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Current protected sites do not allow the representation of endangered invertebrates: the Spanish case

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Abstract. 1. Using a recently created database representing the joint effort of around 100 invertebrate taxonomists, this study uses the information on 52 arthropoda and 27 mollusca species that are endangered and critically endangered to examine to what extent invertebrate species are represented in existing Spanish protected areas.

2. As distribution information is available at a 100 km^2 resolution, we consider different area thresholds to judge cells as being protected.

3. Approximately 19% of the area represented by the grid cells with observed occurrences rates as extant protected reserves, and 36% is included within the Natura 2000 network.

4. If having 50% of the cell area as a Natura 2000 reserve is considered as sufficient to have effective protection, almost 68% of species and 32% of probable populations (contiguous cell groups) would be represented.

5. However, 77% of species and 94% of probable populations are not represented in the current protected reserves if we establish that at least 95% of each cell area should belong to a reserve to provide effective protection.

6. Thus, existing conservation strategies, which are based primarily on the protection of certain areas and vertebrate species, may be insufficient to ensure the conservation of invertebrate species.

Key words. Endangered species, insects, molluscs, protected areas, Spain, species representation.

Introduction

Obtaining reliable information on the distribution of species is one of the main requirements for the design of effective conservation strategies and policies (Margules & Pressey, 2000). Land use planning for a territory and the delimitation of natural reserves require adequate information on the distribution of species. However, limited taxonomic and distribution knowledge about the groups representing most of the biodiversity (Dennis & Thomas, 2000; Lobo *et al*., 2007) has usually led to the exclusion of invertebrates (Martín-López *et al*., 2009) from such design exercises (but see Cabeza *et al*., 2010). Nevertheless, invertebrates, and particularly insects, represent a high part of the known number of species that inhabit terrestrial ecosystems and monopolise most of our lack of knowledge about environmental adaptations and high species diversity (New, 2007; Leather *et al*., 2008). Global estimations indicate that almost four-fifths of the total of terrestrial species are insects (Samways, 2005). These numbers are similar for the Iberian Peninsula and Balearic and Canary Islands – which are global biodiversity hotspots (Brooks *et al*., 2006). About 98% of the total Iberian fauna are invertebrates, and roughly 81% of them are insects (Ramos *et al*., 2001).

A common approach to prevent loss of biodiversity is the establishment of protected area systems. Protected areas play a vital role in the protection of biodiversity and are the mainstay

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of most conservation polices. However, socio-economic and aesthetic criteria usually predominate in the choice of these areas, and reserve selection has traditionally been opportunistic, depending on areas becoming available for conservation, political circumstances, and local goodwill (Pressey, 1994). When reserve selection is based on a systematic conservation planning approach (Margules & Pressey, 2000), protected area networks are generally designed using target species or groups of target organisms, mainly vertebrates and plants (Martín-López *et al*., 2007, 2009). Although repeatable and based on empirical data and efficient selection algorithm procedures, this last strategy is not exempt from generating inadequate reserve selections (e.g. Hopkinson *et al*., 2000; Linnell *et al*., 2000; Powell *et al*., 2000; Bruner *et al*., 2001; Scott *et al*., 2001; Kati *et al*., 2004; Rodrigues *et al*., 2004; Martínez *et al*., 2006).

Identifying high-priority areas for conservation based on vertebrate and plant information may produce sites that host some rare or threatened invertebrate species within the conservation network (Kati *et al*., 2004). However, the conservation of invertebrates typically also requires environmental policies that protect small and/or isolated sites, taking into account both the preservation of habitats at the micro-scale and the particular environmental requirements of these organisms. Otherwise, most of these sites would be considered irrelevant in large-scale planning based on coarse-scale information. Are the spatial designs for the location of areas that need to be protected different when the information about these hyper-diverse groups is considered? Can we have confidence in conservation designs that are only based on information about charismatic species and/or opportunistic political and economic criteria? While the effectiveness of legal protection for small invertebrates may be debated (Hutchings & Ponder, 1999; New & Sands, 2003), in the current situation, the only protection available for these species is the extent to which they occur in protected areas designated on the basis of other groups or habitat features. Using the information provided by a recently published Spanish atlas of endangered and critically endangered invertebrate species and its update in 2010 (Verdú & Galante, 2008; Verdú *et al*., 2011), in this study, we aim to determine the extent to which these species are represented in existing protected areas. In particular, first we examined the spatial distribution of the localities where these species were located and second, evaluated the extent to which protected areas represent the known occurrence of these species.

Materials and methods

The study area comprises Peninsular Spain as well as the Balearic and Canary Islands ($\approx$504 645 km^2). The whole Spanish territory includes a wide variety of biomes, relief, climates, and soil types, where altitude ranges from sea level to 3483 m. Landscapes vary greatly, from some which are almost desert-like to others that are green and fertile. There are also long coasts, to the east along the Mediterranean and to the west along the Atlantic and the Cantabrian Sea. Because of this great variety of relief and climate, Spain presents an enormous diversity of vegetation types, from deciduous and coniferous forests, and evergreen woodland to scrubland and annual grassland (Rey-Benayas *et al*., 2002).

Data sets

The data used come from the Spanish atlas for endangered and critically endangered invertebrate species (Verdú & Galante, 2008) and the Atlas and Red List of threatened invertebrates (Verdú *et al*., 2011), which includes distribution information for 79 species. The information from Peninsular Spain and Balearic Islands (64 species) was treated separately from those of the Canary Islands (15 species) for two reasons: the environmental and historical differences between these two relatively distant regions; but mainly because the total percentage of protected area in the Canary Islands is almost four times higher than the rest of the Spanish territory (Europarc-España, 2010). The species belong to Arachnids (2 species), Insects (50 species), Bivalves (2 species), and Gastropods (25 species) (Table 1). This atlas forms part of the National Inventory of Biodiversity aimed to provide detailed cartographic and taxonomic information for the Spanish biota (www.marm.es/) and was supported by the Biodiversity General Administration of the Spanish Ministry of Rural, Marine, and Natural Environment. It was developed with the collaboration of the Spanish Association of Entomology (http://www.entomologica.es/) and the Spanish Society of Malacology (www.soesma.es/). The data contained in these atlases are the result of the joint effort of almost 100 invertebrate taxonomists who compiled available distribution information from natural history institutions and bibliographical sources, and subsequently visited all known occurrence localities, as well as other neighbouring ones, to carry out intensive field surveys.

The complete database comprises 930 records, which correspond to 432 100 km^2 UTM grid cells (around 6.5% of the whole Spanish territory). The mean number of database records per species is 12.2 $\pm$ 5.5 ($\pm$95% confidence interval) for peninsular Spain and the Balearic Islands, and 9.5 $\pm$ 3.8 in the case of the Canary Islands. However, almost half of all the species considered (33 species) have five or less database records (three species in the Canary Islands). The mean number of grid cells per species is 7.5 $\pm$ 2.6 for Peninsular Spain and the Balearic Islands and 2.9 $\pm$ 1.0 in the Canary Islands, but two-thirds of the species occur in five or less grid cells (12 in the Canary Islands).

Assuming that the observed occurrence cells constitute a reliable geographic representation of the true range of these narrowly distributed species, we estimate the probable populations (P_{POP}) for each species as the number of cell groups with contiguous grid cells including diagonals (i.e. that touch a grid cell in a buffer zone of 10 km in any of the eight possible directions). We also calculate the area of each 100 km^2 UTM cell included within two different protected scenarios: the extant protected reserves (PRs) and the wider and still not completely implemented Natura 2000 network of protected areas (N_{2000}). PRs include National, Natural and Regional parks, Reserves, Natural Monuments, Protected Landscapes as well as the different types of officially protected areas (i.e. those included in the Spanish law). Both PRs and N_{2000} digital cartography were downloaded from http://www.marm.es/. As the distribution information of the species considered is available at a 100 km^2 resolution, we selected twelve area thresholds (>1%, >5%, >10%, >20%, >30%, >40%, >50%, >60%, >70%, >80%, 90%, and 95%) to consider the grid cells as protected; when the percentage of PRs or N_{2000} area was higher than the considered threshold value, the cell was judged as protected as well as the species and/or population present in it. Thus, different protection levels were obtained for both species and P_{POP}. along the gradient defined by two extreme protection scenarios: one relatively undemanding, where occurrence cells only require species to have 50% of their area as N_{2000} to be considered protected and an exigent one, where occurrence cells should have at least 95% of their area included as PRs.

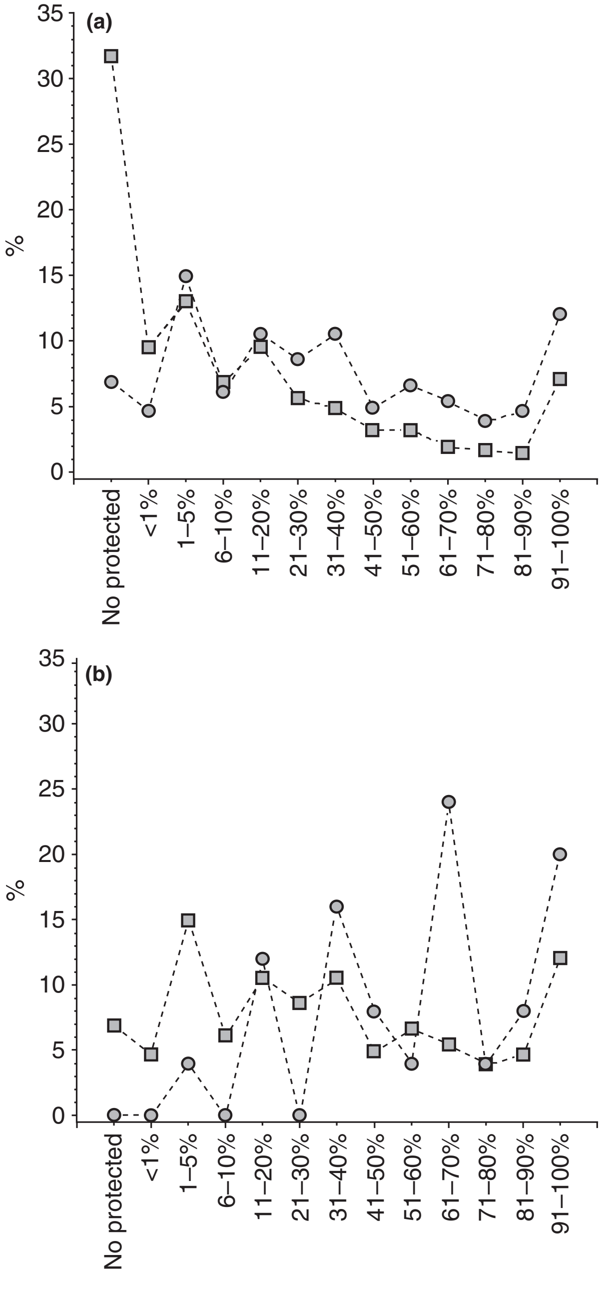

Fig. 1. Percentage of UTM cells of 100 km^2 with observed data of endangered and critically endangered invertebrate species in Peninsular Spain and the Balearic Islands (a) and Canary Islands (b), according to the area threshold selected to consider a grid cell as protected in the case of extant protected reserves (squares) and Natura 2000 network of protected areas (circles).

Results

Approximately 19% of the area represented by the grid cells with observed occurrences of endangered and critically endangered invertebrates is currently protected as PRs in the Iberian Peninsula and the Balearic Islands, and 36% is included within the N_{2000}, network, whereas these percentages are 54% and 57% in the case of the Canary Islands. Almost a third of the grid cells with observed occurrences in the Iberian Peninsula and Balearic Islands do not have any area covered by PRs (Fig. 1a), although this percentage declines to 7% when N_{2000} reserves are considered. Three-quarters of all grid cells have less than 25% of their area protected as PRs, and half of the cells have less than 25% of their area protected as N_{2000}. This situation is very different to the case of the cells of the Canary Islands (Fig. 1b), where

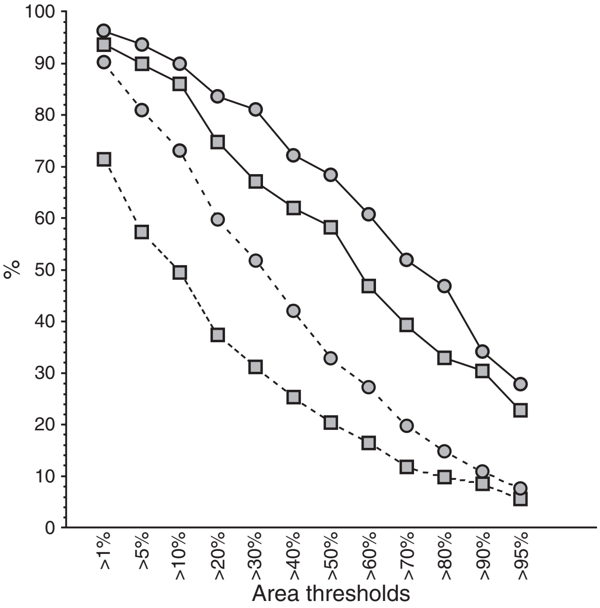

Fig. 2. Variation in the percentage of total Spanish endangered or critically endangered invertebrate species (continuous lines) or probable populations (broken lines) represented in the UTM cells of 100 km^2 according to the area threshold selected to consider a grid cell as protected in the case of extant protected reserves (squares) and Natura 2000 network of protected areas (circles). Probable populations were established as contiguous cell groups with observed presences including diagonals (i.e. touching in any of the eight possible directions of a grid cell in a buffer zone of 10 km).

Table 1. Spanish endangered and critically endangered invertebrate species and their general habitat (*H*) of occurrence (T, terrestrial; F, freshwater), the number of UTM cells of 100 km^2 with observed data (*NC*) and their eventual lack of protection (marked by an X) under two extreme protection scenarios: an exigent one where occurrence cells should have at least 95% of their area included within extant protected reserves (PRs), and a less demanding one where occurrence cells are considered protected if 50% of their area is included within the Natura 2000 network of protected areas (N_{2000}). *S* represents the species for which any of their occurrence cells fulfil the required protection scenario, while P_{POP} indicate the species with probable populations outside both protection scenarios.

			PRs				N_{2000}	
Class	Order	Scientific name	*H*	*NC*	S	P_{POP}	S	P_{POP}
Arachnida	Araneae	*Parachtes deminutus* (Denis, 1957)	T	2				
Arachnida	Opilions	*Maiorerus randoi* Rambla, 1993	T	1	X	X		
Crustacea	Decapoda	*Typhlatya miravetensis* Sanz y Platvoet, 1995	F	1	X	X	X	X
Insecta	Coleoptera	*Amaladera longipennis* (Verdú, Micó y Galante, 1997)	T	1	X	X	X	X
Insecta	Coleoptera	*Anthypna iberica* Drioli, 1980	T	3		X		
Insecta	Coleoptera	*Apoduvalius (Apoduvalius) naloni* Salgado, 1993	T	1	X	X	X	X
Insecta	Coleoptera	*Calathus amplius* Escalera, 1921	T	5	X	X		
Insecta	Coleoptera	*Carabus coarctatus* Brullé, 1838	T	7		X		
Insecta	Coleoptera	*Cionus canariensis* Uyttenboogaart, 1935	T	2	X	X		
Insecta	Coleoptera	*Cybister (Melanectes) vulneratus* Klug, 1834	F	6		X		X
Insecta	Coleoptera	*Dicrodontus alluaudi* Mateu, 1952	T	2	X	X	X	X
Insecta	Coleoptera	*Ildobates neboti* Español, 1966	T	2	X	X	X	X
Insecta	Coleoptera	*Jekelius punctatolineatus* (François, 1904)	T	23	X	X		
Insecta	Coleoptera	*Meloe (Taphromeloe) foveolatus* Guérin de Méneville, 1842	T	2	X	X	X	X
Insecta	Coleoptera	*Mylabris uhagonii* Martínez Sáez, 1873	T	23	X	X		
Insecta	Coleoptera	*Ochthebius montesi* Ferro, 1983	F	8	X	X		
Insecta	Coleoptera	*Oresigenus jaspei* Jeannel, 1948	T	1	X	X		
Insecta	Coleoptera	*Otiorhynchus (Lixorrhynchus) torres-salai* Español, 1945	T	6	X	X		
Insecta	Coleoptera	*Paratriodonta alicantina* (Reitter, 1890)	T	11	X	X		X
Insecta	Coleoptera	*Scarabaeus (Scarabaeus) pius* (Illiger, 1803)	T	7	X	X	X	X
Insecta	Coleoptera	*Trechus detersus* Mateu, 1952	T	4				
Insecta	Dictyoptera	*Loboptera subterranea* Martín y Oromí, 1987	T	3	X	X		X
Insecta	Diptera	*Caliprobola speciosa* (Rossi,1790)	T	1	X	X		
Insecta	Diptera	*Rhyncomyia italica* Bezzi, 1911	T	3	X	X		
Insecta	Ephemeroptera	*Caenis nachoi* Alba-Tercedor y Zamora-Muñoz, 1993	F	3	X	X	X	X
Insecta	Ephemeroptera	*Prosopistoma pennigerum* (Müller, 1785)	F	12	X	X		
Insecta	Ephemeroptera	*Torleya nazarita* Alba-Tercedor y Derka 1993	F	2	X	X		
Insecta	Hymenoptera	*Bombus (Confusibombus) confusus* Schenck, 1861	T	8	X	X		
Insecta	Hymenoptera	*Bombus (Megabombus) reinigiellus* (Rasmont, 1983)	T	4				
Insecta	Hymenoptera	*Gonionma compressisquama* Tinaut, 1994	T	3	X	X	X	X
Insecta	Hymenoptera	*Mendacibombus (Mendacibombus) mendax* (Gerstaecker, 1869)	T	15				
Insecta	Hymenoptera	*Psithyrus (Fernaldaepsithyrus) flavidus* (Eversmann, 1852)	T	4				
Insecta	Hymenoptera	*Rossomyrmex minuchae* Tinaut, 1981	T	3	X	X		
Insecta	Lepidoptera	*Agriades zullichi* Hemming, 1933	T	8		X		
Insecta	Lepidoptera	*Agrotis yelai* Fibiger, 1990	T	8	X	X		
Insecta	Lepidoptera	*Eremopola (Eremochlaena) orana* (H. Lucas, 1894)	T	7	X	X		
Insecta	Lepidoptera	*Eremopola (Eremopola) lenis* (Staudinger, 1892)	T	18	X	X		
Insecta	Lepidoptera	*Lycaena helle* (Dennis & Schiffermüller, 1775)	T	2				
Insecta	Lepidoptera	*Polyommatus golgus* (Hübner, [1813])	T	2				
Insecta	Odonata	*Brachytron pratense* (Müller, 1764)	F	7	X	X		X
Insecta	Odonata	*Gomphus graslinii* Rambur, 1842	F	59				
Insecta	Odonata	*Leucorrhinia pectoralis* (Charpentier, 1825)	F	1	X	X		
Insecta	Odonata	*Lindenia tetraphylla* (Van der Linden, 1825)	F	2	X	X	X	X
Insecta	Odonata	*Macromia splendens* (Pictet, 1843)	F	50				
Insecta	Orthoptera	*Acrostira euphorbiae* García y Oromí, 1992	T	2	X	X		
Insecta	Orthoptera	*Arcyptera brevipennis* (Brunner von Wattenwyl, 1861)	T	7	X	X		
Insecta	Orthoptera	*Kurtharzia sulcata* (Bolivar, 1912)	T	6	X	X		
Insecta	Orthoptera	*Saga pedo* (Pallas, 1771)	T	21				
Insecta	Orthoptera	*Steropleurus squamiferus* (Bolívar, 1907)	T	2	X	X		X

Table 1. (*Continued*).

			PRs				N_{2000}	
Class	Order	Scientific name	*H*	*NC*	S	P_{POP}	S	P_{POP}
Insecta	Plecoptera	*Leuctra bidula* Aubert, 1962	F	3	X	X		
Insecta	Plecoptera	*Nemoura rifensis* Aubert, 1961	F	1				
Insecta	Plecoptera	*Protonemura gevi* Tierno de Figueroa y López-Rodríguez, 2010	F	1	X	X		
Bivalvia	Neotaenioglossa	*Alzoniella edmundi* Boeters, 1984	F	4	X	X		
Bivalvia	Neotaenioglossa	*Alzoniella galaica* Boeters y Rolán, 1988	F	2	X	X	X	X
Gastropoda	Neotaenioglossa	*Islamia lagari* (Altimira, 1960)	F	2	X	X	X	X
Gastropoda	Neotaenioglossa	*Melanopsis penchinati* Bourguignat, 1868	F	1	X	X	X	X
Gastropoda	Neotaenioglossa	*Spathogyna fezi* (Altimira, 1960)	F	2	X	X	X	X
Gastropoda	Neotaenioglossa	*Tarraconia rolani* Ramos, Arconada y Moreno, 2000	F	2	X	X	X	X
Gastropoda	Neotaenioglossa	*Tudorella mauretanica* (Draparnaud, 1805)	T	6	X	X	X	X
Gastropoda	Neritopsina	*Theodoxus boeticus* (Lamarck, 1822)	F	2	X	X	X	X
Gastropoda	Neritopsina	*Theodoxus valentinus* (Gräells, 1846)	F	2	X	X	X	X
Gastropoda	Neritopsina	*Theodoxus velascoi* (Gräells, 1846)	F	2	X	X	X	X
Gastropoda	Pulmonata	*Canariella eutropis* (Shuttleworth, 1860)	T	3		X		
Gastropoda	Pulmonata	*Cryptella susannae* Hutterer, 1990	T	3		X		
Gastropoda	Pulmonata	*Helicella gasulli* Ortiz de Zárate, 1950	T	3	X	X	X	X
Gastropoda	Pulmonata	*Helicella stiparum* (Rossmässler, 1854)	T	8	X	X		X
Gastropoda	Pulmonata	*Hemicycla paeteliana* (Shuttleworth, in Pfeiffer, 1859)	T	2	X	X		
Gastropoda	Pulmonata	*Hemicycla plicaria* (Lamarck, 1816)	T	2	X	X	X	X
Gastropoda	Pulmonata	*Hemicycla saulcyi saulcyi* (d'Orbigny, 1839)	T	1	X	X	X	X
Gastropoda	Pulmonata	*Iberus gualtierianus gualtierianus* (Linnaeus, 1758)	T	15	X	X		
Gastropoda	Pulmonata	*Napaeus isletae* Groh e Ibáñez, 1992	T	1	X	X	X	X
Gastropoda	Pulmonata	*Orculella (Orculella) bulgarica* (Hesse, 1915)	T	4	X	X	X	X
Gastropoda	Pulmonata	*Sculptiferussacia clausiliaeformis* Alonso e Ibáñez, 1992	T	2	X	X		
Gastropoda	Pulmonata	*Vertigo (Vertigo) moulinsiana* (Dupuy, 1849)	F	14				
Gastropoda	Pulmonata	*Vertigo (Vertilla) angustior* Jeffreys, 1830	F	5	X	X		
Gastropoda	Pulmonata	*Xerosecta (Xerosecta) adolfi* (Pfeiffer, 1854)	T	4	X	X	X	X
Gastropoda	Pulmonata	*Xerotricha bierzona* (Gittenberger y Manga, 1977)	T	2	X	X		
Gastropoda	Unionoida	*Margaritifera margaritifera* (Linné, 1758)	F	31	X	X		
Gastropoda	Unionoida	*Margaritifera auricularia* (Spengler, 1793)	F	24	X	X		

all the occurrence grid cells have at least 1% of their area as PRs and only a quarter of the cells have <25% of their area unprotected.

The number of species and P_{POP} represented in the two scenarios of protected areas (PRs and N_{2000}) vary depending on the area thresholds considered (Fig. 2). If having 50% of the cell area as a reserve is considered sufficient to guarantee effective protection, almost 68% of species and 32% of P_{POP} would be represented in the case of the larger N_{2000} reserve network (Table 1 and Fig. 3a). In contrast, 77% of species and 94% of P_{POP} are not represented in the current PRs network if the requirement is that at least 95% of each cell area belongs to a reserve to provide effective protection (Table 1 and Fig 3b).

Discussion

Former results based on vertebrate and plant data (Araújo *et al*., 2007) showed that in spite of the fact that existing protected areas in Spain reasonably represented terrestrial plant and animal species, more than 30 additional reserves would be necessary. Since then, some new protected areas have been recognised (Europarc-España, 2010) and this required number has decreased by half. However, this conservation effort still seems to be insufficient to guarantee the protection of terrestrial invertebrates. Spanish natural protected sites include around 12% of the total country area and the complete implementation of the Natura 2000 network of protected areas may mean increasing this percentage up to 28% (Europarc-España, 2010). However, it is only possible to represent most of the considered species and populations if we consider this wider and still unimplemented figure of protection, and we also accept that a very low proportion of reserve area in each cell is enough to protect invertebrate species. If we consider that obtaining effective protection requires, at least, that 20% of the cell area should be included within the Natura 2000 network of protected areas, then around 27% of endangered invertebrate species would not have any of their population represented within such cells. Furthermore and significantly, 40% of all possible endangered populations estimated by our simple procedure may remain within inadequately protected cells, which implies that 53% of total species (42 species) would have some populations unprotected. If our less demanding criteria is used (50% of cell area included as Natura 2000), then approximately a third part of the species

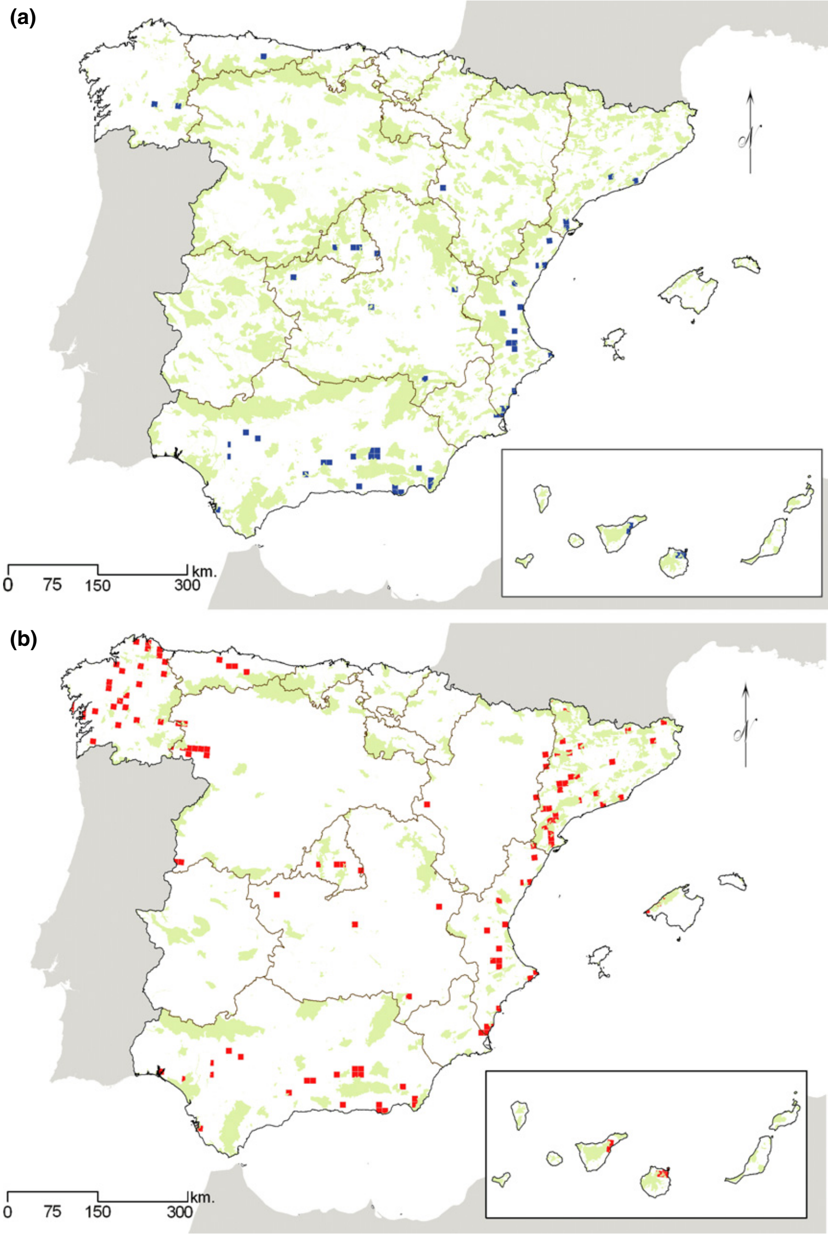

Fig. 3. Distribution of the Spanish critically endangered or endangered invertebrate species that (a) do not have any populations located in the 100 km^2 UTM cells with at least 50% of their area included within Natura 2000 network of protected areas; or (b) do not have at least 95% of their area included within extant protected reserves. Light green areas represent the corresponding protected areas.

and three-quarters of their populations would not be represented.

The Nature 2000 network of protected areas was designed to represent annex 1 habitat types and annex 2 species of the 92/43/ECC Council Directive; therefore, the information on invertebrates has been little considered in the application of this cornerstone of Europe's nature conservation policy. Rough estimates suggest that the Iberian Peninsula may host around 50 000 terrestrial invertebrate species (Ramos *et al*., 2001). What might happen if the information on these species were to be included in a reserve selection procedure? Unfortunately, invertebrate distribution information is biased and scarce (Leather *et al*., 2008; Diniz-Filho *et al*., 2010) and when available it is rarely included in the delimitation of natural reserves (Zamin *et al*., 2010). In this study, we examine the most exhaustive biological information on threatened invertebrate species existent up to now in Spain, which only includes the data of a minimum number of species (n = 79), recognised as such by a large number of taxonomists. Our results demonstrate that, in general, the protection capacity of current or future reserves delimited by standard procedures is not capable of representing the populations of this small set of endangered invertebrate species. Although the conservation of rare invertebrates may not be dependent solely on the establishment of protected areas, our results show that both current and future reserves may not be capable of protecting a large part of invertebrate biodiversity.

The restricted and threatened status of these species may push the establishment of a high number of new micro-reserves (Laguna, 2001; Laguna *et al*., 2004) to enhance their future persistence. From a practical point of view, it is possible to delimit the precise desired location of these micro-reserves, ranking them by considering reasonable criteria such as the number of species populations, the percentage of natural habitats, the distance to protected areas, or the public ownership of land. However, conservation planners and agents should be aware that the required number of protected areas may increase dramatically if information about vulnerable or endemic invertebrate species is included when these figures become available in the future. Currently only 0.7% of globally described invertebrate species have been evaluated according to IUCN criteria for endangered species status, this percentage being almost 50% in the case of vertebrates (IUCN, 2010). Thus, it would be expected that the progressive compilation of invertebrate data and their inclusion in conservation planning exercises would generate similar results to those provided by our study.

This situation shows the inconsistency of designing natural *sanctuaries* (Lobo, 2008), which are relatively protected from the influence of adverse human activities (Usher, 1991), while the remaining unprotected territory experience a high rate of land use change (Galante, 2005). Thus, if the existing conservation strategy based primarily on the protection of certain areas and vertebrate species appears to be insufficient to protect rare invertebrate species, it will be necessary to promote alternative conservation strategies that are compatible with economic development (Mascia *et al*., 2003). Ecosystems are dynamic structures that are rarely in a state of equilibrium, but rather are in a constant state of flux, and the species living in an ecosystem generally depends on the level of habitat conservation as well as the ability to colonise new areas based on dispersal rates. As a result, if we truly want to reduce extinction in the groups that represent most biological diversity, we really need to develop innovative conservation programmes (Hayward, 2009) based on scientific knowledge capable of incorporating the information of the most hyper-diverse groups. Atlases and red books should be important and dynamic tools to assist this process, by promoting the compilation of scattered distributional information available in bibliographical sources and natural history collections, but also by facilitating the continuous update of information on the distribution and conservation status of invertebrate species.

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