The Effectiveness of Iberian Protected Areas in Conserving Terrestrial Biodiversity

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Abstract: *The Iberian Peninsula harbors about 50% of European plant and terrestrial vertebrate species and more than 30% of European endemic species. Despite the global recognition of its importance, the selection of protected areas has been ad hoc and the effectiveness of such choices has rarely been assessed. We compiled the most comprehensive distributional data set of Iberian terrestrial plant and vertebrate species available to date and used it to assess the degree of species representation within existing protected areas. Existing protected areas in Spain and Portugal reasonably represented the plant and animal species we considered (73–98%). Nevertheless, species of some groups (amphibians, reptiles, birds, and gymnosperms) did not accumulate in protected areas at a rate higher than expected by chance (p > 0.05). We determined that to conserve all vertebrate and plant species in the Iberian Peninsula, at least 36 additional areas are needed. Selection of additional areas for conservation would be facilitated if such areas coincided with sites of community importance (SCI) designated under the European Commission Habitats Directive. Additional areas required for full representation of the selected plant and animal species all coincide with SCI in Spain. Nevertheless, the degree of coincidence varies between 0.3% and 74.6%, and there is a possibility that important areas for conservation occur outside the SCI. Our results support the view that current SCI can be used for prioritization of areas for conservation, but a systematic reevaluation of conservation priorities in Spain and Portugal would be necessary to ensure that effective conservation of one of European's most important biodiversity regions is achieved.*

Keywords: complementarity, conservation planning, gap analysis, Iberian Peninsula, Natura 2000, reserve selection

La Efectividad de las Áreas Protegidas Ibéricas en la Conservación de la Biodiversidad Terrestre

Resumen: *La Península Ibérica alberga casi el 50% de las especies europeas de plantas y vertebrados terrestres y más de 30% de las especies endémicas de Europa. A pesar del reconocimiento global de su importancia, la selección de áreas protegidas ha sido ad hoc y la efectividad de esas decisiones ha sido evaluada en raras ocasiones. Compilamos el conjunto de datos, más completos hasta la fecha, de la distribución de especies ibéricas de plantas y vertebrados terrestres y lo utilizamos para evaluar el grado de representación de especies en las áreas protegidas existentes. Las áreas protegidas existentes en España y Portugal representaron razonablemente a las especies de plantas y animales que consideramos (73–98%). Sin embargo, las especies de algunos grupos (anfibios, reptiles, aves y gimnospermas) no se acumularon en áreas protegidas a una tasa mayor a la esperada por azar (p > 0.05). Determinamos que para conservar a todas las especies de plantas y vertebrados terrestres en la Península Ibérica, se requieren por lo menos 36 áreas adicionales. La selección de áreas de conservación adicionales se facilitaría si tales áreas coincidieran con lugares de importancia comunitaria (LIC) designados por la Directiva de Hábitats de la Comisión Europea. En España, todas las áreas adicionales requeridas para una representación completa de las especies de plantas y animales seleccionadas coinciden con los LIC. Sin embargo, el grado de coincidencia varía entre 0-3% y 74.6% y hay una posibilidad*

de que áreas importantes para la conservación ocurran fuera de los LIC. Nuestros resultados sustentan la visión de que los LIC actuales pueden ser utilizados para la priorización de áreas de conservación, pero sería necesaria una reevaluación de prioridades de conservación en España y Portugal para asegurar que se logre la conservación efectiva de una de las regiones más importantes para la biodiversidad en Europa.

Palabras Clave: complementariedad, GAP Análisis, Natura 2000, Península Ibérica, planificación de la conservación, selección de reservas

Introduction

Although its area is <6% of western Europe, the Iberian Peninsula harbors as much as 50% of the European plant and terrestrial vertebrate species. The rate of endemism is also high: 31% of approximately 900 European endemic plant and terrestrial vertebrate species occur on the peninsula (Williams et al. 2000). One common explanation for this high level of species richness and endemism is that the Iberian Peninsula remained relatively ice-free during glacial periods in the Quaternary, thus providing refugia for many northern and central European species (e.g., Hewitt 2000). In addition, the relatively small thermal fluctuations and oscillations of rainfall may have triggered new speciation events or at least fostered the completion of speciation events that began in earlier geological times (Willis & Whittaker 2000). The importance of this region for biodiversity conservation is acknowledged widely. Conservation International's original Mediterranean biodiversity hotspot included nearly 80% of its area (Myers et al. 2000), whereas the European network of important sites for conservation (Natura 2000 network) included more than 20%. Despite such recognition, there has been no systematic assessment of the effectiveness of existing Iberian protected areas for conservation of such a variety of animal and plant species.

Previous attempts to assess the effectiveness of protected areas in the Iberian Peninsula have been limited to either Spain or Portugal (Araújo 1999; Sérgio et al. 2000; Carrascal & Lobo 2003; Araújo 2004; Martínez et al. 2006) or to particular taxonomic groups (Castro Parga et al. 1996; Martín-Piera 2001; Lobo & Araújo 2003). A standardized biodiversity index has been proposed to assess the effectiveness of Spanish protected areas in conserving terrestrial vertebrate diversity (Benayas & Montaña 2003). Nevertheless, the use of such approaches in conservation planning is controversial because planners must compare factors that are measured in different currencies and these are often incompatible and not interconvertible (for discussion, see Williams & Araújo 2002). Systematic conservation planning methodologies that are based on the complementary principle (i.e., a property of sets of objects that exists when at least some of the objects [species] in one set [areas] differ from the objects [species] in another set [areas]) (Williams 2001) avoid the limitations of earlier combinatorial approaches

(see for review Margules & Pressey 2000). As a result of developments in the field, the complementarity principle is now becoming part of the mainstream practice of conservation planning worldwide.

We used the best available data on terrestrial vertebrate and plant species distributions for the Iberian Peninsula (on a UTM 50-km grid) to assess the level of species representation in its protected areas. Because single representation of species within protected areas is an insufficient surrogate of species persistence (e.g., Araújo & Williams 2000) and there are no clear guidelines as to the ideal number of species representations in protected areas, we also sought to determine whether the representation of species in different taxonomic groups was greater than expected by chance. We then attempted to identify and provide guidance as to why, where, and how many additional protected areas would be needed to conserve a representative sample of terrestrial Iberian biodiversity. To assess the management implications of the conservation planning scenarios identified, we explored possible bias in the current land-cover types in existing protected areas and in additional conservation areas needed to fully represent terrestrial Iberian biodiversity.

Methods

Data

We compiled and resampled recorded distributions of species in the 257 Iberian 50 × 50 km UTM cells with at least 15% of surface area not covered by seawater (Fig. 1). The Balearic and Macaronesian islands were not considered. We analyzed 3247 taxa: 2246 dicotyledon, 429 monocotyledon, 124 pteridophyte, 21 gymnosperm, 269 bird, 92 mammal, 26 amphibian, and 42 reptile species. The plant data we used represented approximately 37% of the entire Iberian vascular flora (Castroviejo 2002) and included 554 more species than that used in a previous assessment (Castro Parga et al. 1996). Plant distribution data were compiled from several sources including the *Atlas Florae Europeae* (Jalas & Suominen 1972–1996; Lahti & Lampinen 1999), the ANTHOS project (http://www.anthos.es/), regional atlases at UTM 10 × 10 km (see Lobo et al. 2001 and references therein) and unpublished maps gathered by J.C.M. The vertebrate data we
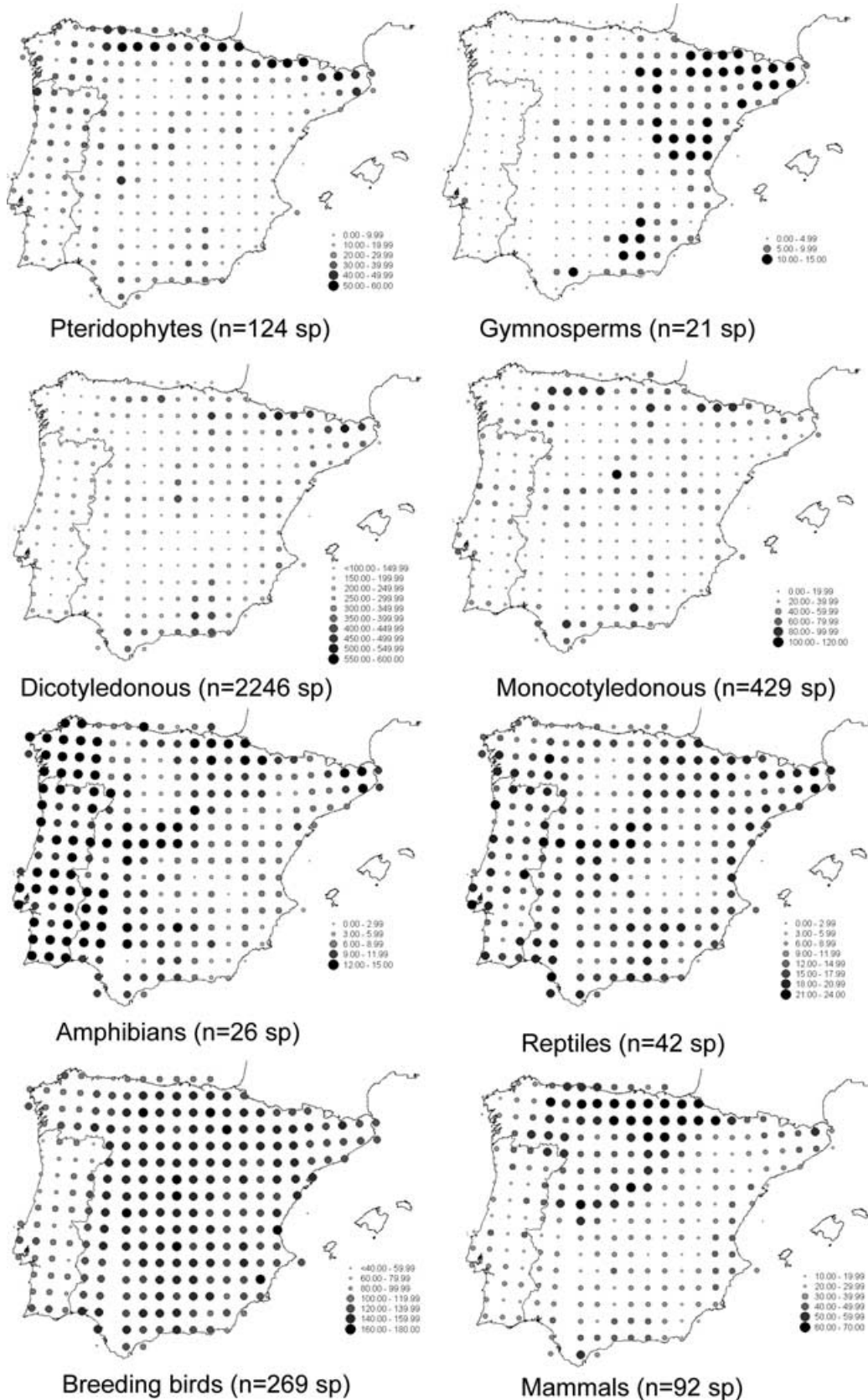
Figure 1. *Species richness of selected terrestrial animal and plant groups among UTM 50 × 50 km grid cells within the Iberian Peninsula. Richness scores were divided into equal-frequency classes (maximum scores in black; minimum scores in light gray).*

used included 100% of the known species and were compiled from existing distribution atlases for Spain (Palomo & Gisbert 2002; Pleguezuelos et al. 2002; Martí & del Moral 2003) and from published and unpublished sources of data for Portugal reported by Araújo (1999, 2004). We complemented these vertebrate data with atlases on European breeding birds (Hagemeijer & Blair 1997), mammals (Mitchell-Jones et al. 1999), and reptiles and amphibians (Gasc et al. 1997).

Digital maps of protected areas were obtained from the Spanish "Banco de Datos de la Naturaleza" (http://www.mma.es/bd_nat/menu.htm) and from the Portuguese "Instituto de Conservação da Natureza" (http://portal.icn.pt/ICNPortal/vPT/). Because protected areas are polygons, often smaller than the grid cells, we applied a filter to identify grid cells that can be considered protected, or protected areas to which species of the corresponding grid cell will be assigned. We calculated the proportion of 50-km grid cells covered by protected areas (PA) with ArcView. Four thresholds (2%, 5%, 10%, and 20% coverage) were set arbitrarily to determine whether protected areas should be considered present in the 50-km grid cells (Fig. 2). Protected areas covering less than the cutoff percentage of a grid cell were not considered present in such a grid cell (see for discussion Araújo [2004]).

Land-cover data at 250-m resolution were obtained from the Corine Land Cover 2000 database (http://terrestrial.eionet.europa.eu/CLC2000). We used these data to calculate the proportion of each land-cover type present in each 50-km grid.

Gap Analysis

Gap analysis is a procedure for assessing the extent to which native animal and plant species are being protected by conservation area networks (e.g., Scott 1993; Rodrigues et al. 2004). We used gap analysis to determine how well existing Iberian protected areas represented plant and vertebrate species. We (1) mapped available species location records to grid cells; (2) assigned protected areas to grid cells with 2%, 5%, 10%, and 20% thresholds; (3) identified gaps in species representation in protected areas visible in overlaid maps obtained in (1) and (2); and (4) compared the level of species representation within protected areas with what would be expected by chance from a random selection of grid cells where species have been recorded (selecting the same number considered to be protected in the 2%, 5%, 10%, and 20% PA scenarios). The result of 1000 random selections was used as an estimate of the number of species that would be expected to be represented by chance. We compared the level of species representation obtained with the four threshold protected-area coverages with the results of random selection of areas at the top 5% of the distribution of scores among the 1000 trials. This comparison is a guide to the maximum number of species possibly represented by chance at $p < 0.05$, so deviations from this model may be interpreted as a test for significant differences in the effectiveness of protected areas from random expectations (see Araújo et al. [2003] for discussion).
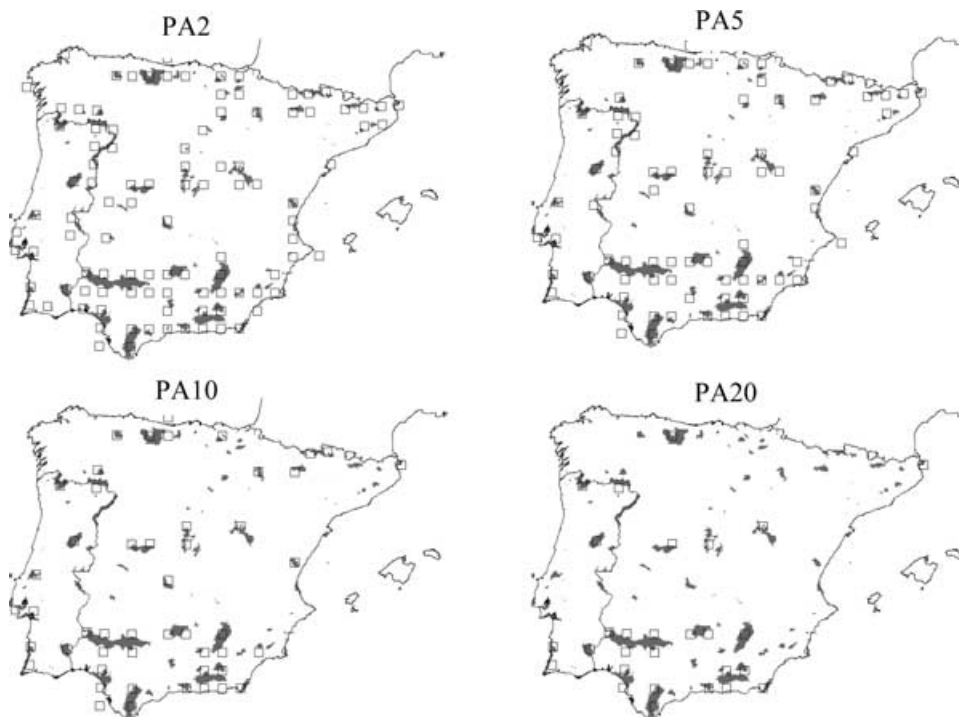

Figure 2. Assignment of protected areas (dark polygons) to grid cells (squares) based on different rules for transforming vector coverage into a raster map: PA2, PA5, PA10, and PA20, grid cells considered protected if protected areas cover more than 2%, 5%, 10%, and 20%, respectively, of the grid-cell area.

Species Representations

The methodology described earlier is based on fixed conservation targets (e.g., representing species in protected areas at least once). Nevertheless, such targets are arbitrary and are sometimes difficult to defend, especially when conservation priorities are appraised against competing land uses. An alternative form of evaluation that avoids fixed targets is to measure departures of species representations in protected areas—in a continuous scale—from that expected by chance. To measure such departures, we regressed the total numbers of species occurrence records in the Iberian Peninsula against the numbers of species representations in protected areas. The slope of this regression reflects the rate at which records of species are added to a protected-area system: the steeper the slope the higher the rate at which the protected areas represent species.

Another useful measure is the shape of the species accumulation curves in protected areas. If the protected area represents species optimally, the species accumulation curve should resemble a logarithmic function (steeper among restricted range species and leveling off for wider-ranging species). This pattern of representation is usually found in species accumulation curves obtained with complementarity reserve-selection methods. Here, the relationship between the total number of species records in the Iberian Peninsula and the number of species records in protected areas was linear (scatter diagrams not shown), which departs from optimal species-accumulation curves.

The intercept of regression analysis, which relates the total number of species occurrence records with the species records in protected areas, is another useful measure of the effectiveness of the protected areas. Intercepts provide a relative measure of the representation of the most restricted-range species in protected areas (i.e., the greater the intercepts the greater the proportion of the distributions of restricted-range species from protected areas chosen at random).

Reserve Selection

Additional areas needed to conserve a representative sample of terrestrial biodiversity were determined with the aid of the progressive-rarity near-minimum set algorithm (Margules et al. 1988). The algorithm first selects all areas with taxa that are equally or more restricted than the representation goal. For the goal of representing each species at least once, it begins by selecting all areas that have species recorded in only one grid cell. Then the algorithm follows a simple set of rules, applied iteratively to select areas richest in the rarest taxa. First, it selects grid cells with the greatest complementary richness in just the rarest taxa (e.g., those occurring twice in the data set, ignoring other taxa). If there are ties, it proceeds by selecting areas among ties that are richest in the next-

rarest taxa. If there are still ties, implementations of the algorithm usually select areas among ties with the lowest grid-cell number. Finally, these steps are repeated until the representation goal (here at least one representation per species) is achieved. A test is performed to reject any grid cell that in hindsight is redundant to the selected goal (Williams et al. 2000).

Sensitivity and Bias

Because there are ties in a selection process, there are a number of alternative reserve-selection solutions that are equally effective in reaching full representation of species (Hopkinson et al. 2001). To assess the sensitivity of our results to alternative solutions, we selected 10 sets of complementarity areas for each one of the four protected-area scenarios; 10 simulations were considered sufficient because after 6 simulations no additional grid cells were selected (see also O'Dea et al. 2006). Selection of these alternative reserve solutions was achieved by breaking ties at random instead of choosing areas with the lowest number of grid cells. All reserve-selection analyses were performed with WORLDMAP (Williams 1999).

Finally, to determine whether there is bias in land-cover types in existing protected areas and additional areas needed to represent Iberian biodiversity, we measured the proportion of land covered with urban, industrial, crop, pasture, forest, and heath lands. We used the Kruskal–Wallis one-way analysis of variance by ranks to test for equality of land-cover medians among protected areas, additional conservation areas, and the wider countryside. Mann–Whitney U tests were then used to test for pairwise differences between the distributions of land-cover classes in the three categories considered.

Results

Representation of Species in Existing Protected Areas

Iberian protected areas represented generally more selected species at least once than expected by chance ($p < 0.05$, Table 1). One striking exception was the amphibians and reptiles, for which all protected-area scenarios represented no more species than expected by chance ($p > 0.05$). Levels of species representation of these groups on protected-area maps ranged from 88% to 100% (Table 1), but the number of taxa in these groups (27 amphibian and 42 reptile species) was very low compared with most of the other groups. Similarly, high levels of species representation in protected areas—but not greater than expected by chance—were recorded for breeding birds (PA2) and gymnosperms (PA2, PA10, and PA20), both with representations above 85%. The latter group had a low number of species ($n = 21$).

Slopes of species accumulation in protected areas were not significantly different from slopes obtained at random

Table 1. Representation of species (%) within Iberian protected areas based on four protected-area maps (n).[a]

Taxon	PA2 (102)	PA5 (78)	PA10 (49)	PA20 (28)
Dicotyledons	97.33[b]	95.58[b]	88.16[b]	74.15[b]
Monocotyledons	97.37[b]	95.47[b]	88.78[b]	77.80[b]
Gymnosperms	100.00	100.00[b]	95.24	85.71
Pteridophytes	98.37[b]	93.50[b]	89.43[b]	80.49[b]
Birds	98.12	97.74[b]	94.74[b]	92.11[b]
Mammals	98.91[b]	98.91[b]	98.91[b]	94.57[b]
Reptiles	100.00	100.00	100.00	90.00
Amphibians	100.00	96.15	96.15	88.46
All taxa	97.57[b]	95.86[b]	89.41[b]	73.39[b]

[a]*Key: PA2, PA5, PA10, and PA20, grid cells considered protected if protected areas cover more than 2%, 5%, 10%, and 20%, respectively, of the grid-cell area; n, number of grid cells selected..*
[b]*Protected areas representing more species than expected by chance (p < 0.05).*

for gymnosperms, birds, mammals, and amphibians (Table 2). Except for mammals, for which protected areas represented species with more restricted ranges than expected by chance, the observed and random intercept values were also not different for these taxa. Observed slopes for reptiles, dicotyledons, monocotyledons, and pteridophytes were significantly steeper than expected by chance, but the intercepts were significantly higher in existing protected areas than random only for plants (except gymnosperms) and mammals.

Additional Areas Needed to Conserve Terrestrial Iberian Biodiversity

Taking PA2 as the baseline protected-area scenario, 36 additional 50 × 50 km grid cells would be necessary to represent the 2.43% animal and plant species not represented within existing protected areas (Fig. 3). We used this scenario because it was the one—among the four protected-area scenarios evaluated herein—that minimized omission errors (i.e., the error of accepting a null hypothesis [protected areas represent species no better than expected by chance] when the alternative hypothesis [protected areas represent more species than expected

by chance] is true). Twenty-six of these 36 cells were irreplaceable (i.e., there were species within these grid cells recorded nowhere else in the peninsula). The remaining 10 cells had fully flexible alternative solutions (i.e., they represented species found elsewhere). When we repeated the reserve selection process 10 times, 49 areas were identified, in addition to the current protected areas, as candidates for conservation (Fig. 3)

Land-Cover Types in Existing Protected Areas and in Additional Areas Needed to Conserve Iberian Biodiversity

The proportion of land cover in current protected areas, additional conservation areas (the 49 area set), and the wider countryside varied significantly for crops and heathlands (Kruskal–Wallis, $p = 0.002$, $p = 0.01$). It was found that protected areas in the Iberian Peninsula have less crops and more heathland than the wider countryside (Mann–Whitney U, $p = 0.002$ and $p = 0.02$, respectively). Additional areas required for full representation of biodiversity not only maintain the tendency for high proportion of heathlands with reference to the wider countryside (Mann–Whitney U, $p = 0.06$) but also show a slight increase in the proportion of crops as for protected areas (Mann–Whitney U, $p = 0.09$).

Discussion

Our results provide the first Iberian-wide assessment of the effectiveness of the current protected areas to conserve a large sample of terrestrial biodiversity. Previous assessments were primarily undertaken at the national level, but because biodiversity knows no political boundaries evaluations of protected areas at broader biogeographical units are desirable. Our results showed that existing protected areas in the Iberian Peninsula provide a reasonable representation of the 429 animal and 2820 plant species considered. Species representation varied between 73% (PA20) and 98% (PA2). Nevertheless, representation values per se provide an incomplete assessment of the effectiveness of protected areas. The crucial question is whether recorded representation values are the

Table 2. Intercept and slope scores (95% CI) of the linear regression between the total number of species records in the Iberian Peninsula and the number of species representations in grid cells with protected area covering more than 2% of its surface, and intercept and slope scores of the same relationships with cells selected at random.

Taxon	Intercept	Slope	Intercept random	Slope random
Dicotyledons	1.588 (0.157)*	0.429 (0.003)*	−0.014 (0.101)	0.392 (0.002)
Monocotyledons	1.191 (0.332)*	0.453 (0.009)*	−0.046 (0.238)	0.389 (0.006)
Gymnosperms	3.221 (4.778)	0.412 (0.244)	1.011 (1.592)	0.412 (0.219)
Pteridophytes	1.845 (0.952)*	0.436 (0.013)*	−0.309 (0.522)	0.403 (0.002)
Birds	1.589 (0.720)	0.395 (0.005)	0.394 (0.482)	0.398 (0.003)
Mammals	3.056 (1.506)*	0.404 (0.010)	−0.243 (0.925)	0.413 (0.007)
Reptiles	2.516 (2.095)	0.439 (0.019)*	0.130 (1.082)	0.403 (0.010)
Amphibians	1.815 (3.010)	0.415 (0.030)	−0.287 (0.961)	0.405 (0.010)

Intercepts or slopes significantly different (p < 0.05) from those obtained by selecting cells at random (covariance analysis).

Figure 3. Current protected areas (dark polygons) and additional conservation areas (squares) required to represent all animal and plant species analyzed in this study when protected areas covering >2% of the grid cell area (PA2) were considered. The size of the square is scaled by the number of times areas were selected in minimum sets simulations (see Methods).

best return for a given investment in conservation (i.e., whether a greater level of species representation could have been achieved with an equally large alternative set of protected areas).

A more robust measure of conservation effectiveness that is independent of arbitrary targets—such as to conserve all species in protected areas at least once—is to compare the recorded level of species representation in protected areas with that expected from an equivalent number of areas selected at random (Table 2). In other words, is the level of species representation achieved by a given protected area system the result of strategic management choices or is it no better than the outcome expected from selecting protected areas with little regard for the distribution of biodiversity? By comparing the level of species representation within protected and random areas, we found limited evidence that all terrestrial vertebrate and plant groups in protected areas are represented at a rate higher than expected by chance ($p <$ 0.05). For example, the rate of species accumulation (the slopes) in protected areas was not different from random for gymnosperms, birds, mammals, or amphibians. The proportion of ranges among restricted-range species was greater in protected areas than that expected by chance (the intercepts) among mammals and plants, but not gymnosperms. Similar results were obtained with the more standard gap analysis for PA2 (Table 1). Taken together these results show that protected areas provide effective samples of species among the great majority of plants and mammals, but provide poor representations for the remaining vertebrate groups and gymnosperms. These

results are consistent with those of former studies that assessed the effectiveness of protected areas in conserving limited groups of organisms in Spain and Portugal (Castro Parga et al. 1996; Araújo 1999; Sérgio et al. 2000; Carrascal & Lobo 2003; Lobo & Araújo 2003).

Identifying gaps in the representation of species in protected areas, although important, is only one step, among others, toward building more robust networks of areas for conservation (Margules & Pressey 2000). We provided a preliminary identification of the areas that need to be added to the existing protected-area network of Spain and Portugal to achieve a more complete representation of Iberian biodiversity. Although it is widely acknowledged that governments in Spain and Portugal have been expanding protected areas consistently over the past 20 years, our results demonstrate that with an optimistic assessment of representation of species in existing protected areas (designed to minimize omission errors) at least 36 additional 50 × 50 UTM cells would be necessary to guarantee full representation of selected Iberian terrestrial vertebrates and plants species. Nearly 72% of these areas are irreplaceable for the goal of full representation of species within protected areas.

In some cases the coarseness of the 50 × 50 km grid used for this study might have affected the quality of the results because small protected areas were omitted (i.e., existence of omission errors despite the low thresholds used to assign presence of protected areas in grid cells). For example, the westernmost conservation grid cell selected to conserve one unrepresented species (the Kittiwake, *Rissa tridactyla*) (Fig. 3) overlapped with the Berlengas Islands reserve, unmapped because of its small size (Fig. 2). After careful examination of our results, we estimated that such problems do not change the broad-scale qualitative statements derived from the analyses, not least because we used conservative thresholds for our tests, and there is no guarantee that species occurring in grid cells with at least 2% protected area coverage are represented within protected areas (i.e., the possibility of existence of large commission errors, a factor not explored in our study).

Despite careful examination of the results, the coarse resolution of our study might still be perceived as limiting the usefulness of our assessment for conservation planning. Nevertheless, identifying gaps on a coarse scale is a preliminary and necessary step to priority setting in conservation. A follow-up would be to define realistic boundaries for protected areas at finer resolutions. Designing boundaries for protected areas would require fine-resolution species data (currently unavailable for most taxa) or the downscaling of individual species distributions (e.g., Araújo et al. 2005). A complete design would also include socioeconomic information to estimate management, acquisition, and opportunity costs associated with the implementation of conservation programs (e.g., Frazee et al. 2003; Williams et al. 2003). Local processes

threatening persistence of biodiversity would also need to be modeled (e.g., Araújo et al. 2002; Wilson et al. 2005).

When studying the possibility of designating additional areas as protected areas it is important to consider a variety of factors, including opportunities for designating areas that already have some sort of conservation status. Here we used nationally designated protected areas as baseline for analysis. Nevertheless, a more detailed assessment of the conservation status of biodiversity would require the consideration of the European Commission's NATURA 2000 network for conserving species and habitats in the Iberian Peninsula. As a preliminary step toward this goal, we examined how current Spanish Sites of Community Importance (SCI), designated under the European Commission Habitats Directive, coincide with the additional conservation areas identified with a complementarity algorithm. All grid cells required for complementing the existing protected areas network in mainland Spain include areas proposed as SCI, but the proportion of the cells covered by SCI varied between 0.3% and 74.6%; three cells alone have an SCI area that covers more than 50% of its total area. Coincidence of SCI with complementary cells is unsurprising because the proposed SCI cover a quarter of the Spanish territory and would add 4.6 times more area to the existing protected-areas network. Nevertheless, the resolution of SCI polygons is finer than additional cells for conservation and there is a possibility that important areas for conservation might occur outside the SCI. Clearly, there are opportunities for using the SCI as a baseline for future prioritization of conservation areas in the Iberian Peninsula, and we hope our assessment will stimulate researchers and planning authorities in both Spain and Portugal to undertake more-detailed examinations of the effectiveness of current protected areas under a variety of different criteria.

Protected areas have significantly less crops and more heathland than the remaining Iberian Peninsula. The additional areas required for full representation of species in the Iberian Peninsula not only maintain a tendency of high proportion of heathland but also have more crops than current protected areas. Land-use data are from the 1990s, and some species records are older, so there is a possibility that such an increase in the amount of cropland might reflect areas of native habitat that were transformed into crops recently. Nevertheless, there is also a possibility that areas of extensive cropland have been neglected by existing conservation policies in the Iberian Peninsula. This is an interesting possibility to explore, because, if true, it would contrast with European conservation priorities that focus on the conservation of traditional cropland. In Europe, croplands, including some extensive agricultural systems of southern Europe, provide key habitats for the conservation of several endangered species (e.g., Great Bustard [*Otis tarda*]). Reconciling the view that conservation should be mainly undertaken in undisturbed areas with the view that conservation can also be done in human-dominated landscapes is important because there is evidence that some of the currently unprotected areas are now being targeted for urban, cropland intensification, and other types of heavy development (e.g., Benayas et al. 2006).

In other regions protected areas often fail to provide complete representation of biodiversity (e.g., Hopkinson et al. 2000; Scott et al. 2001; Rouget et al. 2003; Cantú et al. 2004; Dimitrakopoulos et al. 2004; Norton & Roper-Lindsay 2004; Oldfield et al. 2004; Yip et al. 2004; Riemann & Ezcurra 2005; Maiorano et al. 2006; Soutullo & Gudynas 2006). Unfortunately, evaluations of protected areas have usually been undertaken by reserchers in universities and public research institutes, and studies have had a limited impact on conservation policy and management. It is clear from our study and from several other systematic evaluations of protected areas that existing protected areas in Europe and elsewhere are often insufficient to conserve all biodiversity. Increased cooperation between researchers and conservation practitioners is required to help optimize return from conservation investment.

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