The pitfall-trap of species conservation priority setting

Running title: **Biases on species conservation listing**

Berta Martín-López[1,2,*], José A. González[1] and Carlos Montes[1]

Authors' addresses:

1. Social-Ecological Systems Laboratory, Department of Ecology, c. Darwin, 2. Edificio Biología. Universidad Autónoma de Madrid. 28049 Madrid (Spain).

2. Department of Vegetal Biology and Ecology, Ctra. Sacramento s/n La Cañada de San Urbano. Universidad de Almería. 04120 Almería (Spain).

* To whom correspondence should be addressed:

Berta Martín-López:

Telephone: +34 914976725; Fax: +34 914978001; e-mail: berta.martin@uam.es

Abstract

Threatened species lists are important tools in biodiversity conservation and usually define conservation priorities. In this paper, we examined factors underlying the species conservation listing and the conservation investments at different organizational scales: global, European, national, and sub-national. We found that species most likely to receive conservation attention, such as red-listed species that command regulation and resource allocation, are better-known species, which are closely related to more structurally complex organisms. Moreover, the threatened species lists at the global scale are highly related to the species composition of legal conservation lists at all lower organizational scales, showing that the confusion between conservation status and conservation priority still persists. When a legally binding listing is exclusively based on the Red List status catalogued by the International Union for Conservation of Nature (IUCN), it automatically triggers those threatened species as a conservation priority. Despite the fact that the literature highlights the need to not focus only on extinction risk status and to use other variables, this does not happen, creating a sort of pitfall trap for species conservation priority setting.

Keywords: bias; conservation priorities; threatened species; IUCN Red Lists; conservation legislation; multi-scale analysis; threat status

Abbreviations:

IUCN: International Union for Conservation of Nature

CR: critically endangered

EN: endangered

VU: vulnerable

NT: near threatened

LC: least concern

NCTS: National Catalogue of Threatened Species

SCH: sensitive to habitat change

SI: of special interest

BD: Birds Directive

HD: Habitat Directive

Introduction

Currently, the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (http://www.iucnredlist.org/) is recognized as one of the most authoritative sources of information about the conservation status of species (Lamoreaux et al. 2003; de Grammont and Cuarón 2006; Rodrigues et al. 2006; Miller et al. 2007; Mace et al. 2008). The value of Red Lists is clear both from their widespread use and from the interest that they generate (Fitter and Fitter 1987). Thus, the IUCN criteria were developed to allow comparisons between different red lists (Mace and Lande 1991). Based on these criteria, approximately half of the countries of the world developed national and regional threatened species lists (Rodríguez 2008), establishing red list status as the most important indicator of conservation policies worldwide (Vié et al. 2009). Both governmental and non-governmental organizations increasingly rely on the IUCN Red Lists to influence conservation legislation, inform priorities, and guide conservation investments (Hofmann et al. 2008). For example, at a national level, legislative listing regimes and species conservation decision-making are increasingly based on criteria developed for the global IUCN Red List (Possingham et al. 2002; Farrier et al. 2007). However, these global lists are themselves inevitably biased in favor of species that have attracted research interest, i.e. species located in areas which are accessible to scientists, vertebrates rather than invertebrates, and vascular plants rather than fungi (Burgman 2004). Recent studies demonstrated that scientists focus on species that have high existence values for society, which is measured by their structural complexity (Wilson et al. 2007; Proença et al. 2008).

If a connection exists between scientific information and threatened species listing, and if scientific output is influenced by organismal complexity, the question here is whether organismal complexity is likely a major driver governing the composition of threatened species lists and conservation legislation.

We examined three questions about species conservation listing at four different organizational scales: international, European, national, and sub-national. For the national level, we focused on Spain, a widely recognized biodiversity hotspot (Liu et al. 2003). To understand the factors underlying species conservation listing and priorities, we (1) explore the effect of species' structural complexity on threatened species listing and economic resource allocation for conservation management, (2) determine the current legally binding and non-binding use of the worldwide IUCN Red List in European, national, and sub-national conservation listing procedures, and (3) explore the ways in which the IUCN Red List and national threatened species lists define conservation priorities.

Methods

Species conservation lists in Spain

Threatened Spanish species are protected by laws and agreements at the international, national, and sub-national levels (Table 1). At the European level, the Habitats Directive (Council Directive 92/43/EEC) and the Birds Directive (Council Directive 79/409/EEC) are the two most important instruments for protecting Europe's natural habitats and endangered species. While the Birds Directive focuses solely on birds and their natural habitats, the Habitats Directive aims protect European ecosystems and endangered species as a whole. These two international directives were transposed into national law and implemented by each member state, including Spain. Both directives contain appendices containing species listed with community interest, whose conservation requires European states to designate special conservation zones.

In addition to the species on the European directives, Spain nationally listed threatened species in the National Catalogue of Threatened Species (NCTS) to manage the conservation of biodiversity (Royal Decree 439/90). The NCTS includes those species which require active conservation measures and includes 602 animal and plant species, of which 139 are plants, 42 invertebrates, and 423 vertebrates. Besides this legally binding list, there are unofficial red lists (for different taxonomic groups) developed by academic institutions and nongovernmental organizations based on the IUCN system. The NCTS considers four threatened categories, “endangered” (EN), “sensitive to habitat change” (SHC), “vulnerable” (VU), and “of special interest”(SI), which are similar but not identical to those of the IUCN, “Extinct” (Ex), “Extinct in the wild” (EW), “Critically endangered” (CR), “Endangered” (EN), “Vulnerable” (VU), “Near threatened” (NT), and “Least concern” (LC) (Moreno Saiz et al. 2003). At the sub-national level, autonomous regions have also developed legislation related to species conservation, using the NCTS categorization system.

Effect of organismal complexity on species conservation

As a quantitative indicator of the species’ structural complexity, we used the number of different cell types in an organism (Proença et al. 2008). Data of different cell types was obtained from Proença et al. (2008).

To explore the role of organismal complexity on conservation species listing, we examined the proportion of described species in a taxonomic group listed in the Red Lists or another legally binding conservation listing within the threatened categories. In this paper, the term 'threatened species' refers to the CR, EN and VU species from IUCN Red lists, and to EN, SHC and VU species from the NCTS and sub-national catalogues. We obtained the total number of described species from IUCN (2009). We searched for species listings in each taxonomic group in international and national Red Lists and national binding legislation (Table 1).

To explore the effect of structural complexity on economic resources allocation for species conservation, we obtained conservation funding data from Martín-López et al. (2009) at the European and national level.

Because it is possible that the process of species threat listing is itself biased due to available scientific information, we analyzed if organismal complexity influences the publication of research papers. Available scientific information, measured as the number of publications, was obtained from Proença et al. (2008) at the international level and from Martín-López et al. (2009) at the national level.

For all factors, we used Pearson correlation and simple regression analyses to test the effect of structural complexity. All continuous variables (number of cell types, number of threatened species included in Red lists and legal listings, number of papers, economic funding, and damage costs) were log transformed ($\log_{10}[X + 1]$) prior to analysis.

Utilization of worldwide IUCN Red List in European, national, and sub-national species listing

We searched for all European, national, and sub-national species conservation binding legislation, and international, European, and national Red Lists (Table 1). To avoid information bias, we focused only on vertebrates because they are the best-documented taxonomic group, as 43% of described vertebrate species have been evaluated by the World Conservation Union (IUCN 2009). For each vertebrate species, we recorded the status on IUCN red lists at international, European and national level, the Birds Directive and the Habitats Directive, national legislation in the NCTS, and sub-national catalogues of threatened species (Table 1). For sub-national catalogues, we explored the five autonomous regions with the most active conservation programs (Morillo and Gómez-Campo 2000). To determine which species are from these regions, we used the Spanish National Inventory of Biodiversity (http://www.mma.es/portal/secciones/biodiversidad/inventarios/inb/).

Associations between conservation status of the IUCN Red List and categories of legal threatened species listing at different organizational levels were evaluated using contingency tables (χ^2 test). We used the most restrictive subset of data when comparing different organizational levels (e.g. when we explored associations between the European Red list and the NCTS, we used the species present in the European Red list).

Utilization of threatened categories to define conservation priorities

To clarify the frequent confusion between assessing the "conservation status" and determining the "conservation priority" of species (Munton 1987), we explored the effect of "conservation status" on the decision of economic resources allocation for conservation of vertebrates. We used Pearson correlation analysis to test the relationship between the proportion of threatened species included in the species listing (binding and non-binding) and economic resources allocation (European LIFE funds and national funds) for their conservation in Spain.

We carried out an analysis of variance (ANOVA) to test the effect of threatened species status on resource allocation for species conservation.

Results

Relationship between organismal complexity and species conservation

Our results suggest that species' structural complexity is positively related to the proportion of threatened species on the global IUCN Red List, Spanish Red List, and on the NCTS (Table 2). When we excluded bryophytes, which could be an outlier -probably due to the effort realized by the Red List of Bryophytes of the Iberian Peninsula (Sergio et al. 2006)-, the species on Spanish Red Lists had a better significant positive relationship with organismal complexity (Pearson's r = 0.74, n = 9, p = 0.02; Table 2).

Additionally, conservation investment was also positively related to organismal complexity, as more complex species had more funds allocated toward their conservation (Table 2). The economic resource allocation for species conservation was linearly related to the number of cell types (x) at both organizational levels -European LIFE fund investment: $y = 3.40\ x - 0.26$, R^2 = 56.8%, p = 0.01, n = 10; and national fund investment: $y = 4.18\ x - 2.93$, R^2 = 60.8%, p = 0.008, n = 10; (Fig. 1)-. More complex species, such as vertebrates, attracted more conservation funding than other taxonomic groups.

Finally, both international and national scientific publications were also positively correlated to species' structural complexity (Table 2). Moreover, the international scientific output was strongly related with the proportion of species included in the global IUCN Red List and with the investments allocated at European and national species conservation. Similarly, scientific information at national level was related to the proportion of species included in the NTCS and with the funding investments at national level (Table 2). These results confirm relationship between available scientific information and both threatened species listing and resource allocation at the same organizational level.

Utilization of worldwide IUCN Red List in European, national, and sub-national species listing

We found a strong positive relationship between the proportion of species listed per taxonomic group on the global IUCN Red list and on the national listing (National Red Lists: Pearson's $r = 0.77$, $n = 10$, $p = 0.01$; NCTS: Pearson's $r = 0.78$, $n = 10$, $p = 0.008$; Table 2). At the national level, we also found a relationship between non-binding red lists and legally binding threatened species list (Pearson's $r = 0.67$, $n = 10$, $p = 0.033$; Table 2).

Additionally, there was a correspondence between global IUCN's categories of risk and European and national species listing (both red lists and legal catalogues) (Table 3). We found a strong association between the global IUCN Red list and the European red list because 90%, 89%, 75%, 100%, and 84% of Spanish vertebrates categorized as CR, EN, VU, NT, and LC on the global IUCN Red list were in the same category on the European Red list. In contrast, the categories of NCTS and the global IUCN Red list or the European Red list were less similar. While the "endangered" and "of special interest" categories of NCTS were quite similar to CR and LC global IUCN's categories, respectively, the NCTS's category of "sensitive to habitat change" did not correspond to any IUCN category (Table 3; Table 4). We also found that there was a weak relationship between any IUCN categories at different organizational levels and category of "sensitive to habitat change" in the sub-national catalogues of species (Table 5). Additionally, the "endangered" category of sub-national catalogues was correlated to the CR and EN categories of IUCN, at both global and national levels (Table 5; Table 6), suggesting that when a species is categorized as CR or EN by the global IUCN Red List, it becomes a target of sub-national threatened species laws.

For legally binding species listings, we found a association between European Directives and the NCTS (Table 4) and among the categories of the NCTS and sub-national catalogues' categories (Table 6).

Utilization of threatened categories to define conservation priorities

We found a significant positive relationship between the proportion of species listed as threatened per taxonomic group in the global IUCN Red list and economic resource allocation from either European LIFE funds or national funds. At the national level, we found also a relationship between IUCN national lists and the allocation of European LIFE funds but not national funding (Table 2). When bryophytes were excluded, we found a positive relationship between Spanish IUCN category and the economic resource allocation per taxonomic group (Pearson's $r = 0.59$, $n = 9$, $p = 0.09$; Table 2). An ANOVA test showed that European LIFE fund investment was strongly influenced by the species status defined in the IUCN red lists and the NCTS (Table 5). The more threatened a species is considered on the IUCN red lists, the more funds are channeled to its conservation at European level. We found a similar pattern for the national resource allocation and the species status defined by the NCTS because species categorized as "endangered" received 43% of total national funds (Table 7). Thus, species status and conservation priority are related within an organizational level. In contrast, for the national resource allocation, we found no differences among the species categories defined by the global IUCN Red list (Table 7).

Discussion

This study is a part of a larger project aiming to elucidate the underlying factors for decision making in species conservation. Other parts of this project analyzed public preference and values towards species conservation (Martín-López et al. 2007, 2008) and the effect of social and scientific interest on conservation funding (Martín-López et al. 2009). Here, we extended the previous work to different organizational scales and examined the factors influencing species listing decisions and how these factors affect the allocation of funds for species conservation. Understanding which factors underlie species conservation legislation is essential for redefining criteria for future conservation initiatives (Redford et al. 2003).

Organismal complexity explains conservation efforts

Our results showed that both the conservation listing and the allocation of conservation funds are taxonomic biased towards more highly complex species. This is because conservation efforts are based on the categories defined by the IUCN (Vié et al. 2009), and global, European, and national Red lists are based on available scientific information, which is biased towards more highly complex species (Clark and May 2002; Fazey et al. 2005; Proença et al. 2008). These results are consistent with earlier studies which demonstrate that mammals and birds are disproportionately represented in conservation efforts (Metrick and Weitzman 1996; Restanni and Marluff 2002), captive breeding programs (Balmford et al. 1996), and reintroduction projects (Seddon et al. 2005). Our findings suggest that many conservation choices are made based on subjective grounds –i.e. existence value- (Metrick and Weitzman 1996; Czech et al. 1998; Proença et al. 2008).

Legally binding species conservation listing are based on the IUCN Red lists.

The threatened categories established in the IUCN Red list are indispensable to creating conservation legislation because this information is easily understandable by the general public and policy-makers (Mace and Lande 1991). Thus, the IUCN categories for evaluating extinction risk, originally intended for use at the global level, are increasingly used at national and sub-national level (Miller et al. 2007). Therefore, when a species is globally categorized as endangered is more likely to be nationally/locally endangered than a species that is not. Moreover, we would expect that this association should be stronger in the case of regions with high degree of endemism. Our results show that there is strong association between the NCTS and the European and International Red lists (Table 3; Table 4), and between sub-national legal listing and the Spanish Red list (Table 6). Therefore, the correlations are higher in neighbor scales –i.e. global and national- and lower in more distant scales –i.e. global and sub-national-. Contrary to what was expected, one of the most important endemic areas of the world –i.e. the Canary Islands- (Juan et al. 2000; Izquierdo et al. 2001) has weaker associations with the Red lists at higher organizational levels than the Spanish regions with lower degree of endemism.

Conservation status vs. conservation priority

Red lists are the most prominent and important tool for conservation priority setting, despite the fact that they were not intended for this application (Schmeller et al. 2008). The IUCN Red List criteria were designed to evaluate extinction risk and to inform policy-makers about priorities for conservation action, not to set them (Lamoreux et al., 2003; Rodrigues et al., 2006). The IUCN explicitly notes “The category of threat is not necessarily sufficient to determine priorities for conservation action. The category of threat simply provides an assessment of the extinction risk under current circumstances” (IUCN 2001). Although this distinction has been emphasized previously (e.g. Mace and Lande 1991; Keller and Bollmann 2004), our results show that the confusion persists.

The global IUCN Red list is increasingly setting the worldwide species conservation agenda. Categorization of a species as CR by the global IUCN Red list and by the Spanish Red List determines the allocation of European and national conservation budget, respectively (Table 7). Therefore, the direct consequence of a species reaching CR status is a need for a substantial increase in its conservation funding (Garnett et al. 2003). This promotes that only a small proportion of species recognized as threatened are managed for recovery (Baillie et al. 2004). For example, from 1989-1991, 54% of U.S. funding was dedicated to the conservation of 1.8% of all U.S. threatened species (Metrick and Weitzman 1996). Similarly, between 2003-2007, ~80% of Spanish funding for conservation was allocated to eight vertebrate species (Martín-López et al. 2009).

Despite the fact that the literature highlights the need of conservation policy to not focus only on extinction risk, and to use other variables (e.g. Miller et al. 2007, Schmeller et al. 2008), in practice we demonstrated that this does not happen. We suggest that it is inappropriate to use only the extinction risk criteria to set national fund allocation because economic resources for conservation are limited. Spending the most money on species with the highest extinction probabilities might be not the most effective way of promoting recovery, because some of the most critically endangered species require huge recovery efforts with a small chance of success, whereas other, less threatened taxa might be secured for relatively low cost (Possingham et al. 2002).

In addition, in the pursuit of funds for endangered species, conservation organizations find themselves competing for the economic resources (McShane 2003). When species conservation policy-making is only based on red lists, categorizing a species as CR encourages conservation organizations and formal institutions to compete for funding, and the species becomes a "commodity of conservation". This conservation strategy greatly limits the number of species targeted as priority for preservation programs.

Conclusions

Efforts to classify threatened species constitute an important advance in the management of biodiversity. However, we found that species' cellular complexity explains the extent of available scientific information, and available scientific information influences on how conservationists classify species into threat categories, and how policy-makers decide conservation priorities. These factors –organismal complexity, available scientific information, and species listing– combine to create a sort of pitfall trap, in which few species are considered as conservation priorities (Martín-López et al. 2009). Moreover, Red lists become a central node of the pitfall-trap for species preservation because they are used to inform the development of regional, national, and sub-national conservation legislation, and also the development of national biodiversity strategies (Vié et al. 2009). Thus, increasingly, Red lists have been used for more than just raising awareness or informing and have been applied to setting priorities for species conservation (Mace and Kunin 1994).

The frequently automatic link between listing and conservation response represents a reaffirmation of the community's commitment to threatened species conservation and provides a symbolic guarantee that if a species is at risk of extinction, something will be done about it (Farrier et al. 2007). As countries worldwide become increasingly interested in conserving biodiversity, the profile of national and sub-national threatened species lists expands and these lists become more influential in determining conservation priorities (Miller et al. 2007).

In order to counteract this pitfall trap, we suggest that the IUCN Red list should incorporate the lesser known taxonomic groups (Butchart et al. 2007, Baillie et al. 2008) and should not be the only tool for policy-making, becoming one of many tools to set species conservation priority. The academic literature dedicated to prioritization of species conservation usually recommends ranking species based on several criteria, not only on the extinction risk, but also on evolutionary distinctiveness, ecological importance, social significance, cost of management, and the likelihood the management will succeed (Joseph et al. 2009).

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Figure 1. Regressions of European LIFE funds (above) and Spanish national funds (below) against the structural complexity of taxonomic groups as the number of cell types.

Table 1. Red lists of threatened species and binding legislation at four organizational levels.

Organizational level	Endangered species lists	Reference
International	The IUCN Red List of Threatened Species	IUCN 2009
European	**Binding Legislation**	
	The Birds Directive (*Council Directive 79/409/EEC* of 2 April 1979 on the conservation of wild birds)	
	The Habitats Directive (*Council Directive 92/43/EEC* of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora)	
	Red Lists of Threatened Species	
	The Status and Distribution of Freshwater Fish Endemic to the Mediterranean Basin	Smith and Darwall 2006
	European Red List of Amphibians	Temple and Cox 2009
	European Red List of Reptiles	Cox and Temple 2009
	The status and distribution of European mammals	Temple and Terry 2007
National	**Binding Legislation**	
	The National Catalogue of Endangered Species (NCES)	Anonymus 1990
	Red Lists of Threatened Species	
	Red List of Bryophytes of the Iberian Peninsula	Sergio et al. 1994, 2006
	Red List of Spanish Vascular Flora	Moreno 2008
	Red Book of Spanish Invertebrates	Verdú and Galante 2005
	Atlas and Red Book of fishes in Spain	Doadrio 2001
	Atlas and Red Book of amphibians and reptiles in Spain	Pleguezuelos et al. 2002
	The breeding bird Atlas in Spain	Martí and Moral 2003
	Atlas and Red Book of terrestrial mammals in Spain	Palomo et al. 2007
Autonomous regions	**Binding Legislation**	
	Law 8/2003 of Wild Flora and Fauna of Andalusia.	
	The Aragon Threatened Species Catalogue (*Decree 49/1995*).	
	Canary Catalogue of Threatened Species (*Decree 151/2001*).	
	Regional Catalogue of Threatened Species of Castilla-La Mancha (*Decree 33/98*).	
	Regional Catalogue of Endangered Species of Madrid (*Decree 18/92*)	

Table 2. Correlation between structural complexity, proportion of species included in the Red Lists at world and national level, proportion of threatened species included in legal listing, the number of scientific publications at world and national level, and funding allocation at European and national level. (Variables were $\log_{10}$ transformed. $N = 10$. Significant at * $p \leq 0.1$, ** $p < 0.05$, *** $p < 0.01$).

	Number of cell types	Proportion of threatened species in			Funding allocation at		Number of scientific publications at	
		IUCN Red List	National Red Lists	NCTS	European level (LIFE)	National level	International level	Spanish level
Number of cell types	1							
Proportion of threatened species in IUCN Red List	0.835***	1						
Proportion of threatened species in national Red Lists	0.543*[1]	0.814***	1					
Proportion of threatened species in the NCTS	0.859***	0.777***	0.679**	1				
Funding allocation at European level	0.753**	0.919***	0.793***	0.605*	1			
Funding allocation at national level	0.779***	0.726**	0.395[2]	0.623**	0.732**	1		
Number of scientific publications at international level	0.658**	0.635**	0.420	0.545*	0.670**	0.836***	1	
Number of scientific publications at Spanish level	0.631**	0.511	0.367	0.683**	0.447	0.721**	0.910***	1

[1] Pearson correlation $r = 0.737$, $p < 0.05$ if we did not include the bryophyte taxonomic group.
[2] Pearson correlation $r = 0.674$, $p < 0.05$ if we did not include the bryophyte taxonomic group.

Table 3. Relationships between World Conservation Union (IUCN) Red List and the European and Spanish species listing based on chi-squared statistics of contingency tables. Only cell chi-squared values related to positive and significant associations at *p*-value < 0.05 are shown. IUCN' categories: critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC). NCTS' categories: endangered (EN), sensitive to habitat change (SHC), vulnerable (VU), of special interest (SI). BD = Birds Directive, HD = Habitat Directive.

		The European Red List					**BD and HD[1]**	**National Red List**					**NCTS**			
		CR	EN	VU	NT	LC	Listed	CR	EN	VU	NT	LC	EN	SHC	VU	SI
The World IUCN Red List	CR	141.04						114.63					80.89			
	EN		175.77				3.89		62.43				10.66		24.23	
	VU			126.84					4.89	37.37			6.79			
	NT				135.97		11.85			15.31	6.86				9.73	
	LC					8.07										2.60
Observed association		$n = 295$[2], $\chi^2 = 684.38$, $p < 0.0001$					$n = 678$, $\chi^2 = 46.58$, $p < 0.0001$	$n = 678$, $\chi^2 = 480.67$, $p < 0.0001$					$n = 678$, $\chi^2 = 186.08$, $p < 0.0001$			

[1] Listed in the Annex I of the Birds Directive (BD) and in the Annex II (species of Community interest whose conservation requires the designation of special areas of conservation) and in the Annex IV (species of Community interest in need of strict protection) of Habitats Directive (HD).

[2] Currently, there is not a European Red List of Birds.

Table 4. Relationships between European and Spanish species listing based on chi-squared statistics of contingency tables. Only cell chi-squared values related to positive and significant associations at p-value < 0.05 are shown. IUCN' categories: critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC). NCTS' categories: endangered (EN), sensitive to habitat change (SHC), vulnerable (VU), of special interest (SI). BD = Birds Directive, HD = Habitat Directive.

		National Red List					**NCTS**			
		CR	EN	VU	NT	LC	EN	SHC	VU	SI
The European Red List	CR	52.22					81.37			
	EN		36.73				6.62		7.60	
	VU			22.25						
	NT				15.97					6.77
	LC					70.08				12.14
Observed association		$n = 295$[1], $\chi^2 = 313.65$, $p < 0.0001$					$n = 295$[1], $\chi^2 = 157.63$, $p < 0.0001$			
BD & HD[2]	Listed	9.08	9.46	2.69			17.68	6.29	13.36	
Observed association		$n = 678$, $\chi^2 = 60.50$, $p < 0.0001$					$n = 678$, $\chi^2 = 94.22$, $p < 0.0001$			

[1] Currently, there is not a European Red List of Birds.
[2] Listed in the Annex I of the Birds Directive (BD) and in the Annex II (species of Community interest whose conservation requires the designation of special areas of conservation) and in the Annex IV (species of Community interest in need of strict protection) of Habitats Directive (HD).

Table 5. Relationships between international and sub-national species lists based on chi-squared statistics of contingency tables. Only cell chi-squared values related to positive and significant associations at *p*-value < 0.05 are shown. IUCN categories: critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC). NCTS categories: endangered (EN), sensitive to habitat change (SHC), vulnerable (VU), of special interest (SI).

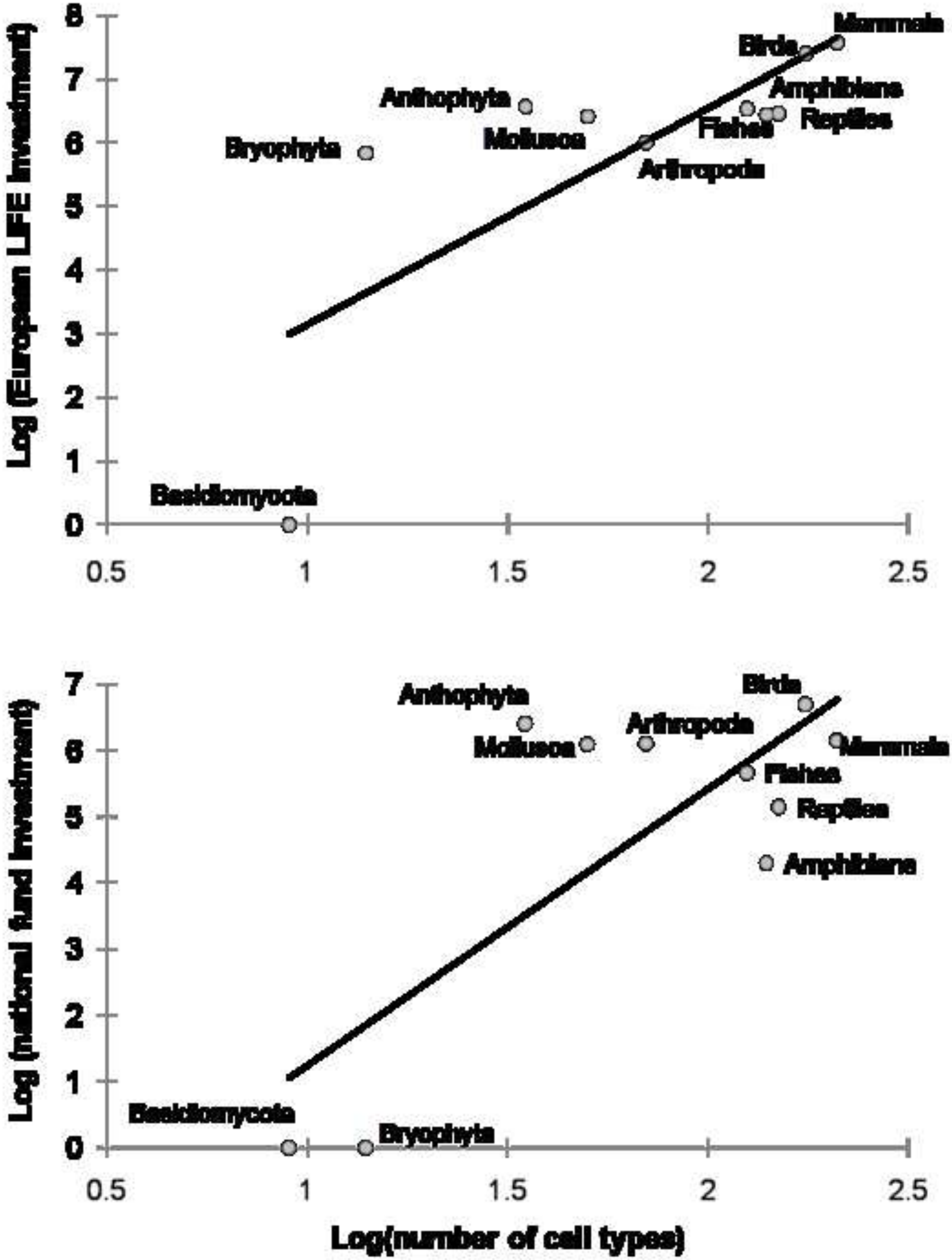
	Andalusia (*Law 8/2003)*				**Aragon (*Decree 49/1995)***			**Canary Islands (*Decree 151/2001)***				**Castilla-La Mancha (*Decree 33/98*)**			**Madrid (*Decree 18/92*)**		
	EN	SHC	VU	SI	EN	SHC	VU	EN	SHC	VU	SI	EN	VU	SI	EN	VU	SI
The IUCN World Red List CR	12.11				64.62			37.99							54.15		
EN	9.89	23.53						9.42				7.16					
VU	33.08					22.07	11.19	11.11				11.30					
NT			17.00			12.98										7.46	
LC				0.93										0.63			
Observed association	$n = 357, \chi^2 = 122.12, p < 0.0001$				$n = 333, \chi^2 = 150.71, p < 0.0001$			$n = 141, \chi^2 = 83.60, p < 0.0001$				$n = 380, \chi^2 = 54.15, p < 0.0001$			$n = 300, \chi^2 = 133.22, p < 0.0001$		

Table 6. Relationships between national and sub-national species lists based on chi-squared statistics of contingency tables. Only cell chi-squared values related to positive and significant associations at *p*-value < 0.05 are shown. IUCN categories: critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC). NCTS categories: endangered (EN), sensitive to habitat change (SHC), vulnerable (VU), of special interest (SI).

		Andalusia (*Law 8/2003)*				**Aragon (*Decree 49/1995)***			**Canary Islands (*Decree 151/2001)***				**Castilla-La Mancha (*Decree 33/98*)**			**Madrid (*Decree 18/92*)**		
		EN	SHC	VU	SI	EN	SHC	VU	EN	SHC	VU	SI	EN	VU	SI	EN	VU	SI
National Red List	CR	92.48				49.36			50.02				89.21			36.10		
	EN	14.85	24.70	7.40		15.24	12.34	11.87			6.88		8.24					
	VU			16.26			6.74	24.56						9.99		28.66	6.71	
	NT				1.91												5.38	
	LC														5.99			
Observed association		*n* = 357, χ^2 = 206.66, *p* < 0.0001				*n* = 333, χ^2 = 209.99, *p* < 0.0001			*n* = 141, χ^2 = 110.67, *p* < 0.0001				*n* = 380, χ^2 = 170.17, *p* < 0.0001			*n* = 300, χ^2 = 126.45, *p* < 0.0001		
NCTS	EN	240.17				110.54			32.53				267.28			54.15		
	SHC		87.26							38.49								
	VU			245.50			10.19	51.56			22.29			11.17			27.17	
	SI				56.18							7.22		2.84	12.73			3.31
Observed association		*n* = 357, χ^2 = 969.79, *p* < 0.0001				*n* = 333, χ^2 = 239.28, *p* < 0.0001			*n* = 141, χ^2 = 160.83, *p* < 0.0001				*n* = 380, χ^2 = 462.10, *p* < 0.0001			*n* = 300, χ^2 = 109.76, *p* < 0.0001		

Table 7. Differences among risk categories of mean conservation budget for European LIFE and Spanish funds. IUCN categories: critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC). NCTS categories: endangered (EN), sensitive to habitat change (SHC), vulnerable (VU), of special interest (SI).

		Mean European conservation budget (€)	***F***	***p*-value**	**Mean national conservation budget (€)**	***F***	***p*-value**
The World IUCN Red List	CR	7,515,108	2.295	0.064	199,256	0.159	0.956
	EN	2,043,956			96,893		
	VU	1,050,250			216,095		
	NT	1,705,076			142,616		
	LC	1,132,332			190,420		
	Non-listed	409,757			-		
The Spanish IUCN Red List	CR	5,455,504	2.148	0.093	340,411	4.679	0.012
	EN	1,581,284			172,133		
	VU	1,491,993			217,730		
	NT	465,279			39,072		
	Non-listed	561,689			67,045		
NCTS	EN	3,596,040	3.396	0.018	285,056	5.003	0.012
	SHC	251,146			208,500		
	VU	949,792			-		
	SI	1,181,920			103,543		
	Non-listed	665,189			71,082		



Log (European LIFE investment)
8
7
6
5
4
3
2
1
0
0.5
1
1.5
2
2.5
Mammals
Birds
Amphibians
Anthophyta
Reptiles
Fishes
Mollusca
Bryophyta
Arthropoda
Basidiomycota
Log (national fund investment)
7
6
5
4
3
2
1
0
0.5
1
1.5
2
2.5
Anthophyta
Birds
Arthropoda
Mollusca
Mammals
Fishes
Reptiles
Amphibians
Basidiomycota
Bryophyta
Log(number of cell types)