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Methodological proposal for the analysis of the adequacy of European protected spaces: application to Castilla y León, Spain

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Resumo - The European Union (EU), through its initiative Natura 2000, established the classification and selection of protected areas at European level in order to ensure biodiversity conservation. However, there are not clear and uniform parameters to enable member countries to make the best decisions of zoning for biodiversity conservation. For this reason, a methodology based on evaluation of criteria importance for biodiversity conservation is presented in this thesis. The introduced methodology aims to establish relevant criteria that can be analyzed through statistical method of multicriteria analysis and interpolation of data with the kriginggeostatistical method. The objective is to verify the suitability of areas designated for Natura 2000 network in Castilla y León, Spain and to develop a proposal for zoning based on biodiversity importance values in consideration of land use. The proposed methodology was performed with basic criteria of biodiversity conservation that can be adapted and applied in different EU member countries contributing to an optimal selection of protected areas with clear and uniform parameters for zoning.

Proposta metodológica para análise da adequação dos espaços europeus protegidos: aplicação para Castilla y León, Espanha

Abstract - A União Europeia (UE), através da sua iniciativa Natura 2000, estabeleceu a classificação e seleção de áreas protegidas na Europa, a fim de assegurar a conservação da biodiversidade. No entanto, não há parâmetros claros e uniformes para permitir que os países membros tomem as melhores decisões de zoneamento para a conservação da biodiversidade. Por esta razão, uma metodologia baseada na avaliação de critérios de importância para a conservação da biodiversidade é apresentada nesta tese. A metodologia introduzida visa estabelecer critérios relevantes que podem ser analisados através do método estatístico de análise multicritério e interpolação de dados com o método geoestatístico de krigagem. O objetivo é verificar a adequação das áreas designadas para a rede Natura 2000 em Castilla y León, Espanha, e desenvolver uma proposta de zoneamento baseada em valores de importância da biodiversidade quando considerando o uso da terra. A metodologia proposta foi realizada com critérios básicos de conservação da biodiversidade que podem ser adaptados e aplicados em diferentes países membros da UE, contribuindo para uma seleção ótima de áreas protegidas com parâmetros claros e uniformes para o zoneamento.

Introduction

The growing concern over the loss of biodiversity from the mid-twentieth century has been reflected in various initiatives and agreements at national, European and international level (Velázquez, 2008). One of these initiatives at European level is the network Red Natura 2000, created with the approval of the Habitats Directive (Council of the European Communities, 1992, 2009), which also planned the incorporation to this Network of some designated spaces under the Directive 79/409 / EEC on the conservation of wild birds (currently Directive 2009/147 / EEC) (Council of European Communities, 2009). The Natura 2000 network is based on the designation of a "coherent ecological network" of protected areas under the basis of biological criteria, choosing on one hand places that contribute significantly to the maintenance of habitats and species of Community

interest, and on the other hand more suitable spaces for the maintenance and recovery of all wild bird species depending on their needs for food or breeding areas.

The aim of the European initiative Natura 2000 is to ensure in long-term the survival of species and most threatened habitats in Europe, helping to halt the loss of biodiversity caused by the adverse impact of human activities, and that is why this initiative is the main instrument for nature conservation in the European Union (España, 2016).

The designation of Sites of Community Interest (SCIs) within the scope of the Habitats Directive and Special Protection Areas for Birds (SPAs) of the Birds Directive (Figure 1), has been made by biogeographic regions, relatively homogeneous territories which are intended to facilitate the identification process of places and the evaluation of proposals submitted by Member States by the European Commission (Velázquez et al., 2010).
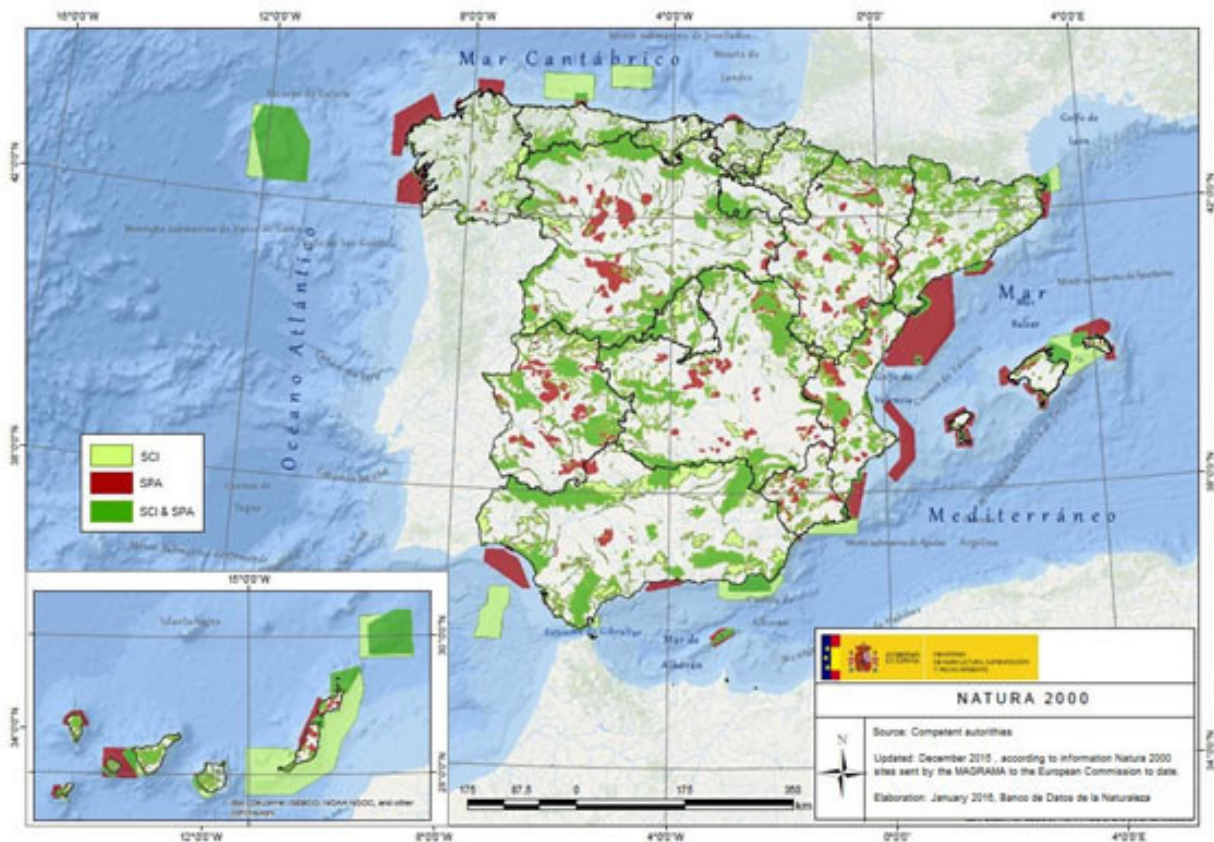

Figure 1. Sites of Community Interest (SCIs) and Special Protection Areas for Birds (SPAs) in Spain. Source: España (2016).

To achieve the conservation objectives suggested by the Red Natura 2000 is of great importance the proper location of spaces to be protected. However, they do

not have established clear and homogeneous criteria at European national and regional level to guide the selection of these spaces.

The establishment of nature reserves is the basis of regional conservation strategies (Kingsland, 2002), that hence the importance of properly designation of areas for conservation; in addition, the establishment of biological reserves in habitats is a key method of preventing the loss of biodiversity (Costello & Polasky, 2004). Until the present time, some initiatives have been developed at international and national level using optimization methods for the selection of protected areas, which identify sets of nature reserves that maximize the representation of diversity (Cabeza & Moilanen, 2001; Tanskanen, 2006). In the case of Crete (Greece) there is an study which examines the effectiveness of designated sites within the Natura 2000 network as Special Areas of Conservation (SACs) at regional level, in terms of representativeness of plant biodiversity (Dimitrakopoulos et al., 2004; D'Amen et al., 2013). The results of these studies show that SACs included in the Natura 2000 network in Crete (Greece) seems to be insufficient to ensure a satisfactory representation of the regional flora biodiversity, due to the lack of well-defined criteria in spaces appointing process.

Other studies have focused on connectivity, as is the case of the Systematic evaluation of conservation to improve connectivity (Briers, 2002, Van Teeffelen et al., 2006, Saura et al., 2011) as it is considered a fundamental part of the efforts to the conservation of biodiversity and ecological functions, which is also set as a legal requirement. But, like other parameters or methods used to select spaces, legislation is not explicit regarding the instrument to achieve the preservation and conservation of spaces through a clear methodology which proposes the necessary measures to implement this protection (Torrubia et al., 2014).

The European Commission has not formally submitted criteria for the selection of areas (Wills, 1994), however, several methods have been provided for selecting conservation areas aimed at the protection of bird species. One of the most worldwide recognized methods is Important Bird Areas (IBA), designated by Birdlife International as a result of a series of ornithological criteria which have been validated by the European Court of Justice (ECJ) (Wills, 1994). These criteria are globally threatened species, restricted-range species, groups of species linked to a habitat type (biome), concentrations of global importance, concentrations of European importance, species with unfavorable conservation status in Europe, species status favorable conservation more than 50% of the world population in Europe and areas of importance in the European Union for the species and subspecies of Annex I to the birds directive. The application of these criteria allows to obtain a number of places with a high ornithological value (SEO BirdLife, 2011).

The establishment of well defined criteria for biodiversity conservation in order to select protected areas is essential, as the main objective of the ecological assessment is to provide criteria and information that can be used to identify conservation priorities, and thereby support the process of decision-making in nature conservation through an optimal selection of spaces to be protected (Geneletti & Van Duren, 2008, Hernando-Gallego et al., 2010).

The description, classification and interpretation process of the habitats of the European Union (EU) and its interpretation is complex. Its analysis even cursory allows us to understand some of the problems that the implementation of the Habitats Directive contemplates, especially the interpretation of the "habitat types of community interest" listed in Annex I of the Habitats Directive (Fernández Prieto & Díaz González, 2003); that Annex collects the list of the EU habitats that members States must protect through the designation and management of protected areas known as Special areas of Conservation; this list of habitats has grown from 170 in 1992 to 231 in 2007 due to the enlargement of the EU from 12 to 28 members. The Manual of interpretation of European Union habitats (European Commission, 2013) describes the habitats, but often there are variations between Member States in how to interpret the habitat types, due to sometimes these variations are generated between the regions in the same country (Evans, 2010), and they do not have established an specific and homogeneous habitat classification criteria nor a methodology for their selection.

In this context, a great need to define clear criteria for the selection of protected areas is observed, which allows Member States an optimal selection of these spaces and also implement better management aimed at the protection and conservation; that is why this thesis aims to develop a methodology to verify the suitability of the areas designated as protected in the region of Castilla y León and also to adapt the Natura 2000 Network through an specific evaluation of biodiversity, in which an optimal zoning proposal is drafted. In addition it aims to create a clear and uniform methodology that can be

applied in different member countries of the European Union, thus unifying the criteria for the allocation of protected spaces in the Natura 2000 Network.

Material and methods

Study area

The study area is centered in the region of Castilla y León, in Spain, located in center-west of the Iberian Peninsula, which is limited in the North by the regions of Asturias, Cantabria and the Basque Country, at the East by La Rioja, Madrid and Aragón, at the West by Galicia and Portugal and finally at the South by Extremadura and Castilla – La Mancha. This region has an approximate area of 94,222 km², being the biggest Spanish region and one of the largest in Europe (Figure 2).

The region of Castilla y León consists of 9 provinces, and its capital is Valladolid. The estimated population of this region is 2.5 million people (Instituto Nacional de Estadística, 2014).

Castile and León is a plateau in the middle of the northern half of the Iberian Peninsula. Much of its territory consists of a large, central plateau - the Meseta. Its height lies between 700-1,000 m. The whole region is surrounded by mountain ranges; Picos de Europa in the north; Montes de León northwest; the Iberian Range in the east and at the south the Central System closes the territory of this Region.

In the case of Castilla y León region, the national network of protected spaces consists of Protected Natural Areas, Sites of Community Importance (SCIs), Special Areas of Conservations (SACs), Public Forests with over than 1,000 ha, and watercourses, applying the connectivity criteria laid down in Directive 92/43 / EEC (Council of European Communities, 1992).

It was identified in Castilla y León region 120 SCIs and 70 SACs to be incorporate to the European Natura 2000 network, which represent approximately 26% of Castilla y León region territory (España, 2016).
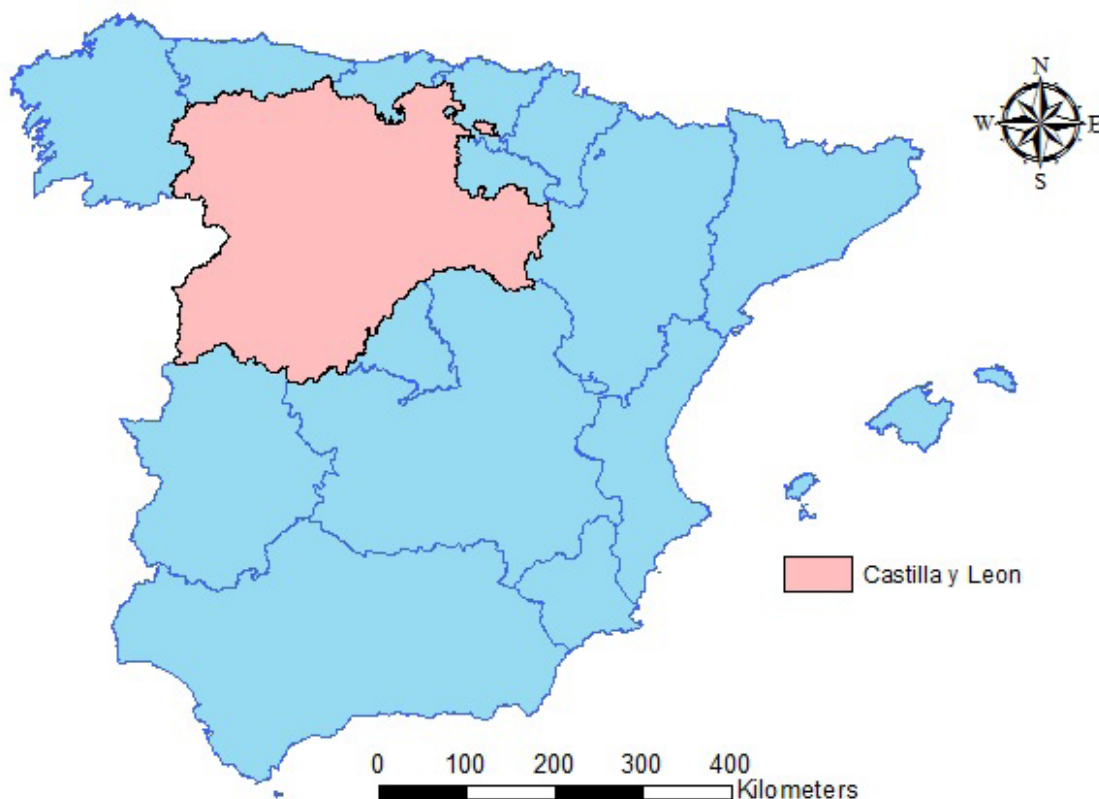

Figure 2. Study Area: Region of Castilla y León, Spain.

Methodology

The proposed methodology consists of three general phases (Figure 3) with the goal to achieve a suitable evaluation of biodiversity, which allows selecting protected areas by relevant criteria that contribute to biodiversity conservation within protected spaces.

By these criteria, a value of importance for biodiversity will be determined, enabling an optimal selection of protected areas and their inclusion in the Natura 2000 network. The methodological phases are:

Phase I: Information gathering and selection of criteria for assessment.

Phase II: multi criteria analysis and mapping generation of areas of importance for biodiversity.

Phase III: Analysis of the level of adequacy of the Natura 2000 network in the region of Castilla y León and zoning proposal.
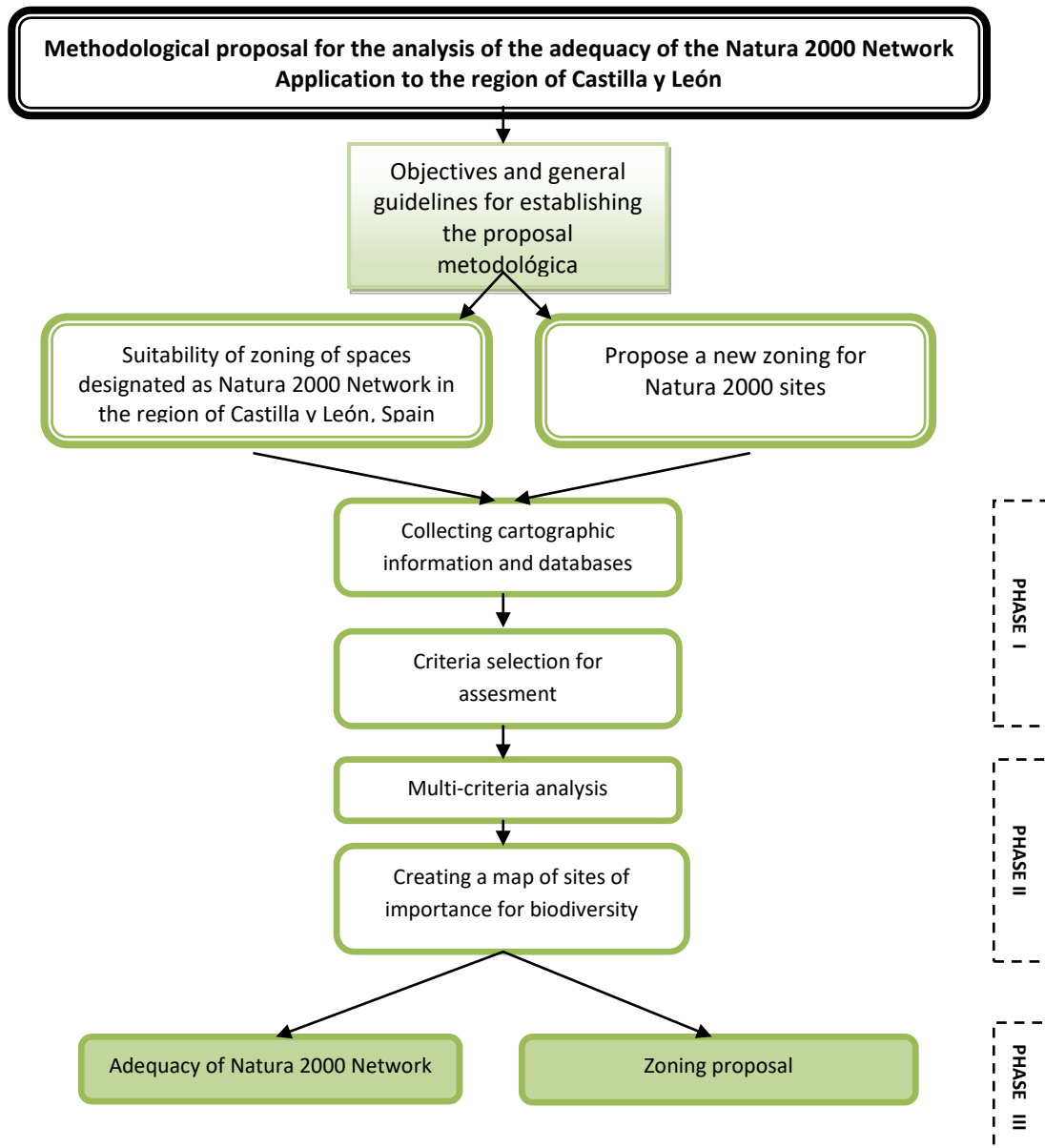

Figure 3. Methodological proposal for the analysis of the adequacy of the Natura 2000 Network Application to the region of Castilla y León, Spain.

Phase I

Information gathering and selection of criteria for assessment

Relevant information for this study was obtained through the following accessible sets of data by public administrations: habitats and protected species of the Habitats Directive (Directive 92/43 / EEC) (Council of the European Communities, 1992), protected species in the Birds Directive (Directive 79/409 / EEC) (Council of European Communities, 2009), Land Use according to CORINE Land Cover 2006 and SIOSE Land Cover (España, 2010), Inventory of Vertebrate of National Biodiversity Inventory, National Catalogue of Endangered Species (Royal Decree 139/2011) (España, 2011). In addition mapping tools were used. The map of Castilla y León region was divided by a grid of 10 km x 10 km, corresponding to the grid used in the National Biodiversity Inventory (España, 2011).

These databases were analyzed to implement the methodology according to the following procedure:

-   Protected habitats of the Habitats Directive: habitats from the Annex I of Habitats Directive were identified (habitats of Community interest and priority habitats of Community interest).
-   Protected species of the Habitats Directive: protected species under Annex II of this Directive were discussed.
-   Protected species of the Birds Directive: Directive 79/409 / EEC on the conservation of wild birds (Council of European Communities, 2009). The inventory of protected birds registered in Annex I was used.
-   CORINE Land Cover 2006 (CLC 2006) and SIOSE Land Cover: provide information on land use coverage at European and national level.
-   Land uses in artificial surfaces were excluded: Urban areas, industrial, commercial and transport, areas of mining, landfills and construction and non-agricultural artificial greenery areas, because they do not have a high value for conservation.
-   CLC 2006 and SIOSE data recorded in agricultural areas were used: arable land, permanent crops, pastures and meadows and heterogeneous agricultural areas; forest areas with natural vegetation and open spaces: forests, shrubbery spaces and/or herbaceous, open spaces with little or no vegetation; wetlands: continental wetlands; Water surfaces: Inland waters.

-   National Biodiversity Inventory (NBI): All information classified as vertebrate's wildlife in Castilla y León region was used. The vertebrate groups were mammals, reptiles, fish, birds and amphibians; in the national inventory of biodiversity they are related to a grid of 10 km x10 km of Castilla y León region, and they constitute very relevant criteria for determining species richness in the study area, determined by the presence of species in the grid.
-   National Catalogue of Endangered Species (NCES): categories representing threat of extinction (critically endangered CR, endangered species and vulnerable species VU IN) were considered.

Selection of criteria for assessment

It aims to select criteria for identifying suitable areas in Natura 2000 network for defining a value of importance of biodiversity.

The selected criteria were defined based on indices and/or indicators to value the biodiversity of a place from the information collected.

Table 1 shows the selected criteria and their description; these selected criteria are re-scaled based on the maximum value reached by each criterion, in order to obtain a coherent multi-criteria analysis.

Phase II

The objective of the second phase is to analyze and process all the previously gathered information, using multi-criteria analysis, and mapping the results obtained from it, creating at a map places of importance for biodiversity.

Multi-criteria analysis

Multi-criteria analysis was conducted in order to assign a value of importance for the conservation of biodiversity, which would be representative for decision making. It begins with an expert panel in which an ordinal scale is used, ordering from minor criteria (1) to high (5) depending on the importance value. The experts were selected among decision makers and academic staff in Castilla y León region, so they could drive their decision to value objectively each criterion.

These multi-criteria techniques help solving decision problems when you need to take into account numerous criteria in order to find an optimal solution. In this case, it is intended to perform a multi-criteria analysis using

a method of the theory of multi-attribute utility called Additive Model Simple (Keeney & Raiffa, 1993). In this method a utility function (U (x)) is constructed, representing the structure of preferences of the decider from utility functions for each of the attributes by the Equation 1.

$$U(x)=p_1u_1(xi_1)+p_2u_2(xi_2)+.....+p_nu_n(xi_n) \qquad (1)$$

Where: p_j = weights; $u_{ijpartial}$ = subjective utilities; and x_{ij} = actions that are under analysis.

It was chosen because it is a simple method, where the functions used transform performance data of the alternatives against criteria (objective / subjective-qualitative / quantitative) in a common dimensionless scale where the best alternative will be the one in which the value function has a higher value (Tejera & Gonzalez, 2009). It is important to clarify that although in this analysis it is not intended to find a "better alternative" among the several candidates, the method itself is valid to know the value of "importance" of each surface of the weighted grids for all analyzed variables.

Alter giving the valuation of each criterion by experts we proceed to determine the weights of each of them in order to generate a value of importance for biodiversity (VIB) according to the selected criteria (Table 1). It is developed through a system of weighting criteria which acts like a factor based on the consideration that not everyone has the same importance; therefore, each of them assumes a relative weight factor that will make some criteria have more impact on the final suitability for goal proposed.

Table 1. Criteria and indicators for identifying suitable areas in Natura 2000 network.

Criterion	Name	Indicator
1a	% Amphibian fauna	Presence of amphibians in the 10 km x 10 km grid of GDP compared to the total amphibians in Castilla y León region (%).
1b	% Birdlife	Presence of birds in the 10 km x 10 km grid of GDP compared to the total of birds in Castilla y León region (%).
1c	% Wildlife mammals	Presence of mammals 10 km x 10 km grid of GDP compared to the total mammals in Castilla y León region (%).
1d	% Wildlife fish	Presence of fish 10 km x 10 km grid of GDP compared to the total fish in Castilla y León region (%).
1e	% Wildlife Reptiles	Presence of reptiles 10 km x 10 km grid of GDP compared to the total reptiles in Castilla y León region (%).
1f	% Total Fauna	Presence of wildlife total of 10 km x 10 km grid of GDP compared to the total species in the region of Castilla y León; expressed in %.
2a	NCES Amphibian	Number of amphibian species included in the NCES as endangered species "Critically Endangered", "Endangered and / or vulnerable" in the 10 km x 10 km grid of NBI.
2b	NCES Birdlife	Number of bird species including the endangered species NCES as "critically endangered", "endangered and/or vulnerable" in the 10 km x 10 km grid of NBI.
2c	NCES Mammals	Number of species of mammals included in the NCES as endangered species "critically endangered", "endangered and/or vulnerable" in the 10 km x 10 km grid of NBI.
2d	NCES Fish	Number of fish species including the endangered species NCES as "critically endangered", "endangered and/or vulnerable" in the 10 km x 10 km grid of NBI.
2e	NCES Reptiles	Number of species of reptiles included in the NCES as endangered species "critically endangered", "endangered and/or vulnerable" in the 10 km x 10 km grid of NBI.
2f	NCES Total	Number of animals included in the NCES as endangered species "critically endangered", "endangered and/or vulnerable" in the 10 km x 10 km grid of NBI.
3a	Amphibian Habitats Directive Annex II	Number of amphibian listed in Annex II of the Habitats Directive within the 10 km x 10 km grid of NBI.
3b	Birds Directive	Number of birds listed in the Birds Directive within the 10 km x 10 km grid of NBI.
3c	Habitats Directive Annex II Mammals	Number of mammals listed in Annex II of the Habitats Directive within the 10 km x 10 km grid of NBI.
3d	Fish Habitats Directive Annex II	Number of fishes listed in Annex II of the Habitats Directive within the 10 km x 10 km grid of NBI.
3e	Habitats Directive Annex II Reptiles	Number of reptiles listed in Annex II of the Habitats Directive within the 10 km x 10 km grid of NBI.
4a	% Of habitats protected of community priority interest	Area of habitats of priority community interest in relation to the surface of the 10 km x 10 km grid of GNI (%).
4b	% Protected habitats of community interest	Area of habitats of community interest in relation to the surface of the 10 km x 10 km grid of GNI (%).
5	Shannon index	Shannon biodiversity index at the base of CLC 2006 and SIOSE with 10 km x 10 km grid of NBI.

The assessment seeks to express the preferences of the experts on the set of criteria or attributes in terms of importance for biodiversity. It is a model of preferences aggregation made on individual criteria on which the global preferences are modeled.

Given the weight of each criterion assessment, we proceeded to weight each criterion with Wc value and determine the value of importance for biodiversity (VIB), which is obtained as the sum of the weighted values.

Creating a map of importance for biodiversity in Castilla y León

The aim is to create a map of important places for biodiversity from VIB obtained by weighting of the criteria, and by data interpolation with the lower average square error.

This stage of the second phase is accomplished by establishing centroids for each of the grids of 10 km x10 km grid in Castilla y León region that contain the VIBs. The centroids are defined points that allow an interpolation which generates new points and permit a deeper analysis of the distribution of VIB in that region. Thus, we have a basis for creating a zoning proposal from places with more importance for biodiversity.

Three statistical interpolation methods are selected and compared to have parameters in order to define the better proposal generate as a result of this work. We seek to compare and discuss the different approaches in the interpolation of the same set of variables (Attorre et al., 2007).

Phase III

The goal of the third phase is to test the suitability of the current Natura 2000 network in Castilla y León region with the results of the second phase, and to develop strategies that allow the adaptation of the Natura 2000 network to present a proposal of new zoning based on VIBs in accordance with land use (CORINE and SIOSE Land Covers).

Adequacy of the Natura 2000 network

The assessment of the adequacy of the Natura 2000 network is done through VIB of the study area, which is made by superimposing the map of protected Natura 2000 sites and VIBs in order to obtain a VIB figure in each of the areas designated as SCIs and SPAs in Castilla y León region.

The analysis of this information will permit a clear view of the current state of SCIs and SPAs against the criteria defined in the second phase that originated the VIB and thus checking the suitability of the protected areas, to finally submit a new zoning proposal.

Zoning proposal

To establish the proposal of a new Natura 2000 spaces zoning, places with higher values of VIB are overlapped with current Land Uses (CLC 2006 and SIOSE), avoiding land uses classified as urban-industrial, which are not relevant to biodiversity conservation. Then, quartiles are determined by classification of the distribution of the VIB in the different polygons of proper land uses for biodiversity conservation in Castilla y León. These polygons than contain information about the relevant criteria for biodiversity conservation (VIB) and current land uses allows us to establish a four level protection classes of the territory, taking into account their importance for biodiversity conservation in Natura 2000 network and the land use adequacy for conservation.

Results

The results obtained in each of the methodological phases are focused on two main objectives and relate to each of them.

Adaptation of the Natura 2000 network

By weighting each criterion with the Wc value obtained in Phase I, the value of biodiversity importance (VIB), which is achieved with the sum of the weighted values of all criteria grid was determined; these values are those that analyze the areas of greatest relevance to biodiversity conservation of Castilla y León region.

With the VIB obtained in the calculation of weighting of the criteria, a 10 km x10 km grid of Castilla y León region with the importance values is generated. In order to develop a clear and homogeneous methodology, we proceed to apply an interpolation method in which data is optimized, and where we obtain a more appropriate model to be adopted. In order to perform the interpolation process, we determined the centroids (points that measure the geometric center of each grid); they have a VIB value that allows the interpolation method to distribute the values on the map and have a clearer outcome of the areas with the value of importance for biodiversity.

Given the VIB of each grid and having defined the centroids, we proceeded to determine the most appropriate method of interpolation to process values. Therefore to define the optimal method that would make decisions based on the results, different interpolation models were proposed and a comparative analysis was performed in order to select the model that best fits the objective of this work. Two deterministic methods were used as interpolation models: inverse distance weighting IDW and radial basis function, and geostatistical method: kriging.

The choice of these three interpolators is based on the following considerations:

- The IDW method uses the measured values surrounding the place of prediction, to predict a value for any other unsampled place, based on the assumption that things that are closer are more alike than those that are more separate; therefore it is considered a suitable method because the values generated are close to reality.

- The method of radial basis function uses five basic functions to process each value of the measured sample, thereby creating an accurate surface interpolation. It is also relevant to this case.

- Kriging geostatistical method is a method that estimates points by model histograms for data collection. It calculates the weights given to each reference point used in the assessment, and it is based on the premise that the spatial variation continues with the same pattern; thus being an interpolation method for determining relevant values in different parts of the Region of Castilla y León.

The three methods provide pertinent information to develop a distribution map of values; however kriging was the selected method because of its lower value of mean square error compared with the others methods (Table 2). Kriging uses statistical models that allow a variety of output surfaces including predictions, standard errors of prediction, probability and quantiles.

With the defined interpolation method (kriging) a map called Map of value of importance for biodiversity (VIB) was created, which is overlapped with the map of Natura 2000 sites (Figure 4). The map produces a comparison between the values of importance for biodiversity (generated previously with the multi-criteria analysis) and the current allocation of protected Natura 2000 sites in Castilla y León region. This allows checking the suitability of the spaces according to the criteria defined in this work as relevant. We can also consider this as the first step to initiate a zoning proposal in which places with very high VIB are included and are not currently covered by the Natura 2000 network.

Zoning proposal

The zoning proposal expects to consider in a special way places with high VIB which are consistent with land use (CLC 2006 and SIOSE), in order to classify areas according to their biodiversity conservation importance, improving management mechanisms.

To develop this zoning proposal, we join the VIB map with database of land use CLC 2006, where the values are grouped into quartiles. In order to classify VIB into groups of importance quartiles for these values were generated, which were associated with the polygons of the land uses base, and thus consider the importance of each space, that is at the same time consistent with land use, because a zoning proposal cannot be isolated from the territorial distribution of the study area.

After joining the VIB with land uses, we proceed to order the resulting polygons according to the code given in the nomenclature of the CLC 2006 and VIB, obtaining a first classification, grouped by VIB quartiles and land uses. This step allows us to gather information about the areas of the territory and to grant importance for biodiversity based on the most suitable land uses.

Having defined this classification the degree of importance of each of the polygons is determined by VIB. This allows to set levels of protection (Table 3), which are grouped by the type of protection and where the level is determined by the different classifications of land use: determining levels of protection, we can group zones according to their value, with the aim of making zoning proposals depending on the characteristics of importance for biodiversity in Castilla y León region. In addition, it must be said that levels are guidelines for determining various zoning proposals that can be very exclusive or flexible depending on the combination of zones and their respective valuation.
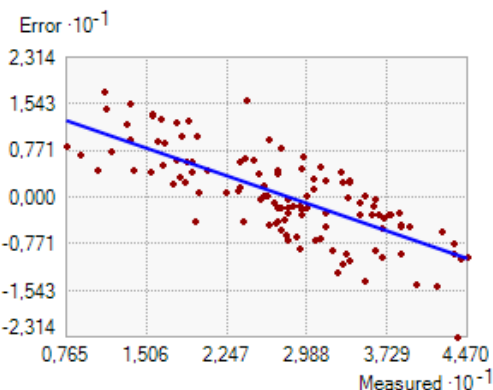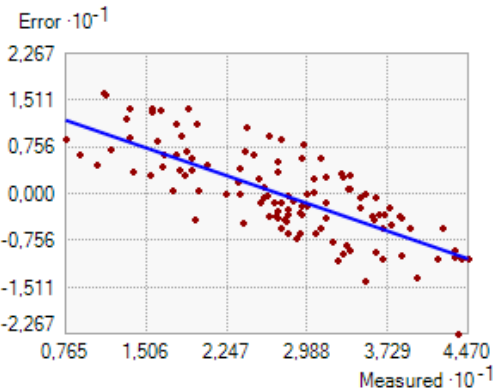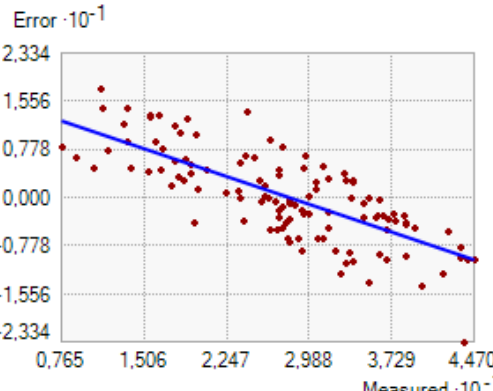
Four levels of protection were defined (Table 3), which vary from 0 to 3, with level 0 as the most exclusive, because it determines the spaces with VIB higher (VIB first quartile) and level 3 the most flexible because it considers more areas as spaces for biodiversity conservation with VIBs in the last quartile. Each of the

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levels of protection overlaps with the map of Red Natura 2000 and is presented as zoning proposal (Figure 5).

On the map the zoning proposals are contemplated by the level of importance. We can see that there are areas of great importance with very high VIB that are not currently listed as protected areas of Natura 2000, as well as some areas that are currently part of Natura 2000 network, not being classified with high VIB in the results obtained with the evaluated criteria in the methodology proposed in this work. However, each of the proposals has been based on biodiversity criteria and allows a clear view of the areas of greatest importance to the region of Castilla y León in conservation and environmental protection terms, thus enabling developing management plans appropriate for each one of the LICs, since there are clear and homogeneous classification criteria.

Table 2. Comparative table of interpolation methods

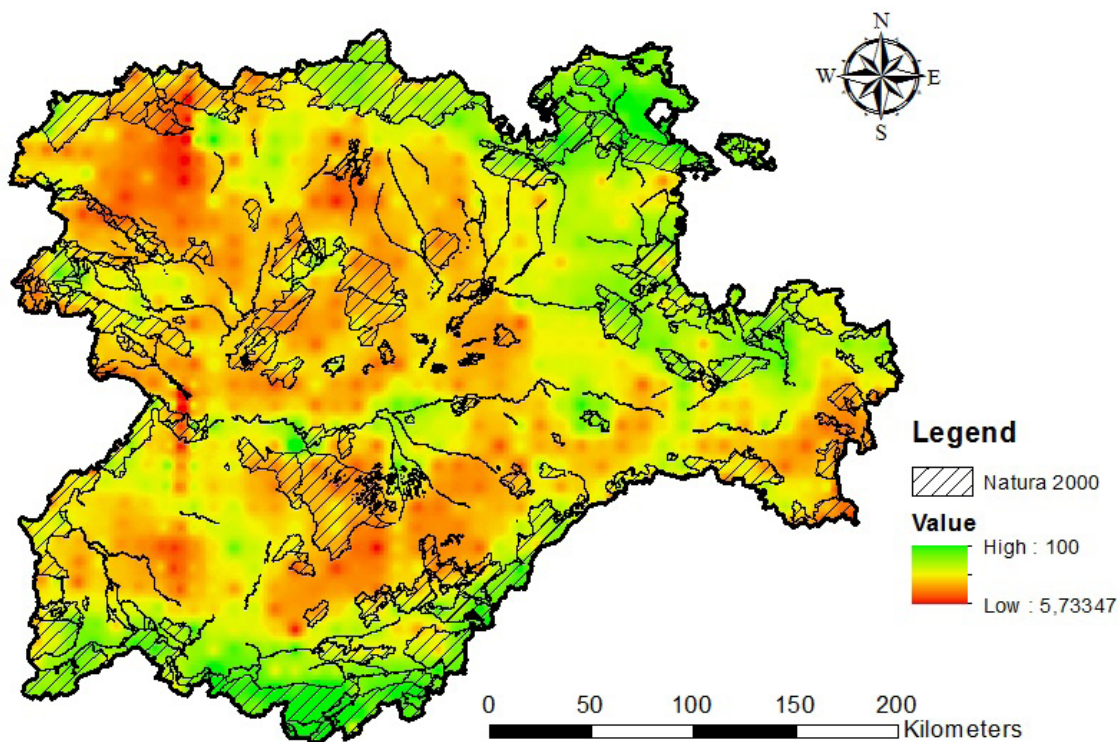| Interpolation method	Mean	Root-mean square	Normal (/Noyes/)	Error graphic
IDW	0.1331	7.4123		
KRIGING	0.0024	7.1688		
RADIAL	0.0400	7.2732		

Figure 4. Map of Importance for Biodiversity (VIB) of Castilla y León region.

Table 3. Zoning levels proposed for prospective Natura 2000 areas in Castilla y León Region

CORINE code	Description (CORINE/VIB classification)	Classes of protectin	Levels of protection			
			0	1	2	3
211	Non-irrigated arable land/VIB 4th quartile	1a1				X
211	Non-irrigated arable land/VIB 3rd quartile	2a1		X	X	X
211	Non-irrigated arable land/VIB 2nd quartile	3a1	X	X	X	X
211	Non-irrigated arable land/VIB 1st quartile	4a1				
212	Permanently irrigated land/VIB 4th quartile	1a2				
212	Permanently irrigated land/VIB 3rd quartile	2a2				
212	Permanently irrigated land/VIB 2nd quartile	3a2		X	X	X
212	Permanently irrigated land/VIB 1st quartile	4a2	X	X	X	X
221	Vineyards/VIB 4th quartile	1a3				
221	Vineyards/VIB 3rd quartile	2a3				
221	Vineyards/VIB 2nd quartile	3a3		X	X	X
221	Vineyards/VIB 1st quartile	4a3	X	X	X	X
222	Fruit trees and berry plantations/VIB 4th quartile	1a4				
222	Fruit trees and berry plantations/VIB 3rd quartile	2a4				
222	Fruit trees and berry plantations/VIB 2nd quartile	3a4		X	X	X
222	Fruit trees and berry plantations/VIB 1st quartile	4a4	X	X	X	X
223	Olive groves/VIB 4th quartile	1a5				
223	Olive groves/VIB 3rd quartile	2a5				
223	Olive groves/VIB 2nd quartile	3a5		X	X	X
223	Olive groves/VIB 1st quartile	4a5	X	X	X	X

Table 3. continuação.

| CORINE code	Description (CORINE/VIB classification)	Classes of protectin	Levels of protection			
			0	**1**	**2**	**3**
231	Pastures/VIB 4th quartile	1a6				X
231	Pastures/VIB 3rd quartile	2a6				
231	Pastures/VIB 2nd quartile	3a6		X	X	X
231	Pastures/VIB 1st quartile	4a6	X	X	X	X
242	Complex cultivation patterns/VIB 4th quartile	1a7				X
242	Complex cultivation patterns/VIB 3rd quartile	2a7			X	X
242	Complex cultivation patterns/VIB	3a7		X	X	X
242	Complex cultivation patterns/VIB	4a7	X	X	X	X
243	Land principally occupied by agriculture, with significant areas of natural vegetation/VIB 4th quartile	1a8				X
243	Land principally occupied by agriculture, with significant areas of natural vegetation/VIB 3rd quartile	2a8			X	X
243	Land principally occupied by agriculture, with significant areas of natural vegetation/VIB 2nd quartile	3a8		X	X	X
243	Land principally occupied by agriculture, with significant areas of natural vegetation/VIB 1st quartile	4a8	X	X	X	X
244	Agro-forestry areas /VIB 4th quartile	1a9				X
244	Agro-forestry areas /VIB 3rd quartile	2a9				
244	Agro-forestry areas /VIB 2nd quartile	3a9		X	X	X
244	Agro-forestry areas /VIB 1st quartile	4a9	X			
311	Broad-leaved forest /VIB 4th quartile	1b1				
311	Broad-leaved forest /VIB 3rd quartile	2b1			X	X
311	Broad-leaved forest /VIB 2nd quartile	3b1		X	X	X
311	Broad-leaved forest /VIB 1st quartile	4b1	X	X	X	X
312	Coniferous forest /VIB 4th quartile	1b2				
312	Coniferous forest /VIB 3rd quartile	2b2			X	X
312	Coniferous forest /VIB 2nd quartile	3b2		X	X	X
312	Coniferous forest /VIB 1st quartile	4b2	X	X	X	X
313	Mixed forest /VIB 4th quartile	1b3				
313	Mixed forest /VIB 3rd quartile	2b3			X	X
313	Mixed forest /VIB 2nd quartile	3b3		X	X	X
313	Mixed forest /VIB 1st quartile	4b3	X	X	X	X
321	Natural grasslands /VIB 4th quartile	1b4				
321	Natural grasslands /VIB 3rd quartile	2b4			X	X
321	Natural grasslands /VIB 2nd quartile	3b4		X	X	X
321	Natural grasslands /VIB	4b4	X	X	X	X
323	Sclerophyllous vegetation 4th quartile	1b5				
323	Sclerophyllous vegetation 3rd quartile	2b5				X
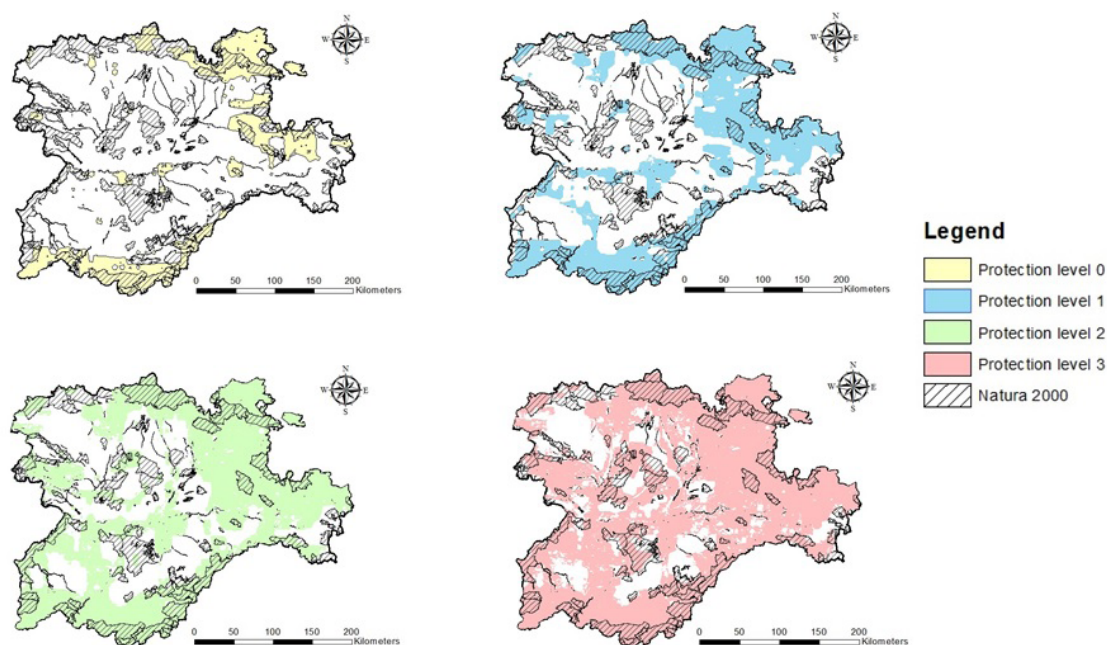
Figure 5. Map of proposed zoning levels of biodiversity conservation importance for Castilla y León region.

Conclusions

It is clear that the lack of clear guidelines for the selection of protected areas has caused confusion and some errors in determining areas of importance for conservation or places of community interest in member countries of European Union. However, there are different methodologies from various approaches for establishing optimal criteria of selection. The point of view of this study was the biodiversity conservation, so the results are based on obtaining areas with significantly high value for biodiversity conservation and that from homogeneous and coherent criteria can be analyzed and applied in different member countries of the European Union and adopted as a unified methodology for the allocation of protected areas.

Once the multi-criteria analysis in the region of Castilla y León was developed, the suitability of the areas covered by the Natura 2000 network could be checked. In this sense, we can conclude that the designation of protected areas in the study has a very high approximation to the results on the assessment of biodiversity criteria, therefore there is a zoning close to the optimum, but there are some places of great importance that are not covered and that could be designated as protected areas.

The results obtained in accordance with CORINE and SIOSE land cover database allowed to develop four zoning proposals considering areas with higher importance value in relation to land use. Some proposals can be adopted according to the level of restriction required or considered as relevant. Also it allows for appropriate management plans and they can be defined as special areas of conservation (SACs).

The methodology developed is a first step in establishing criteria for zoning and is valuable as a support or justification at the time of decision making regarding the conservation of biodiversity in specific locations. It is a flexible methodology which can add more criteria that provide a more specific outcome according to the needs of each member country of the European Union, and thus have a unified method that avoids confusion and mistakes when determining which sites are of Community interest and which require special treatment to ensure the conservation of biodiversity and to implement the habitats and birds directives of the European Union.

The importance of the application of this methodology lies in the proper land management that contributes to sustainable development of member countries of the European Union by establishing areas for conservation

in order to ensure the natural resources required. Also, it facilitates the compliance of the European politics in the environmental field.

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