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The "Umbrella Effect" of the Natura 2000 network

An assessment of species inside and outside the European Natura 2000 protected area network

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CITATION: Lawrence Jones-Walters, Simon Gillings, Thomas Groen, Stephan Hennekens, David Noble, Luca Santini, Henk Sierdsema, Andre van Kleunen, Chris van Swaay and Theo van der Sluis (2016) *The "Umbrella Effect" of the Natura 2000 network: An assessment of species inside and outside the European Natura 2000 protected area network.* Wageningen, Alterra Wageningen UR (University & Research centre), Alterra report XXXX. ?? blz.; ? fig.; ? tab.; ?? ref.

This executive summary presents the main finding of a research consortium consisting of 6 organisations. The full detail of the study is found in the background report: 'How much biodiversity is in Natura 2000?' (2016). Theo van der Sluis, Simon Gillings, Thomas Groen, Stephan Hennekens, Andre van Kleunen, Luca Santini, Henk Sierdsema, Chris Van Swaay and Lawrence Jones-Walters. Alterra Report no. xx, Wageningen, The Netherlands.

This research was funded by Directorate General-Environment (Study contract number ENV.B.3/ETU/2014/0019)

Alterra Wageningen UR, Wageningen, April 2016

Alterra report XXXX

Keywords: biodiversity, Natura 2000, Habitats Directive, Birds Directive etc.

Alterra report XXXX | ISSN XXXX-XXXX

Cover photographs (clockwise from top left): Sand Lizard (*Lacerta agilis*) photographer Fabrice Ottburg; Wild boar (*Sus scrofa*) photographer Nathan Ranc; Violet Copper (*Lycaena helle*) photographer Chris van Swaay; Longtailed Duck (Clangula hyemalis) photographer Edmund Fellowes; centre - habitat of the butterfly *Euchloe bazae* in the Hoya de Baza, photographer Chris van Swaay.

1. Introduction/background/context

Natura 2000

Natura 2000 is a network of protected areas that now covers around 18% of the land surface of the European Union. These sites are designated under the Birds and Habitats Directives and the network includes both terrestrial and marine sites (Marine Protected Areas, MPAs). The ultimate goal of the two 'Nature Directives' is to ensure the long-term sustainability of more than 230 habitats and 1,500 species of animals and plants of 'Community Interest' and all bird species naturally occurring in the EU (fig. 1). The ecological condition delivering such long-term sustainability is known as 'favourable conservation status' (FCS).

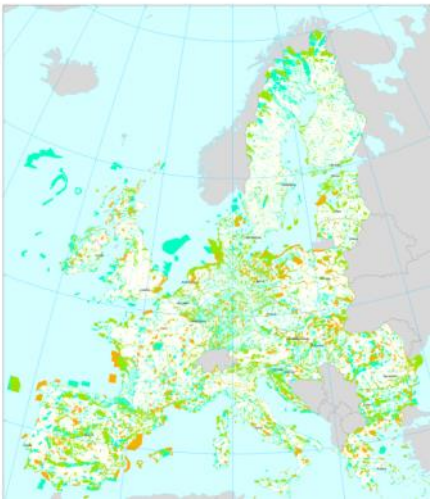


Figure 1: The Natura 2000 network for the EU-28, which comprises the areas of the Birds Directive (SPAs, orange) and Habitats Directive (SCI, SAC, blue-green) or both (green). EEA 2014

In May 2015 the Commission published the report *The State of Nature in the European Union* an evidence base which sets out the status of and trends for habitat types and species covered by the Birds and Habitats Directives for the period 2007-2012. The report, which is based on information reported by 27 Member States, provides a basis for formally judging the success of the nature directives in relation to their original goals.

Exploring the umbrella effect

The *State of Nature* report does not show the wider contribution of Natura 2000 to the conservation of species that are not listed in the annexes to the Directives. The need to understand this contribution is driven by a general inquiry into the effectiveness of the Nature Directives and the EU strategic target, expressed within the Biodiversity Strategy to 2020, to "halt the deterioration of all species and habitats and achieve a significant and measurable improvement in their status…." It focusses in particular on the functionality of the Natura 2000 network in Europe as a key prerequisite for conserving biodiversity. In 2013 the European Commission therefore initiated a research project to assess the significance of the presumed "umbrella effect" of Natura 2000, related to its potential contribution in terms of halting and reversing the loss of species other than those for which the Natura 2000 sites have been set-up.

2. Key research questions and approach

The research was focussed on terrestrial habitats and, in order to provide a specific investigation of the umbrella effect of Natura 2000, it addressed the general question of: *"How much biodiversity is covered by Natura 2000?"*, which was further specified as follows*:*

- *Which are, amongst the species regularly occurring within the European territory of the EU-28 Member States (common species), those that significantly benefit from the Natura 2000-related site conservation requirements under the EU Birds and Habitats Directive?*
- *What is e.g. in percentage of all species occurring in the wild in the EU, the share of EU species significantly benefitting from Natura 2000?*
- *How significant is this contribution of Natura 2000 in relation to the objective of halting and reversing biodiversity loss?*

Key considerations were the spatial distribution, the geographical range[1] of species within the EU-28 countries[2], and the presence of species within Natura 2000 and outside the network. The presence can be expressed in the form of a simple figure or percentage of the distribution of a species within Natura 2000.

[1] 'Range' refers to the overall geographical envelope within the EU territory and 'distribution' is the spatial occurrence within the envelope.

[2] Some specific areas that do not form a coherent part of the EU territory were excluded because from biogeographical point of view they belong to a different zone or data was not available. These included the Macaronesian Islands, some Spanish enclaves on the African mainland and, for the birds, reptiles and amphibians, Cyprus.

Specific consideration was given to species which are not included in the annexes of either directive (i.e. species other than those for which areas were designated). However, in all cases the conservation value of species was assessed based on their position on Red Lists and status as endemics. The study was accompanied by a literature review that provided context in relation to the research questions.

The approach used existing data, for as many groups as possible and covered the plants, (terrestrial) mammal, bird, reptile, amphibian and butterfly species. The analysis is mostly based on GIS processing of species distribution data in relation to their presence within protected areas of the Natura 2000 network. Statistical distribution models were used as a cross-validation tool. Figure 2 shows the basic analytical framework used in the assessment.

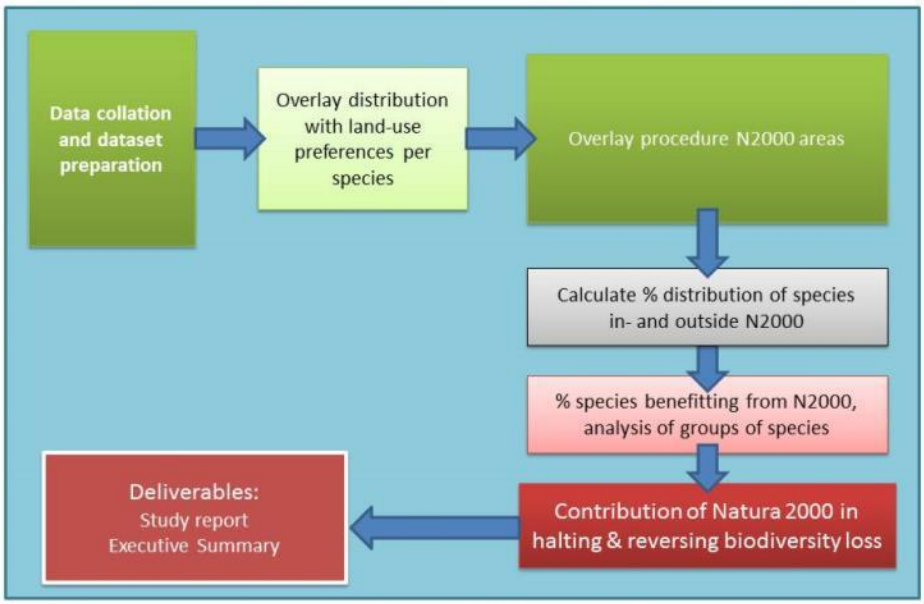


Figure 2: Analytical framework of the assessment

The taxonomic groups differed in relation to the available data (some groups are recorded better than others), as well as within groups (some countries are better investigated than others), in some cases markedly. Available data may consist of atlas data or observation data[3]. Variation in data availability and quality among and within taxonomic groups critically determined the analytical approaches used. The general approach for the analysis was based on habitat masking of 50 by 50 km data with CLC or GLC data (except for plants, see below). The robustness of the results provided by the general approach was validated by applying models at finer resolutions, and with a different approach. This was carried out first at 5 km by 5 km for the whole of Europe and for specific countries, with more detailed data, at the scale of 1 km by 1 km (Table 1).

Table 1: Scale levels for the different taxa that the analysis was performed at.

Taxa	50x50 km	5x5 km	2x2 km	1x1 km
Plants			×	
Mammals	×	×		
Birds	×	×		×
Reptiles and amphibians	×	×		×
Butterflies	×	×		

In relation to the question of 'significant beneficial effect', 18% of Europe's land surface is Natura 2000. With a totally random distribution of species over the EU, it would therefore be expected that 18% of them would occur in Natura 2000. However, if the distribution of species is more than 18% in Natura 2000 (or less), this can provide the basis for considering if a benefit is being provided or whether some other effect may be being observed. 18% also provides an easily communicated baseline for judging the benefits provided by Natura 2000 to common species in the EU. For the consideration of individual countries their specific figure for Natura 2000 coverage was used as the baseline.

There is also a potential for sampling bias (because species presence data are collected on an opportunistic basis and there may be more collection of species records within Natura 2000). A spatial

[3] Available data can consist of atlas data or observation data: atlas data is published data on presence and absence of a species, while observational data is normally observation data which are compiled in databases, or sometimes papers and reports, with x and y locations of presences. This implies that absence data is lacking, but data has often higher spatial accuracy.

bias correction technique was therefore applied; this allowed for a reduction of the error by predicting a high probability of presence where many presence data are available, and predicting low probability of presence where presence data are unavailable (but the species could be present).

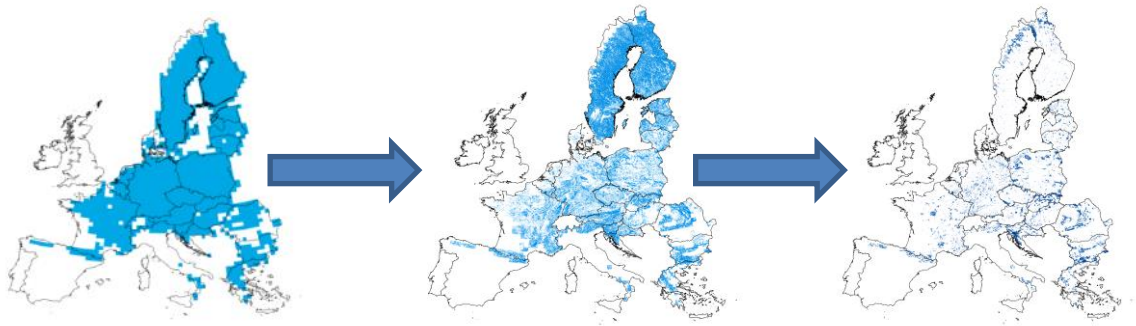
3. Analysis

The research questions for the analysed species of this study should ideally be answered based on real data of species occurrence inside Natura 2000. However this data is not available for all species and the entire territory of the EU-28. A robust approach was therefore developed to assess the importance of Natura 2000 areas for the species, given the available species distribution data.

*Figure 3: The Alpine Ibex (*Capra ibex*) is considered Least Concern by the European Red List. Its distribution covers 0.4% of European territories and 38.4% of its distribution is protected by Natura 2000. (Photographer Nathan Ranc)*

'Habitat masking' was carried out to estimate the fine-scale spatial distribution of available habitat within each 50×50 km cell occupied by a species. Species-specific habitat masks were made by assigning species to Corine Land Cover (CLC) habitats - Level 3 (CLC-3) or the Global Land Cover (GLC) map. The CLC-3 map is based on 2012 Remote Sensing data (Greece: 2006 data), (EEA 2013) and is available for the EU-territory with the exception of The Azores and Madeira. Geographical ranges for mammals were refined using habitat suitability models in Rondinini et al. (2011). Next an overlay was made between the species' 50×50 km distribution maps (fig. 4A) and the CLC types, resulting in maps showing apparently suitable CLC types within the species known range for the EU-28 (fig. 4B). These 'masked' distribution maps were validated by experts. This validation revealed some limitations of the CLC map. In general the land cover types distinguished in Corine do not adequately differentiate among habitat types occupied and unoccupied. Furthermore the Corine map seems too coarse: in particular small land cover features are absent or underrepresented in the land cover data sets, for instance: streams, small rivers, small lakes, fens and open areas in forests. Habitat masked maps that were obviously incomplete or incorrect were excluded from further analysis; for the breeding birds 44 species (which are searchable in the data tables associated with the project technical report) were therefore excluded due to the unsuitability of the CLC information and 7 additional island endemic species were simply not covered by CLC.

The extent of a species' distribution in and outside Natura 2000 was then estimated based on combined atlas data and potentially suitable habitat, derived from CLC data (fig. 4C).



A: 50×50 km distribution *B: habitat masking* *C: habitat within Natura 2000*

*Figure 4A: An example of the habitat masking process as applied to the Black Woodpecker (*Dryocopus martius*).The observed distribution of a species. Fig. 4B: after selection of suitable habitat based on CLC-3 or GLC the area is refined 4C: after an intersection of habitat with the Natura 2000 map (EEA 2015) we derive at the distribution map of habitat in Natura 2000.*

Two approaches were then followed to model species distribution, the approach chosen was based on the available data and modelling results:

1. Based on the 50×50 km distribution data from the species atlas. These were downscaled to 5×5 km cells using spatial regression modelling techniques, taking into account aspects like: soil and climate data, forest management, nitrogen and sulphur deposition and the CLC types, and GLC maps. This resulted in modelled species distribution maps at the 5x5 km scale.
2. Based on species observations available from different NGOs, or data submitted to the web portals, country counting data and EU Bird Directive reporting 2008–2012 10×10 km distribution maps (www.eea.eu) spatial models were built to compile distribution maps. Also here soil and climate data, forest management, nitrogen deposition and the CLC types and GLC maps were used to improve the models.

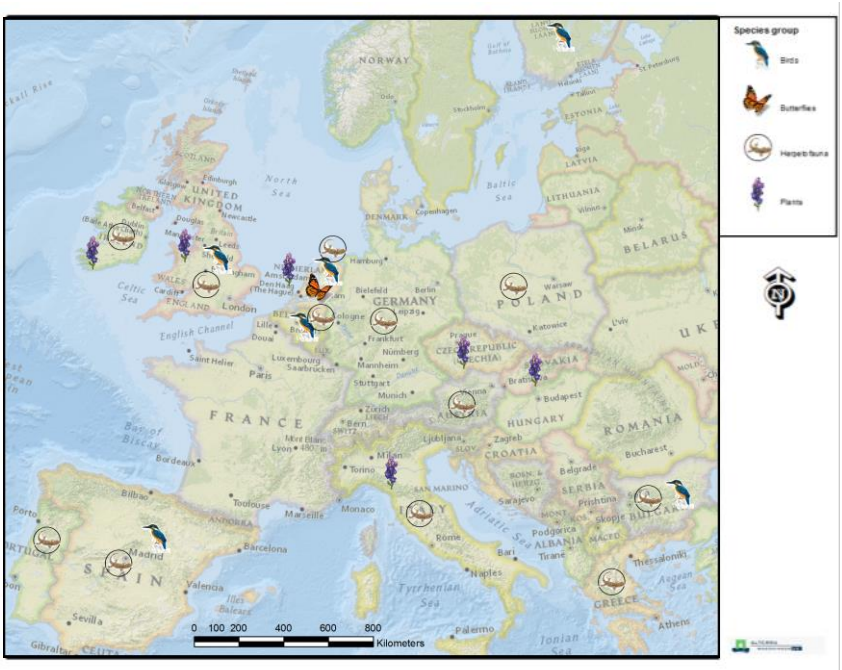


Figure 5: Countries for which detailed distribution modelling was done

Detailed distribution atlas projects in European countries, with distribution data at relatively fine scale (e.g. 5×5 km or 10×10 km) was used specifically to ground-truth estimates of species coverage by the Natura 2000 network. Such data was used for birds, mammals, reptiles and amphibians and butterflies.

The approach for the plants was different. To assess what the importance is of the Natura 2000 network for plant biodiversity in Europe the vegetation data stored in European Vegetation Archive EVA was used. The EVA database currently contains 1,122,134 vegetation plots, comprising 25,069,904 species recordings. The assessment was restricted to vascular plants which are better represented in the database than cryptogams. Altogether 779,635 vegetation plots are georeferenced and located in EU-28 countries, representing 395,499 unique locations. These unique locations in EU-28 countries have been assigned to 107,730 unique 2x2 km grid[4] cells, of which 52,695 grid cells are located within Natura 2000 sites and 55,035 grid cells outside Natura 2000 sites.

[4] The grid size of 2x2km has been chosen because of the uncertainty of the location precision of the plots. With a grid size of 1x1 km too many plots would have been excluded.

*Figure 6: Yellow lady's slipper (*Cypripedium calceolus*)*

The analysis was restricted to the rare and diagnostic plant species, which are those plant species that are listed in European Red List of vascular plants of the IUCN, and a number of national Red Lists. Criteria for selecting national Red List species were the availability of national Red Lists of vascular plants in digital form, as well as the availability of sufficient well located plot data in the vegetation database at national levels. Species indicated as 'Least Concern' (LC) were excluded from the analysis, as well as species from the Annex II list. The rule for LC species was applied to all Red lists including the IUCN list; practically it was a problem to include these species because of the scale of the analysis that would then have been required. The Annex II species were excluded as they have contributed to the designation of Natura 2000 sites. In general the Red Lists contain few Annex II species (with the exception of the IUCN European Red List of vascular plants). Even after having excluded LC and Annex II, 513 species remained for the analysis. Common species were subjected to a separate analysis.

A list of around 500 European orchid species was also compiled on the basis of EVA and a list of species diagnostic for 40 Annex I habitat types, representing habitats which are in most cases widely distributed in Europe. Orchid species are selected because they capture the interest of many people, but also because these species often occur in vulnerable habitats.

Within each species group the number of species was counted in random selected grid cells, inside and outside Natura 2000 sites. Based on these random selections, the ratio was defined for the selected species inside and outside Natura 2000 sites. For the first two groups (Red List of European vascular plants and orchid species), the number of random selected grid cells was set to 5,000 inside and 5,000 outside Natura 2000 sites. For the analyses on national level the number of random selected grid cells was set to 500 (500 grid cells inside and 500 grid cells outside), since the selections were only performed on the country specific grid cells. Within each group, a grid cell was selected only once.

4. Results

The combined results for the different animal groups are shown below. The plants are presented separately. Figure 7 shows that (based on the 18% baseline):

- All species groups benefit above what could be expected based on a random distribution – so that more than 18% of their distribution occurs in Natura 2000
- Species for which Natura 2000 areas were not specifically designated (non-annex species) do benefit from the Natura 2000 network
- The species of the annexes benefit more than the 'other' species; this is in particular the case for birds and butterflies, for reptiles and amphibians the difference is negligible.

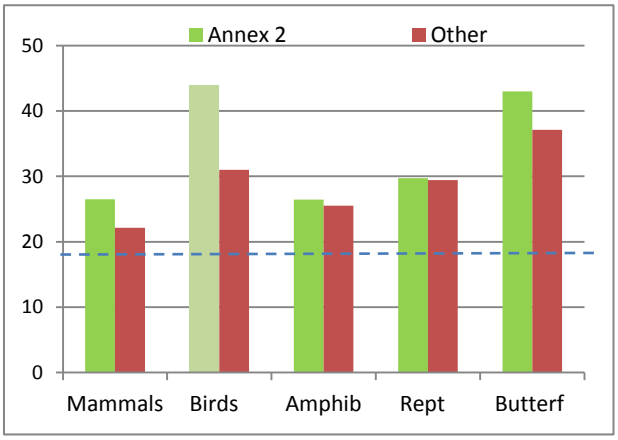


Figure 7: Average share of the occurrence of annex versus non-annex species occurring inside Natura 2000 areas in the EU-28 countries. Results are based on masking analysis. Note: bird species are Annex 1. Striped line indicates the 18% baseline for Natura 2000.

To assess the extent to which species benefit from the Natura 2000 network it was determined whether the share of species distribution within Natura 2000 exceeds the share of Natura 2000 within a country (fig. 8). The territory of Natura 2000 differs a lot for all countries, from 8% in the UK to almost 38% in Slovenia. Figure 7 shows that in particular the butterfly species have a relatively high presence within the Natura 2000 network. This illustrates that most habitats for butterfly species are within the Natura 2000 network. In fact, limited

populations and species still survive in the surrounding habitats, due to intensive land use and farming practices, as has been reported in the literature. Also mammal, amphibian and reptile species show a larger presence within the Natura 2000 network. Bird species demonstrate a pattern which resembles very much the share of Natura 2000 in the countries, except for Sweden which has a relatively high share, and Slovakia with a small share of birds in Natura 2000. Cyprus and Malta have relatively low shares of most faunal groups within Natura 2000.

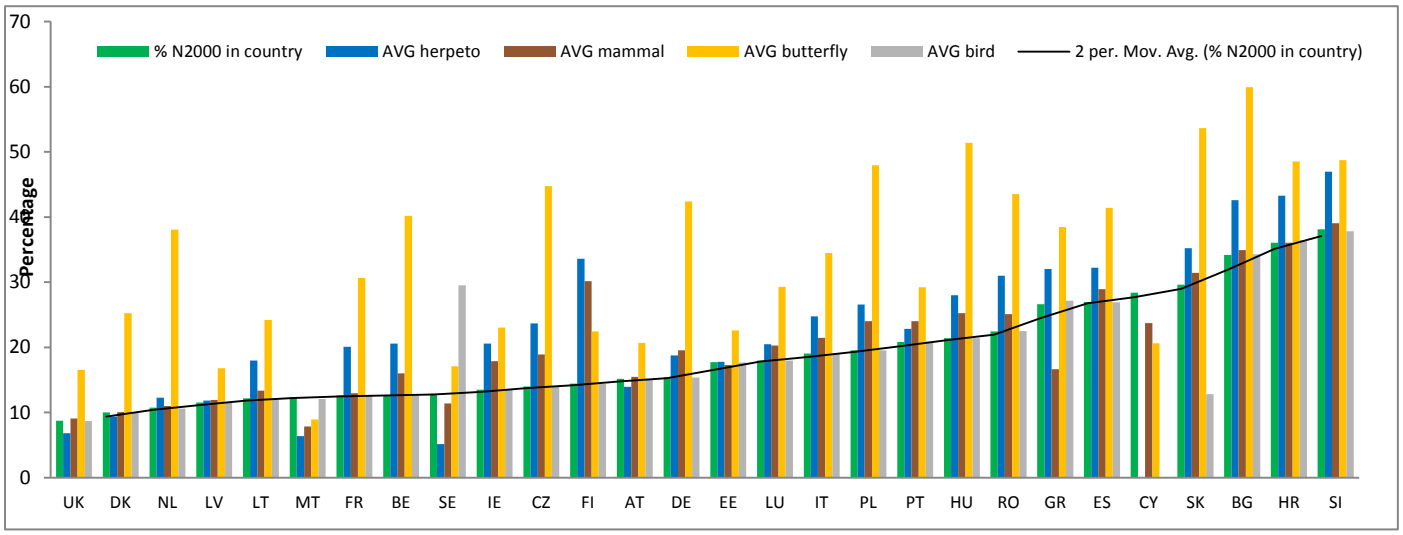


Figure 8: The average share of the occurrence of species inside Natura 2000 areas in the EU-28 countries for mammals, birds, reptiles and amphibians and butterflies.

The presence of threatened species (Red List species) in and outside Natura 2000 (fig. 9) was compared.

- The analysis shows that for all species groups a relatively large share of Red List species occurs within the Natura 2000 network
- The threatened species benefit more than the not threatened species, mostly 35-40% are found within Natura 2000
- Not evaluated species (i.e. species classified as 'data deficient', or 'not evaluated')have significantly lower presence in Natura 2000
- Threatened birds, reptiles and butterflies in particular benefit from Natura 2000 areas

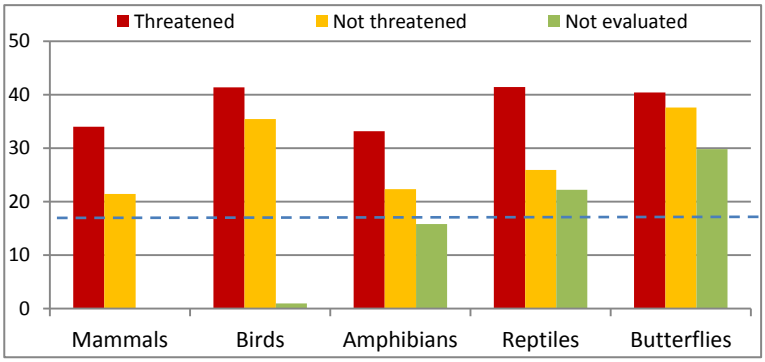


Figure 9: Average share of the occurrence of threatened, non-threatened and not evaluated species occurring inside Natura 2000 areas in the EU-28 countries based on the European Red Lists. Threatened=CR, EN and VU.

Bird endemism at species level in the EU is very low and most are found in the Macaronesian islands which were, in any case, excluded from all the analyses carried out for this research. Birds are therefore not included in the results for endemic species (fig. 10) where for the other groups it was found that:

- The presence of endemic species seems consistently higher in Natura 2000
- Endemic and non-endemic reptile species are evenly distributed regarding Natura 2000
- Endemics and non-endemics of all species groups have a relatively large presence in Natura 2000 in relation to the 18% baseline.

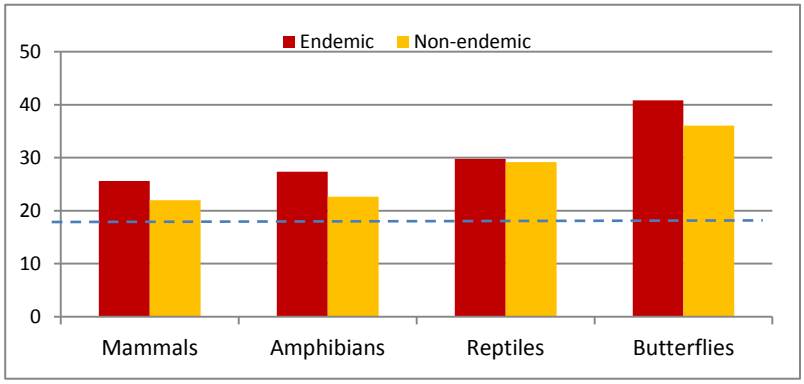


Figure 10: Average share of the occurrence of endemic versus non-endemic species occurring inside Natura 2000 areas in the EU-28 countries.

Figure 11 shows an index of species presence within Natura 2000 areas. The calculation was based on the presence of species relative to the share of Natura 2000 in a country. If species presence conforms to the share of Natura 2000, the value will be 100; the value will exceed the value of 100 for any country with higher species presence in Natura 2000. It also illustrates the relatively small share of species inside Natura 2000 on Cyprus and Malta and in Greece.

The approach for plants differed due to the different resource base (EVA), which consists of a large dataset of observations. Even though the data covers a large part of Europe, it is by no means comparable to systematically collected atlas data like that for the animal groups. Furthermore not all countries are evenly represented in the database.

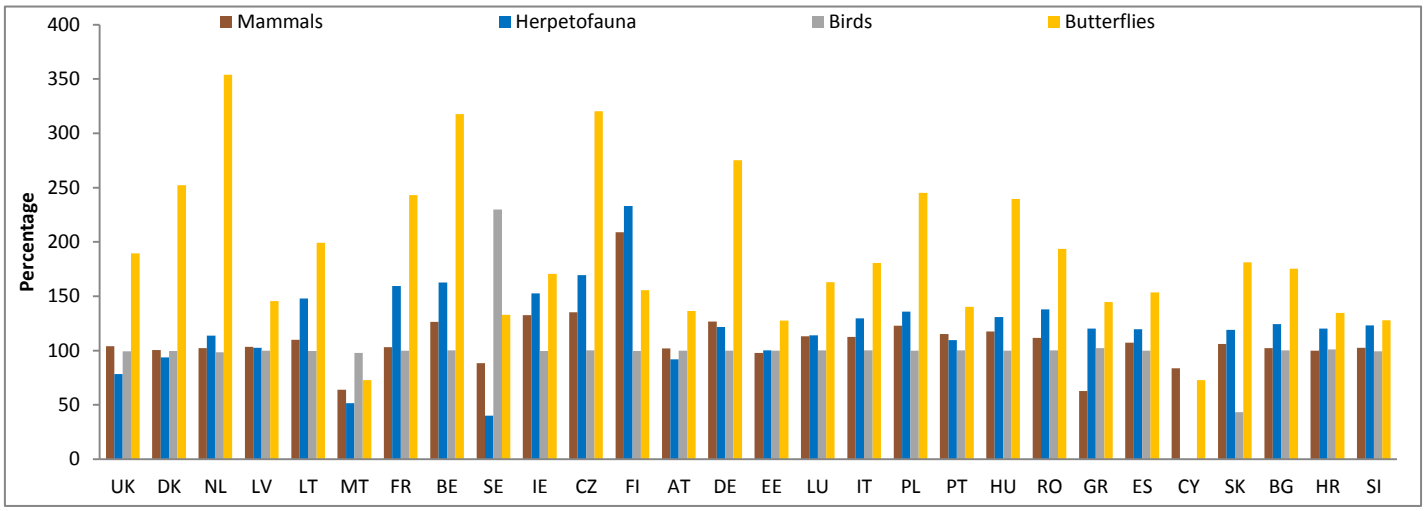


Figure 11: An index of species presence within Natura 2000 areas: calculated as species presence / proportion of Natura 2000 in a country. If species presence conforms with the proportion of Natura 2000, the value will be 100, for countries with higher species presence in Natura 2000, species groups will therefore exceed the value of 100.

Overall Red List based analysis

Figure 12 clearly shows that Red List[5] plant species and Orchid species are more likely to be found (more than 50%) in Natura 2000 sites than outside these sites. The group of Orchid species would probably show a bigger difference between inside and outside Natura 2000 if the more common species such as *Listera ovata* and *Epipactis helleborine* would have been excluded.

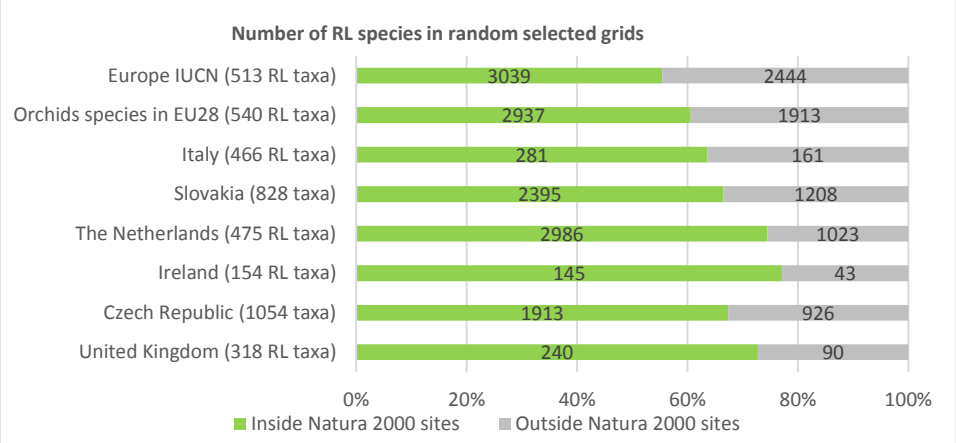


Figure 12: Number of Red List plant species in random selected grid cells in and outside Natura 2000 sites. Annex II species are excluded from the analysis.

Hot spot analysis

Plant hotspots were calculated inside and outside Natura 2000 areas. A hotspot is defined as a 2x2 km grid cell with a minimum of 5 different Red List (or Orchid) species. The counting was performed on the

[5] The IUCN species cover 3 specific groups (aquatic plants, crop-wild relatives and species that are already covered by international policies) and are therefore not fully representative for overall biodiversity and may not be good indicators for this kind of analysis. However, the IUCN list does have an important status and was therefore included rather than omitted.

basis of 2,500 unique random selected grid cells at European level, and 250 random selected grid cells at national levels. This procedure was repeated 500 times to obtain a statistically reliable result. The graphs below clearly show that hot spots are more likely to be found inside than outside Natura 2000 sites (figs. 13 and 14). The differences between inside and outside Natura 2000 sites are less notable when the minimum number of 'hot-spot species' is set to a low value, and more obvious when increasing the minimum number of species per grid cell.

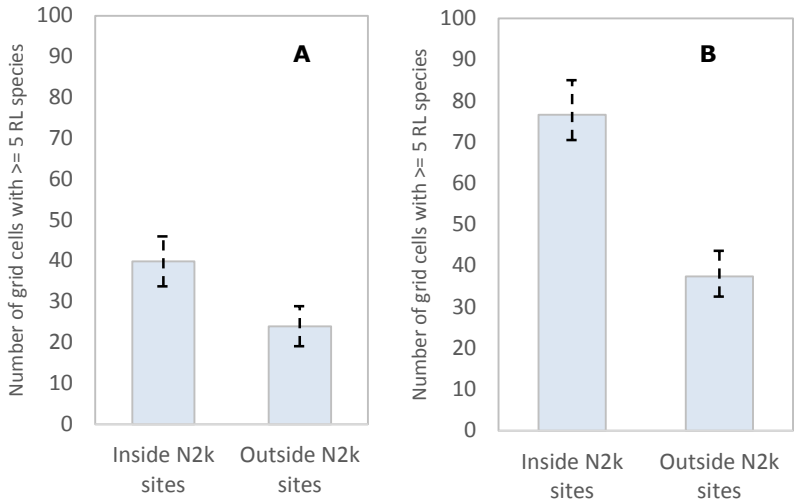


Figure 13. A: Hotspots European Red list species IUCN. B: Hotspots European orchid species. Based on 2500x2500 random sampled grids in- and outside Natura2000 sites.

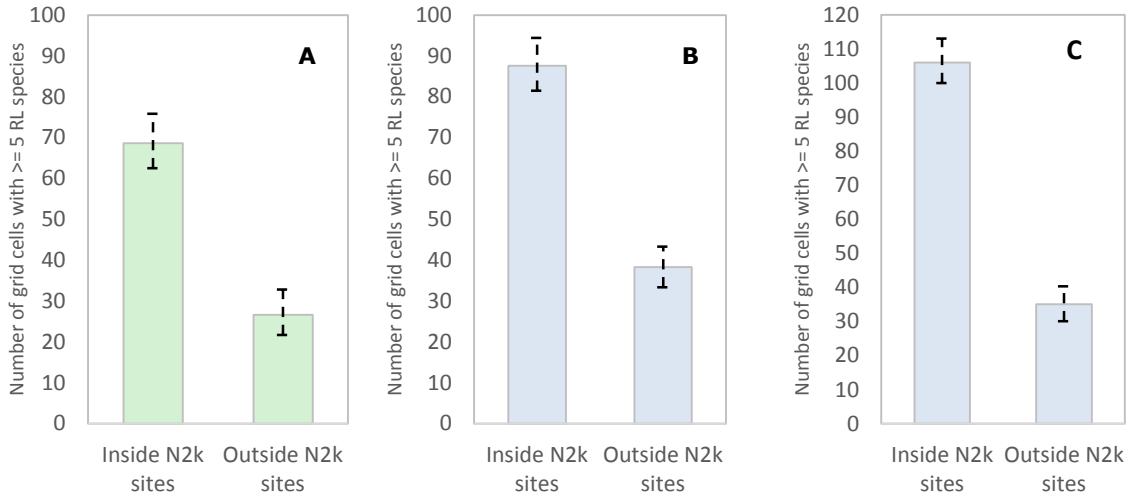


Figure 14. Hotspots in the Czech Republic (A), Slovakia (B) and the Netherlands (C). Based on 250x250 random sampled grids in- and outside Natura2000 sites.

Common Plant Species

We also examined the distribution of 300 most commonly occurring species in the database in relation to their occurrence inside and outside Natura 2000 sites (fig. 15). The minimum number of the selected common species per grid cell (2x2 km) was set to 25 to assign a cell as hotspot. Figure 14 clearly shows that even though there are slightly more grids that meet the criterion outside rather than inside Natura 2000 sites, common species are more or less equally distributed inside and outside Natura 2000 sites.

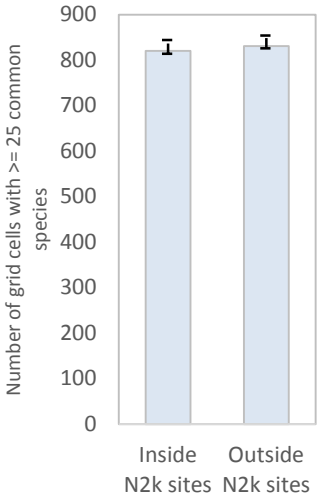


Figure 15: Common plants present inside and outside Natura2000. Based on 250x250 random sampled grids.

Figure 16: Intensive agriculture leaves little room for even common plant and animal species in particular butterflies (Photographer Chris van Swaay)

Buffer zone analysis

To gain insight into the biodiversity in the area immediately adjacent to the Natura 2000 sites, a buffer of 500 meters around all Natura 2000 sites was incorporated into a further analysis. This was carried out for the Czech Republic, Slovakia and The Netherlands and the results are shown in figure 17. The figures for the three countries show that the number of hotspots in the buffer zones was between the numbers inside and outside Natura 2000 sites. This means that – at least for the countries concerned – the biodiversity just outside Natura 2000 sites may not be as important as the biodiversity inside the sites, but is still higher compared with areas further away from the sites. There can be various reasons for this, such as better site conditions, less environmental pressure, previous history of land use and management or the presence of nearby seed sources.

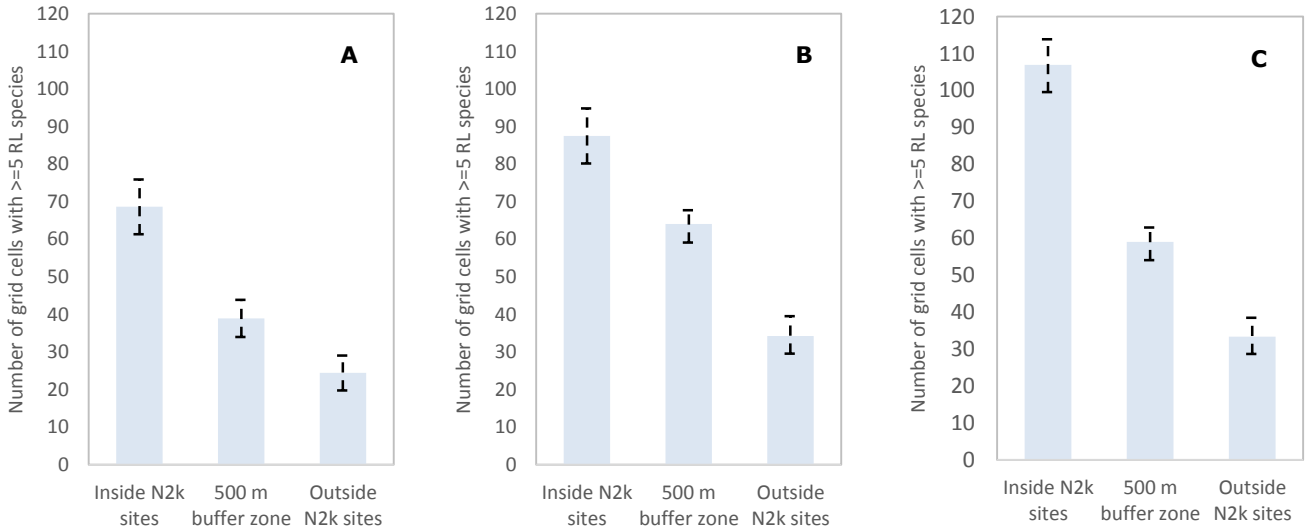


Figure 17: Hotspots in the Czech Republic (A) and Hotspots Slovakia (B) and The Netherlands (C). Based on 250x250 random sampled grids in Natura2000 sites, in a 500 m buffer zone, and outside Natura2000 sites

Biogeographical Regions

Figure 18 shows the presence of species in Natura 2000 in relation to the Biogeographical regions for all of the animal species groups The Black Sea and Alpine biogeographical regions are where the greatest percentage of species is present within Natura 2000. Species in the Atlantic and Boreal regions have the lowest percentage presence within Natura 2000, in particular for mammal species and reptiles and amphibians; for Boreal species four of the five groups fall below the baseline of 18%. This is partly a product of the relatively small numbers of species in these regions; thus for the reptiles and amphibians in the Boreal region only 2 species were considered (the adder *Vipera berus*, and the common lizard *Zootoca vivipara*) which are both rather common and have a wide distribution. Bird and butterfly species are consistently better represented within Natura 2000 in almost all biogeographical regions. For the butterflies this reflects that the main occurrence of their preferred habitats is nowadays within Natura 2000.

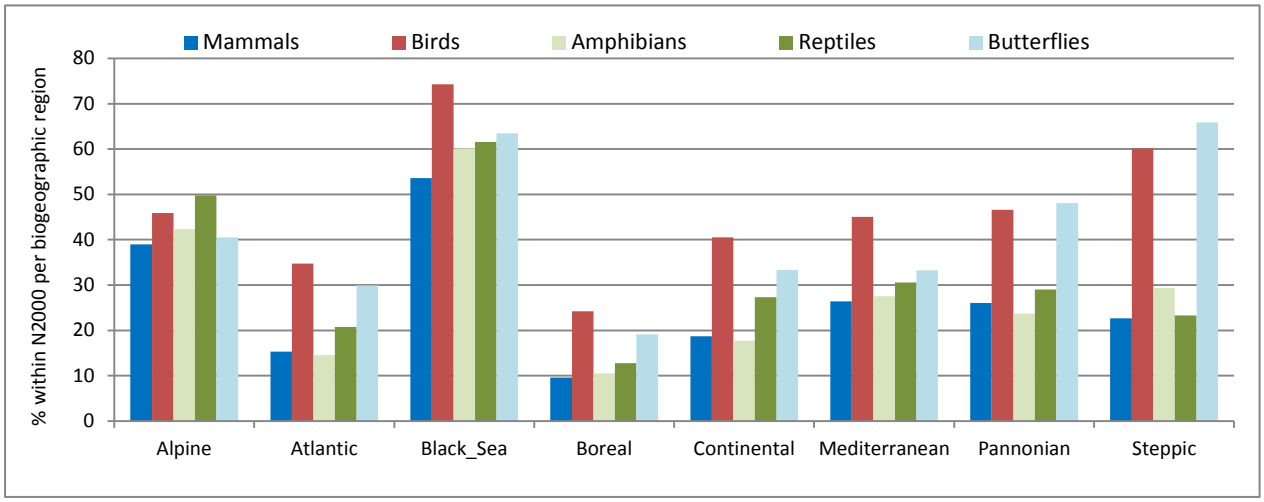


Figure 18: Presence of species in relation to the Biogeographical regions for all the animal species groups.

An analysis was also carried out for the presence of plant species hot spots within Natura 2000 in four biogeographical regions. The results show a greater presence of Red list species (fig. 19a) inside Natura 2000, which is a general trend for all regions but in particular for the Atlantic and Continental. Red list plant species hotspots have their highest presence in the Natura 2000 sites within the Continental biogeographical region, whilst in the Mediterranean their presence in Natura 2000 is comparatively low, but still with more hotspots inside than outside.

For Orchids, the Alpine biogeographical region is particularly important (fig. 19b). In the Mediterranean region there are more orchid species outside Natura 2000 as a proportion of those inside Natura 2000, when compared to other regions. In general Orchid species, require open areas that are not or less densely vegetated. In this region their specialised habitat requirements may occur more commonly outside Natura 2000.

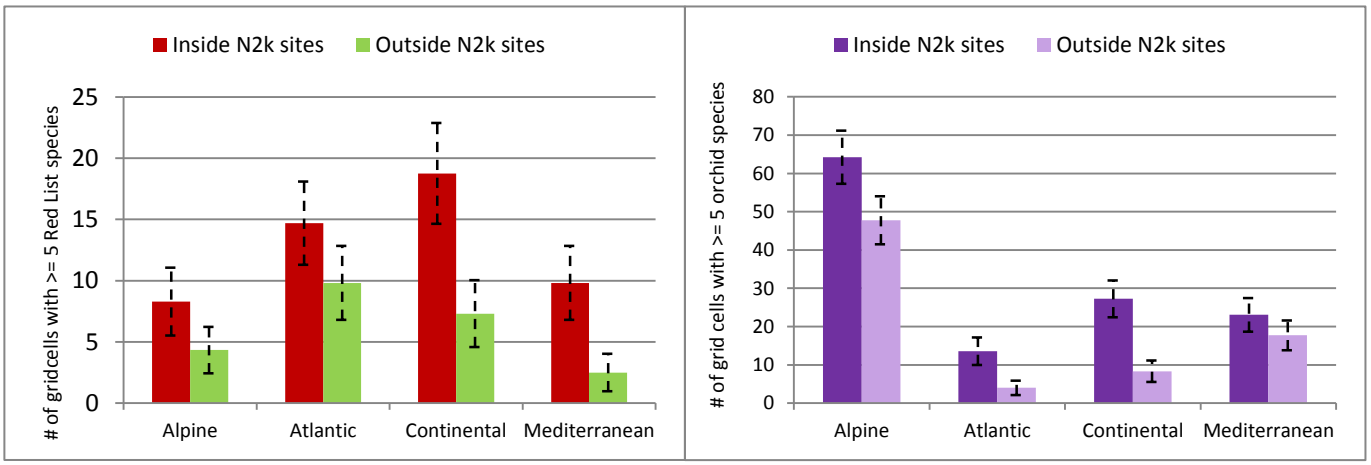


Figure 19a: Presence of plant species (Red List) hot spots and 19b: Orchid species hot spots in relation to the Biogeographical regions.

5. Conclusions

General Conclusions

In summary for the animal groups:

- *A greater number of common animal species and other 'non-Annex' animal species occur inside Natura 2000 than outside (in particular breeding birds and butterflies).*
- *Animal species for which Natura 2000 areas were not specifically designated (non-annex species) do, therefore, gain benefit from the Natura 2000 network.*
- *The species of the annexes benefit more (that is, generally occur more frequently within the Natura 2000 site boundaries) than the 'other' species; this is in particular the case for birds and butterflies, for amphibians and reptiles the difference is negligible.*

*Figure 20: Goldcrest (*Regulus regulus*) is a relatively tiny warbler characteristic of coniferous woodland whose widespread distribution is under-represented by the Natura 2000 network. (Photographer Jill Pakenham).*

The combined results for the different animal groups show that all species groups benefit more than might be expected based on the terrestrial coverage of Natura 2000. More specifically, 18% of the land area of the Member States is covered by Natura 2000 sites; if species were randomly distributed then it would be likely that 18% of their distribution would fall within the Natura 2000 site boundaries. As it is, for every animal group, a greater proportion of the species that are not the reason for the designation of the sites (the common species and other 'non-Annex' species) occur inside Natura 2000 than outside. Species for which Natura 2000 areas were not specifically designated (non-annex species) do, therefore, gain benefit from the Natura 2000 network. In addition, the Annex-listed species for which the Natura 2000 sites are designated also generally occur more frequently within the site boundaries[6], in particular for birds and butterflies. Natura 2000 sites do not only therefore serve their purpose in protecting the Annex 1 (Birds Directive) and Annex 2 (Habitats Directive) species but also provide significant added value to non-Annex species. The reasons for this are evident in the results for the individual animal groups, in particular the birds and butterflies, and these are all discussed below.

Birds

Table 2 shows the bird species that benefit most highly from Natura 2000, showing consistently more than twice as high relative percentage distribution within Natura 2000 than expected.

Table 2: Bird species which benefit in particular from Natura 2000

Species	Annex 1	EU Red List	Habitat
Clangula hyemalis		VU	coastal/marine
Gypaetus barbatus	x	VU	open natural habitat
Falco rusticolus	x	VU	open natural habitat
Lagopus mutus		VU	open natural habitat
Charadrius morinellus	x	LC	open natural habitat
Calidris maritima		NT	open natural habitat
Limosa lapponica	x	LC	marshlands/wetlands
Stercorarius longicaudus		LC	open natural habitat
Larus genei	x	LC	marshlands/wetlands
Eremophila alpestris		NT	open natural habitat
Anthus cervinus		NE	marshlands/wetlands
Prunella collaris		LC	open natural habitat
Monticola saxatilis		LC	open natural habitat
Pyrrhocorax graculus		LC	open natural habitat
Calcarius lapponicus		NT	marshlands/wetlands
Plectrophenax nivalis		LC	open natural habitat

[6] A small number of Annex II species provide notable exceptions to this rule, listed and explored in more detail in the full technical report.

The species in table 2 are associated with habitats for which the best examples (the most characteristic, complete and, often, the largest) are mostly now found in Natura 2000 sites (in particular mountainous areas and wetlands).

However, the converse is true for a number of other bird species that have a relatively limited percentage distribution within Natura 2000 areas. Using the 18% baseline, it can be seen in table 3 that Annex 1 forest species are underrepresented. In many cases these are boreal species. This reflects the fact that large areas of boreal forest habitat of sufficient quality to support these species occur outside Natura 2000 and further indicates that, with the exception of forest habitat, much of the 'better' habitat for birds is within Natura 2000 (for Annex and non-Annex species).

*Figure 21: Skylark (*Alauda arvensis*) is a widespread species of farmland and cultivated land not well represented in Natura 2000*

Species such as the Corncrake (*Crex crex*), Eurasian Skylark (*Alauda arvensis*), Northen Lapwing (*Vanellus vanellus*) and Common Quail (*Coturnix coturnix*) are characteristic of open country but also show a strong association with cultivated land, particularly crops, for breeding and foraging. Populations of these species are under-represented because this relatively intensively managed habitat is widespread over large parts of Europe but poorly covered by the Natura 2000 network. These species are still widespread but suffering significant declines from agricultural intensification (which reflects the fact that they are Vulnerable – whereas the forest species are mainly Least Concern).

Table 3: Bird species which are underrepresented in Natura 2000

Species name	Annex1	EU Red List	Habitat
Circus cyaneus	x	LC	semi-natural open+farmland
Tetrastes bonasia	x	LC	forest/shrub
Tetrao urogallus	x	LC	forest/shrub
Coturnix coturnix		LC	semi-natural open+farmland
Crex crex	x	LC	semi-natural open+farmland
Haematopus ostralegus		VU	semi-natural open+farmland
Vanellus vanellus		VU	semi-natural open+farmland
Glaucidium passerinum	x	LC	forest/shrub
Strix uralensis	x	LC	forest/shrub
Strix nebulosa	x	LC	forest/shrub
Aegolius funereus	x	LC	forest/shrub
Alauda arvensis		LC	semi-natural open+farmland
Anthus pratensis		VU	semi-natural open+farmland
Locustella fluviatilis		VU	marshlands/wetlands
Sylvia communis		LC	semi-natural open+farmland
Phylloscopus trochilus		LC	forest/shrub
Regulus regulus		NT	forest/shrub
Nucifraga caryocatactes		LC	forest/shrub
Sturnus vulgaris		LC	generalist

Further relevant conclusions for birds are that:

- *Species with smaller ranges and restricted distributions have better coverage in the Natura 2000 network compared to species with large ranges and wider distributions.*

- *Species associated with natural habitats (as opposed to semi-natural habitats), in particular mountainous areas, have better coverage/ over-representation in the Natura 2000 network.*
- *The countries having highest coverage of species' distribution in Natura 2000 are the 'set' of South and East European countries: Bulgaria, Croatia, Slovakia, Hungary, Slovenia, Romania, Greece and Spain.*
- *In general, species for which Natura 2000 sites have been designated (Annex I species) have a larger proportion of their distribution in the network than non-Annex I species.*

Bird species of open natural habitats and coastal and marine habitats are best represented within the Natura 2000 sites. Forest-species are generally represented according the proportion of Natura 2000 sites. Bird species of farmland are relatively well presented in the Mediterranean area, but underrepresented in the Atlantic and continental part of Europe; this is given more emphasises by the fact that in western Europe large areas of farmland are designated for the protection of wintering birds and not so much for breeding birds. Generalist bird species are, not surprisingly, most underrepresented within the Natura 2000-network since large parts of their ranges lie within intensively used areas like cities.

*Figure 22: Dotterel (*Charadrius morinellus*) is an arctic-alpine wader with a restricted European distribution, relatively well represented in the Natura 2000 network. (Photographer Edmund Fellowes).*

Butterflies

The beneficial effects of the Natura 2000 network are also seen with butterflies. So, for example, the more widespread a species is the more the proportion of its distribution inside Natura 2000 will approach the proportion of the land-cover of Natura 2000. Non-Annex butterflies (more than any other animal group) occur more frequently inside Natura 2000 than outside. This is mainly because butterflies in general show a particular preference for specific CLC-3 level habitat types which are mainly now only found inside Natura 2000; outside they have been lost as a result of a range of modern pressures and threats and competing land uses (such as agricultural intensification, urban sprawl, etc).

The butterfly species which profit most from Natura 2000 are those species with a very limited distribution that, for example, occur on small islands, of which most (or even all) is inside Natura 2000. Remarkably all of the species that were considered occur in Natura 2000 (even if at a low percentage). Butterflies on Annex II of the Habitats Directive, for which Natura 2000 areas have to be designated, occur significantly more in Natura 2000 than other species. Threatened butterflies, both on the European and the EU-27 list, clearly benefit from Natura 2000 areas. Endemic species, that only occur in Europe or the EU-27 and for which we have a high responsibility, also occur more in Natura 2000 areas than other species.

Figure 23: In Eastern and Southern Europe in particular grasslands become abandoned and turn into shrub and later secondary forest, losing all specialist butterfly species and thereby increasing the relative importance of Natura 2000 (Photographer Chris van Swaay).

For butterflies it can be further concluded that:

- *In almost all countries butterflies are benefitting from Natura 2000.*
- *Threatened and endemic butterflies also occur more in Natura 2000 areas than outside.*
- *Threatened butterflies, either on the pan-European or on the EU-27 list, are benefitting from Natura 2000 areas.*
- *Endemic butterflies benefit from Natura 2000 areas.*

*Figure 24: The scarce fritillary (*Euphydryas maturna*) is a species of woodlands. In most of Europe it is found in Natura 2000 areas. (Photographer Chris van Swaay).*

The main reason for this is that butterfly habitats occur much more in Natura 2000 than in urban and agricultural areas. Furthermore, in Eastern and Southern Europe in particular, where grasslands become abandoned and turn into shrub and later secondary forest they lose all specialist butterfly species. Active management of the butterfly habitats in Natura 2000 will ensure long term survival of butterflies and these areas therefore provide an important tool for preserving Europe's butterfly diversity.

Mammals

The mammals showed similar but less strong trends to the birds and butterflies with a different pattern emerging for large mammals. Thus it can be concluded that:

- *A majority of European mammal species benefit from Natura 2000.*
- *Large mammals are less likely to show an association with, or to derive an identifiable benefit from Natura 2000.*

*Figure 25: The Wild boar (*Sus scrofa*) is considered Least Concern by the European Red List. It covers 67.7% of the European territory and 18.9% of its distribution is protected by Natura 2000. (Photographer Nathan Ranc).*

Large mammals often live at relatively low densities and their territories can cover very large areas, that may include Natura 2000 but which will extend far into the wider countryside beyond. They are therefore less likely to be closely associated with Natura 2000 using the methods applied in this study.

*Figure 26: The Iberian Lynx (*Lynx pardinus*) is considered Critically Endangered by the European Red List. It covers 1.8% of European territory and 45.3% of its distribution is protected by Natura 2000. (Photographer Nathan Ranc).*

Furthermore:

- *Natura 2000 sites are not evenly distributed in EU-28, and some countries have relatively low percentages of coverage but, irrespective of the total coverage, some countries protect mammal species less than expected by the total number and area of sites.*

Illustrative examples are Malta, Sweden, Cyprus. This outcome may however be indicative of mammal species distribution and behaviour and is not necessarily policy-related.

Amphibians and Reptiles

For the amphibians and reptiles it can be concluded that:

- *A majority of European species benefit from Natura 2000.*
- *There is hardly any difference in the level of protection by Natura 2000 for Annex II species compared to non-Annex II species.*

Four Annex II species had relatively restricted distributions and their Natura 2000 coverage was below the threshold of 18%. For three of the four Annex II species higher detail data was available at the country level, revealing that they are in fact probably well protected. Only one species, Italian Agile Frog (*Rana latastei*), was identified that really had lower coverage by Natura 2000 than the suggested baseline of 18%. Furthermore:

- *There was a clear north south gradient in the level of coverage by Natura 2000.*

*Figure 27: The European green toad (*Bufo viridis*) is a species of toad found in many areas in mainland Europe, including steppes, mountainous areas, semi-deserts, and urban areas. (Photographer Fabrice Ottburg)*

Reptiles and amphibians are not evenly distributed across European countries. Northern countries have fewer, common and widely distributed species that occur proportionately less in Natura 2000 because of their overall distribution. Southern countries have more species that are often restricted in their distribution and which have higher coverage by Natura 2000 because their preferred habitats occur more frequently in Natura 2000. Finally:

- *The assessment was less accurate for marsh turtles and cave salamanders*

The marsh turtles and salamanders are typically difficult to assess. The major land cover types that are associated with marsh turtles (small wetlands and marshes) are underrepresented in the CLC map, leading to an underestimation of the distribution of their habitat. This causes higher estimations of their protection by Natura 2000. For salamanders of the genus *Speleomantes* (cave salamanders) detailed maps of the caves are not available at the extent of Europe or even country (Italy, and a small part of France) where these species occur. However, in all cases these species were considered to be more covered by Natura 2000 than expected by chance.

*Figure 28: The grass snake (*Natrix natrix*) is widespread in the European territory where it has several subspecies. (Photographer Fabrice Ottburg)*

Plants

Based on the analyses of plant species distribution it may be concluded that:

- *Red list species and some other rare species occur significantly more inside than outside Natura 2000 sites.*
- *None of the plant species that have been taken into account has a strong preference for areas outside Natura 2000 sites*

Natura 2000 sites are generally selected on habitat based criteria; qualifying habitats are generally species-rich, often including rare species. In this way, confirming the results for the animal groups, it demonstrates that Natura 2000 is protecting the majority of the most diverse and species-rich habitats and that outside Natura 2000 there are less species of nature conservation interest present.. Nevertheless, most Red list species and some other rare species do – to some extent – also occur outside Natura 2000 sites. From this, it might be concluded that biodiversity is not an exclusive phenomenon for Natura 2000 sites. Furthermore:

- *Natura 2000 sites exert a strong 'buffer zone' effect.*

By extending the plant analysis beyond the boundaries of Natura 2000 sites by creating a 500 meter 'buffer zone' it was shown that, at least for the countries covered by the analysis, biodiversity in those buffer zones (measured in terms of number of hotspots) is intermediate between the Natura 2000 sites and the area outside the buffer zone. The presence of Natura 2000 sites therefore seems to better secure biodiversity in, but also around Natura 2000 – with implications for both policy and practice.

*Figure 29: Bee orchid (*Ophrys apifera*) (Photographer Fabrice Ottburg)*

Areas for Future Research

The presence of a strong buffer zone effect around sites suggests that, whilst future work could look at the implications of this, there are also questions that reach into the wider countryside beyond. Green infrastructure has Natura 2000 and other protected areas at its heart and the approach and analysis that have been used here could be applied to questions about policy and practice in relation to buffer zones, stepping stones and ecological corridors. This could be linked to Copernicus data and remote sensing.

Furthermore the approach can be applied to issues such as climate change, modelling the impacts of temperature increase. Another policy issue of relevance here, linked to the importance of high quality habitats for a range of species, and which could be modelled is that of abandonment. This process has already had a detrimental effect on groups such as butterflies, less so potentially for large mammals. However, it is important to assess these impacts.

Finally, the role of groups such as butterflies as indicators might also be explored as their sensitivity to both biotic and abiotic change could tell us much about species, in particular invertebrates with similar associations to habitats, the general health of habitats and ecosystems within and outside Natura 2000.

Concluding Remarks

The results confirm that Natura 2000 sites are offering important additional value for common biodiversity and among the groups tested the butterflies and birds benefit the most. The study also confirmed that they are fulfilling their primary purpose of protecting the species in Annex I of the Birds Directive and Annex II of the Habitats Directive.

It is clear that the majority of the remaining species rich habitats are already in Natura 2000 sites. This emphasises the importance of policy and financial instruments and the associated management measures which continue to maintain or to restore habitats in Natura 2000 sites in a condition that is favourable for all of their associated species. The exception to this may be boreal habitats and some areas of traditionally managed agricultural land in Eastern and Southern Europe. Whilst this should be further investigated, the results presently suggest that more forest and traditional agricultural land could be included within Natura 2000 or, at least, should be considered for sympathetic management.

Figure 30: The Hohes Venn (Hautes Fagnes, Hoge Venen) a Natura 2000 site on the Belgian-German border, a haven for Europe's wild plants and animals and a resource for the public to enjoy. (Photographer Lawrence Jones-Walters)