks of natural protected areas [29]. On the other hand, the provision of an extensive Natura 2000 network has allowed Spain to lead 821 projects and to participate in 903 projects of the LIFE Programme in 25 years [13]. This means an average participation in 34 LIFE projects per year, making Spain one of the leader countries in terms of the implementation of these initiatives for nature conservation. Finally, it is worth mentioning the establishment of strong synergies with other protection figures, especially the Spanish Network of Biosphere Reserves, whose core areas have been delimited fundamentally around the Spanish Natura 2000 network [30].

## 4. Biosphere Reserves in Spain

Spain has been one of the countries in the world that has bet more decisively for Biosphere Reserves model, becoming a benchmark on the development of the objectives of the Seville Strategy [31, 32], while the promotion of new designated Biosphere Reserves has placed Spain at the top of the World Network of Biosphere Reserves (WNBR). After the last meeting of the UNESCO International Coordination Council held in Paris in June 2017, WNBR is made up of 669 designated Biosphere Reserves distributed in 120 countries around the world [33]. In Spain, a total of 48 Biosphere Reserves have been designated, 7% of the WNBR, which makes the country with the highest number of Biosphere Reserves, ranking above countries with a much larger territorial scope, such as the United States, Russia, or China.

The numerous and large set (**Figure 7**) of Spanish Network of Biosphere Reserves (SNBR) houses a wide variety of habitats, ecosystems, and socioeconomic and population realities. From a geo-statistical point of view, SNBR has been delimited fundamentally around the Mediterranean biogeographical region. A total of 29 Biosphere Reserves are included totally or partially within this region, with a total area of 40,139 km<sup>2</sup>. This area is appreciably higher in absolute value with respect to the Biosphere Reserves delimited totally or partially in the Atlantic region, which brings together a set of 18 Reserves, including a total area of 12,446 km<sup>2</sup>. These differences are even greater with respect to the Biosphere Reserves in the Spanish Macaronesian or Alpine regions. However, if the analysis is relativized from a biogeographical point of view, the values indicate a completely different reality (**Table 3**).



**Figure 7.** Distribution of the Spanish Network of Biosphere Reserves with respect to biogeographical regions (prepared from [15, 16]).

Region	Spain (%)	No. of reserves	Biosphere Reserves area (km <sup>2</sup> )			Region (%)
			Total	Marine	Continental	
Mediterranean	85.7	29	40.139	1.185	38.954	8.9
Atlantic	11.0	18	12.446	33	12.413	22.3
Alpine	1.9	1	992	–	992	10.2
Macaronesian	1.4	7	8.400	4.721	3.679	52.4

**Table 3.** Surface distribution by biogeographical region of the Biosphere Reserves in Spain (prepared from [15, 16]).

Although Spanish Mediterranean Biosphere Reserves include 38,954 km<sup>2</sup> of terrestrial areas, they only represent 8.9% of the Spanish Mediterranean continental areas. Both in the Atlantic and Macaronesian regions, the percentage included in the SNBR is significantly higher (**Table 3**), and they also exceed the index values of 11th Aichi Biodiversity Targets [5].

The high percentage of the Spanish Atlantic region (22.3%) that has been included in the Biosphere Reserves is consistent with the territorial distribution of habitat diversity in the Iberian Peninsula (**Figure 5**). In the Spanish Atlantic region, there is a high presence of areas with the highest abundance of habitats in the Iberian Peninsula [17] and even in the European Union [18, 20]. This is indicative of the biodiversity harbored by the Iberian Atlantic area and of the sustainability that has governed the management and conservation of this territory, and therefore it has allowed the establishment of a large set of Biosphere Reserves into the Spanish Atlantic region.

The reason for the harbored biodiversity by the Iberian Atlantic region combines climatic and geographical factors [34–36]. Rainfall occurs abundantly and is well distributed throughout the year, so that the summer drought does not exist or is very low, because even in summer the winds of component N loaded with moisture provide effective and hidden precipitation. The distance from the coast to the continent does not exceed 120 km from the shore of the Atlantic Ocean, so a low continentality and a reduced annual thermal amplitude are typical, especially in comparison with Mediterranean territories further away from the sea, in which continentality produces a greater oscillation between winter and summer temperatures. Everything causes the optimal conditions for Atlantic vegetation to converge in NW Spain [25], which allows a higher variety of ecosystems [24, 37, 38], and consequently a greater richness of habitat types [17] and species [39].

## 5. Biosphere Reserves in the Spanish Atlantic region

The Biosphere Reserves delimited totally or partially in the Spanish Atlantic region form a set of 18 Biosphere Reserves (**Figure 8**) whose total area amounts to 12,446 km<sup>2</sup> of which 33 km<sup>2</sup> (0.3% of the total) correspond to marine waters, while the remaining 12,413 km<sup>2</sup> (99.7% of the total) correspond to terrestrial and inland water areas.

In this set of Biosphere Reserves, a wide ecological range is represented, being possible to identify reserves in which marine, littoral, and coastal environments are represented



Figure 8. Territorial distribution of the Biosphere Reserves in the Spanish Atlantic region (prepared from [15, 16]).

(Urdaibai, Mariñas-Mandeo, Rio Eo-Oscos-Burón), whereas in other cases, wetlands are the main component (Terras do Miño). There are also examples in which traditional agrosystems are the main component (Allariz), although most include inland valley-range systems (Muniellos, Laciana, Babia, Omaña-Luna, Alto Bernesga, Los Argüellos, Gerês-Xurés, Redes) or high mountain ecosystems (Somiedo, Picos de Europa, Ancares Lucenses, Ancares Leoneses, Ubiñas-La Mesa).

The 18 Biosphere Reserves in the Spanish Atlantic region respond to different governance models (Table 4). Eight of them are managed by the regional governments, differentiating those that coincide territorially with the limits of a national park (NP) and that are managed jointly with this protected area, of which they are directed directly by the regional government. As for the rest, it is possible to differentiate those Biosphere Reserves linked to provincial and local entities, from those that are directed by foundations or associations of various kinds. This variety in the management bodies is representative of the success example of adaptive management that Biosphere Reserves of the Spanish Atlantic region have become, so their management is designed from the development needs of local communities to regional priorities.

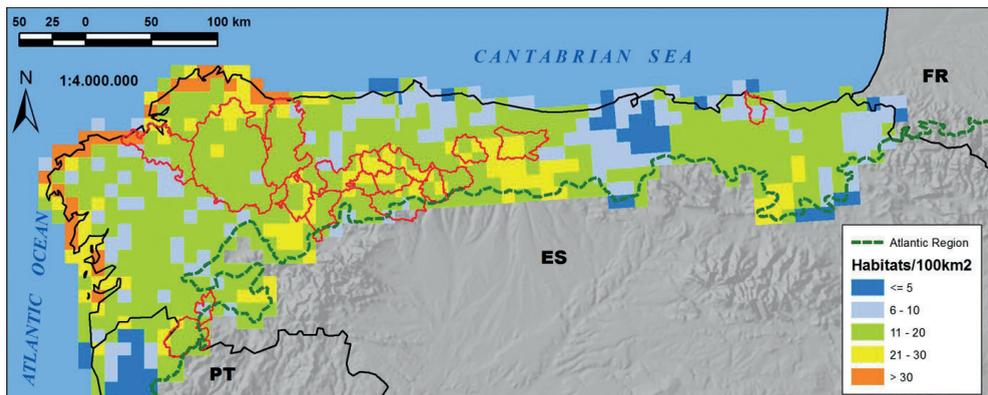
The set of Biosphere Reserves in the Spanish Atlantic region, given their proximity to the biogeographical boundary and as transition to the Mediterranean territories, has a large number of unique components of the natural heritage and biodiversity. They harbor a remarkable richness of natural and seminatural habitats that are threatened with disappearance in the whole of the European Union or that have a very small territorial representation (marshes, dune ecosystems, rivers and lagoons, peat bogs, wet heathland, dry heathland, orophilic scrubs, hay meadows, deciduous and evergreen forests, rocky habitats, caves not exploited by tourism, etc.), as well as an important group of endemic or threatened wild species or subspecies.

According to distribution analysis of habitat types in the Iberian Peninsula [17], the Biosphere Reserves in the Spanish Atlantic region have been delimited over the areas that harbor the highest diversity of habitat types (Figure 9), so the distribution of the number of habitats per  $10 \times 10 \text{ km}^2$  grid is similar to the rest of the Spanish Atlantic region (Table 2). It is worth highlighting the maximum interval of habitat types (>30 types), which reaches a proportion that far exceeds

	NP	Managing entity	Habitat number		
			Total	Priority	Non-priority
Mariñas-Mandeo		Foundation/association	49	12	37
Río Eo-Oscos-Burón		Regional government	48	12	36
Picos de Europa		Regional government	41	10	31
Somiedo	*	Regional government	37	8	29
V. Omaña y Luna		Local entity/consortium	36	10	26
Terras do Miño		Provincial Deputation	35	11	24
Ancares Lucenses		Provincial Deputation	35	11	24
Las Ubiñas-La Mesa	*	Regional government	35	8	27
Redes	*	Regional government	34	8	26
Ancares Leoneses		Local entity/consortium	34	8	26
Muniellos	*	Regional government	33	7	26
Babia		Local entity/consortium	33	9	24
Valle Laciana		Foundation/association	32	8	24
Urdaibai		Regional government	32	6	26
Alto Bernesga		Local entity/consortium	30	8	22
Argüellos		Local entity/consortium	29	7	22
Gerês-Xurés	*	Regional government	28	8	20
Área de Allariz		Foundation/association	13	2	11
Total			78	19	59

NP: presence of National/Natural Park.

**Table 4.** Typology of the management bodies and richness of habitat types in Biosphere Reserves of the Spanish Atlantic region.



**Figure 9.** Habitats richness per UTM grid 10x10 km<sup>2</sup> in Biosphere Reserves of the Spanish Atlantic region (prepared from [17]).

(between 4 and 9 times) the value reached in the entire Atlantic Biogeographic region and even in the European Union (**Table 2**). The four UTM 10×10 km<sup>2</sup> grids with more than 30 types of habitat are located in littoral Biosphere Reserves (Mariñas-Mandeo, Río Eo-Oscos-Burón), due to the great diversity of the Atlantic coastal environments. In contrast, Urdaibai, Allariz, and Gerês-Xurés Biosphere Reserves do not include grids of more than 20 habitat types. The remaining 13 Biosphere Reserves are in an intermediate situation, housing grids of up to 30 habitat types.

The total amount of habitat types housed by each Biosphere Reserve of the Spanish Atlantic region (**Table 4**) is directly proportional to their territorial distribution over the number of habitat types by UTM 10×10 km<sup>2</sup> grids (**Figure 9**). So Biosphere Reserves with a greater number of habitat types are Mariñas Coruñesas, Terras do Mandeo (49 habitats), Río Eo, and Oscos e Terras de Burón (48 habitats). The high diversity of habitat types housed in these two is due to the fact that they include coastal, sublittoral, and continental areas. Excluding the coastal areas, Picos de Europa would be the Biosphere Reserve with the largest number of habitats of community interest (41 habitats), followed by the Somiedo Biosphere Reserve (37 habitats). On the contrary, Allariz Biosphere Reserve is the one with the smallest number of habitat types included in Annex I of the DC 92/43/CEE, with 13 types.

Similarly, Mariñas Coruñesas y Terras do Mandeo and Río Eo, Oscos e Terras de Burón Biosphere Reserves are the ones that hold the largest set of priority habitat types, with a total amount of 12 types, due to the presence of coastal priority types that are not able to be found in the rest of the Biosphere Reserves in the Spanish Atlantic region. However, it is also worth highlighting the presence of 11 priority types in Terras do Miño and Os Ancares Lucenses Biosphere Reserves or of 10 types in Picos de Europa and Valles de Omaña and Luna Biosphere Reserves.

Biosphere Reserves of the Spanish Atlantic Region host an amount of 78 types of habitats, of which 19 are considered priority (**Table 4**). That is, the Spanish Atlantic Biosphere Reserves contain 88% of the diversity of habitat types identified in the Spanish Atlantic region and 64% of the diversity of habitats in the European Atlantic region (compared with **Table 1**). Regarding to priority habitats, the Biosphere Reserves of the Spanish Atlantic region still play a more important role: they include 100% of priority types in Spanish Atlantic region and 63% of priority habitats identified in the whole European Atlantic biogeographical region (compared with **Table 1**).

Some of the identified habitats in the Biosphere Reserves of the Spanish Atlantic region are widely distributed in all the 18 Biosphere Reserves, since they are characteristics of the Spanish Atlantic landscape [38, 39]. These types correspond to habitats linked to the Atlantic river courses (3260 water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, 6430 hydrophilous tall herb fringe communities of plains and of the montane to alpine levels, 91E0\* alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*), dry heathland (4030 European dry heaths), and oak forests (9230 Galician-Portuguese oak woods with *Quercus robur* and *Quercus pyrenaica*).

The set of Biosphere Reserves in the Spanish Atlantic region hosts a large group of interesting species for nature conservation (protected and catalogued species). The implementation of Natura 2000 network has led to standardization regarding the inventorying of natural values through the Standard Data Forms (SDFs). These register the habitats and species of community interest in each Natura 2000 area, allowing a homogeneous treatment of the data hosted in the database of the European Topic Centre on Biological Diversity [40], dependent on the European

	Plant	Inverteb.	Fish	Herpet.	Birds	Mamm.	Total
Urdaibai	3	7	1	3	153	6	173
Gerês-Xurés	11	7	7	5	93	9	132
Río Eo-Oscos-Burón	2	9	4	4	85	11	115
Mariñas-Mandeo	6	6	4	4	72	7	99
Terras do Miño	6	6	4	4	61	6	87
Picos de Europa	7	13	2	4	35	13	74
Redes	2	8	0	4	45	9	68
Ancares Lucenses	7	6	1	4	42	7	67
Babia	4	3	2	3	36	8	56
Las Ubiñas-La Mesa	3	4	1	4	35	8	55
V. Omaña y Luna	4	3	2	3	33	8	53
Ancares Leoneses	4	6	2	5	30	5	52
Somiedo	4	3	0	3	35	7	52
Valle Laciana	5	4	2	2	33	6	52
Muniellos	2	6	0	3	32	7	50
Área de Allariz	1	1	1	0	32	5	40
Argüellos	5	3	2	4	6	7	27
Alto Bernesga	3	1	0	3	6	5	18

**Table 5.** Richness of species in Biosphere Reserves of the Spanish Atlantic region.

Environment Agency (EEA). The core areas of the Biosphere Reserves in the Spanish Atlantic region have been included almost completely within the Natura 2000 areas, so an analysis of their SDFs has been carried out to compare diversity of the species of community interest present in each of the Biosphere Reserves of the Spanish Atlantic region has been carried out (**Table 5**).

The total number of present species in the Biosphere Reserves of the Spanish Atlantic region is high as a whole and depends to a large extent on the diversity of birds, since they are the most numerous group by far. In this way, Biosphere Reserves with the largest number of species (>80 species) are Urdaibai, Gerês-Xurés, Río Eo-Oscos-Burón, Mariñas-Mandeo, and Terras do Miño, which in turn are those that have a greater number of bird species (>60 species). Also, noteworthy are a set of flora (11) and fish (7) species of Gerês-Xurés, invertebrates (13) in Picos de Europa, or mammals in Picos de Europa (13) and Río Eo-Oscos-Burón (11).

## 6. The seed for new projects and initiatives

The Spanish Atlantic region is one of the European areas with greater value for biodiversity conservation of the European territory, including a large group of habitat types and species

considered of interest for conservation under Directives 92/43/EEC and 2009/147/CE. This has enabled the delimitation of a profuse set of Natura 2000 areas, which have served as support for the core areas of the set of Biosphere Reserves established in the Spanish Atlantic region. The synergy created between the importance of the hosted values and these new instruments for the protection, planning, and management of the territory have made possible the start-up of new projects and initiatives for nature conservation and sustainable development in this territory, fundamentally through the LIFE Programme of the European Union [13].

The peatland ecosystems, present throughout the entire Iberian Atlantic region, have been the subject of several restoration projects in Natura 2000 areas. It should be highlighted LIFE Parga-Ladra-Támoga project (LIFE00 NAT/E/007330), that has been complemented by LIFE Tremedal project (LIFE11 NAT/ES/000707), should be highlighted. In both cases, actions have been carried out to restore peatland habitat types (7110\*, 7130\*, 7140, 7150, 7210\*, 7230) and other types of wetlands (3110, 3190, 6410, 6510, 91E0\*), as well as the taxa of interest for the conservation that they harbor, with special attention to the priority species *Eryngium viviparum*\* and others such as *Spiranthes aestivalis* or *Narcissus pseudonarcissus nobilis*. This kind of projects is of great interest not only for the environmental benefits they generate but also because they allow for the increase of knowledge as they generate up-to-date and homogeneous information on the distribution and conservation status of the key elements for biodiversity, gathering experiences for its better management and restoration [41]. In a complementary way, the generated information allows improving and increasing the communication and awareness of society about the values and environmental services that provide the ecosystems for biodiversity conservation and specifically the types of habitats and species of interest for conservation.

The forest ecosystems have also been the subject of several LIFE projects, highlighting the LIFE BACCATA project, which aims to improve the conservation status of the yew forests (*Taxus baccata*), considered a priority habitat type (9580\*) that has a scarce distribution at the European Union level, and which is present in the Iberian Atlantic region [42]. The relevance of this project is high, since it includes the increase of the area occupied by this habitat type by 7% and an improvement in the conservation status by 26%, complemented by a genetic characterization of *Taxus baccata* in the Spanish Atlantic region, in order to determine the variability and degree of genetic connectivity between populations and the kinship structure. The dissemination, diffusion, and awareness of society about the conservation of forests in general, and of yew forests in particular, are also included in LIFE BACCATA project, together with the transfer of its results for replication to the different agents involved throughout Spanish and European territory.

Other conservation projects have focused on species of interest for conservation, with special attention to those considered in danger of extinction. In this case, there is no doubt that in the Cantabrian Mountains two species have received the greatest investigative and conservative effort: the brown bear (*Ursus arctos*\*) and the capercaillie (*Tetrao urogallus*).

The territorial area formed for the most of the Biosphere Reserves of the Spanish Atlantic region (Os Ancares Lucenses, Los Ancares Leoneses, Muniellos, Somiedo, Valle de Laciana, Babia, Valles de Omaña y Luna, Las Ubiñas-La Mesa, Alto Bernesga, Los Argüellos, Redes, and Picos de Europa) forms a continuum in which various instruments and actions for the conservation of *Ursus arctos*\* have been set in motion. These instruments and initiatives include the monitoring of the Cantabrian brown bear population and brown bear habitat improvement actions,

through several LIFE projects that have been developed in recent decades (Corredores Oso, Oso/Cantabria, Oso/Galicia, Oso en Asturias, LIFE Bear Defragmentation, etc.). The initiative for the implementation of these projects arose from the provision of the Spanish Strategy for the Conservation of the Cantabrian Brown Bear [43]. However, new projects were also initiated seeking synergy between brown bear conservation and other aspects such as climate change (“Osos CO2”) or insect conservation (“Abejas en Acción”). In a complementary way, support is available for the maintenance of mountain livestock by the different regional governments where brown bear is present.

Regarding the capercaillie (*Tetrao urogallus*), this species has been the object of a conservation strategy parallel to the brown bear's, since its presence is distributed in the same Biosphere Reserves as the plantigrade, reaching in some cases to share programs and actions of conservation (LIFE Ancares/Galicia and Ancares/Castilla y León) that were designed in a coordinated and complementary way. Nevertheless, capercaillie has had its own projects (LIFE + Urogallo Cantabrico). All these projects have pursued the improvement of the habitat for the capercaillie in the Cantabrian Mountains and the reintroduction of the species in areas where it had disappeared, and they have been supplemented by the aids for the maintenance of mountain livestock.

In addition to the previous habitats and species, other examples have been the subject of LIFE projects in the Spanish Atlantic region in response to its high variety of ecosystems and because of its extraordinary biodiversity. In this way, the dune ecosystems (2110, 2120, 2130\*) have also been the subject of LIFE projects (LIFE + ARCOS, LIFE Dunas Laida), while several taxa of interest for conservation have also been the main beneficiaries of LIFE projects, as is the case of *Galemys pyrenaicus* (LIFE Desmania), *Margaritifera margaritifera* (LIFE Margal Ulla), or *Woodwardia radicans* (LIFE Miera), among many others.

## 7. Final considerations

The Atlantic portion of Spain is one of the most biodiverse areas of the entire Atlantic biogeographical region and even of the entire European Union, since it includes a significant proportion of the whole variety of habitat types in the European Atlantic region. This has motivated Spain to be one of the countries that has bet more strongly on the Natura 2000 network, mainly through the SCI/SAC and SPA delimited in the Atlantic region.

The importance of the housed biodiversity values and the territorial representativeness of the Natura 2000 network have favored the establishment of a profuse and large set of Biosphere Reserves in the Spanish Atlantic region, which constitute territories that develop initiatives for the biodiversity conservation, the sustainable development, and the improvement of knowledge and capacities of the population.

The situation generated in the Spanish Atlantic region has allowed the development and implementation of LIFE projects for the conservation and restoration of habitats and populations of species of interest for conservation. Consequently, the Spanish Atlantic region has become a reference area when launching new strategies, functioning as a living laboratory to develop and test new experiences of biodiversity conservation, promotion of sustainable development, and logistical support for research, monitoring, education, and information exchange.

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