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Is the Natura 2000 network of the European Union the key land use policy tool for preserving Europe's biodiversity heritage?

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ABSTRACT

The Natura 2000 network of protected areas is considered by the European Commission to be the centrepiece of the European Union's nature and biodiversity policy. This paper reviews the European Environment Agency's public Natura 2000 database. It comprises data for birds, mammals, fish, amphibians, reptiles, invertebrates and plants submitted by the 28 EU Member States. For each Natura 2000 site a calculation was made of the conservation value of each species, together with an assessment of population isolation in relation to natural range and global conservation value. The results show that the great majority of national species populations of Community interest and birds are just covered by each Natura 2000 site up to only 2% at maximum. The most frequently reported high negative impacts on Natura 2000 sites are human induced changes in hydraulic conditions, hunting and collection of wild animals, and grazing. Natura 2000 sites alone are unlikely to safeguard Europe's biodiversity heritage, because most species occur predominantly outside Natura 2000 protected areas. Recommendations are made for improved reporting by EU Member States to provide quantifiable data based on monitoring and comparable indicators. Reform of the Natura 2000 network is needed for an integrated ecosystem approach to allow natural and human induced fluctuations of structures and functions of species habitats. 100% landscape management of the wider countryside should be enforced as a result of the limited coverage of Natura 2000 sites for Europe's biodiversity heritage.

1. Introduction

1.1. Biodiversity policy background of the reporting on the Natura 2000 network in the EU

According to the European Commission (EC, 2017a) "*The Natura 2000 Network works to ensure the long-term survival of Europe's most valuable and threatened species and habitats, and is the centrepiece of the EU's nature and biodiversity policy.*". This network of protected areas is designated on the basis of species and habitat types of Community interest, which are listed in annexes to the EU Habitats Directive (EC, 1992) and the EU Birds Directive (EC, 2009). The network presently comprises 27312 terrestrial and marine Natura 2000 sites covering 1 147 956 km^2 in total (18.12% of the land area) of the European territory of the 28 Member States of the European Union (EC, 2016a). The species of Community interest were mainly selected by each EU Member State for their rarity and conservation status, vulnerability, and typicalness for the respective biogeographical regions of Europe (Zisenis, 2009). The target of the Natura 2000 network is to achieve a favourable conservation status of the natural habitat types listed in Annex I and habitats of the species listed in Annex II of the EU Habitats Directive within their natural range (EC, 1992) and species listed within Annex I of the Birds Directive (EC, 2009). The Natura 2000 network includes the Special Areas of Conservation (SAC) and Special Protection Areas (SPA) designated, respectively, under the EU Habitats Directive and the EU Birds Directive.

The EU Member States report frequently on the conservation status of species and habitat types of Community interest, as well as birds in the Natura 2000 network of the European territory. Every six years, they also report nationally on species and habitat types of Community interest within their respective biogeographical regions, namely the Alpine, Atlantic, Black Sea, Boreal, Continental, Macaronesian, Mediterranean, Pannonian, and Steppic regions (EC, 2016b; Eionet-ETC/BD, 2015).

1.2. Studies on the effectiveness of the Natura 2000 network

Several studies have investigated the effectiveness of the Natura 2000 network for covering listed species of Community interest and birds, as well as other species which are of national and regional value. Modelling species distribution and habitat suitability are widely-used at grid scale for largely coverage analysis by Natura 2000 sites.

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At EU level, Abellán and Sánchez-Fernández (2015) calculated, based on a threshold of minimum 50% grid cell coverage, that 45% of the distribution of selected amphibian species and 46% of reptiles were covered by Natura 2000 sites in 26 EU Member States (excluding Hungary and Croatia). The respective figures were 30% for amphibians and 26% for reptiles within nationally protected areas.

Maiorano et al. (2015) modelled that only 18.8% of the amphibian species listed in the EU Habitats Directive did not meet a species distribution related representation target in Natura 2000 sites. For reptiles the figure was 7.0%, and for birds 6.4%. On average, Natura 2000 sites covered naturally occurring terrestrial vertebrate species to a larger extent than nationally protected areas according to the calculation in 28 EU Member States (EU28). The authors also concluded that Natura 2000 sites improved habitat and species connectivity.

Kukkala et al. (2016) modelled species distribution data using a habitat suitability model of amphibians, reptiles, and mammals of Annex II and IV of the EU Habitats Directive, as well as birds in Annex I of the EU Birds Directive. On average, 33.6% of their distribution was covered by Natura 2000 sites.

Gruber et al. (2012) used a representation index for modelling the coverage by Natura 2000 sites of Annex II listed species of the EU Habitats Directive within 25 EU Member States (EU25). The authors assumed that a higher proportional representation within Natura 2000 sites than in the share of the total area distribution within the EU25 indicates an 'over-representation', i.e. a representation index higher than one. 115 out of 714 species had a representation index lower than one.

van der Sluis et al. (2016) modelled the habitat suitability of different land use types for each species. The 50 × 50 km grid cell species distribution maps were overlaid with Corine Land Cover type data and validated by experts. Regression modelling was used to further downscale. As a result, 67.5% of mammal species on the European Red List were covered by Natura 2000 sites at minimum baseline of 18% of the EU28 land area. For birds, 84% of their distribution was within Natura 2000 sites, and 80% for reptiles and amphibians. For plants, a random selection of 5000 grid cells in and outside Natura 2000 sites was selected to calculate the probability of Natura 2000 coverage for more than 50% of Red List plant species and orchids. In total, 86% of the investigated plant species were more likely to occur within Natura 2000 sites than outside.

Jantke et al. (2011) used species distribution and habitat models for all 70 vertebrate wetland species of the Annexes of the EU Birds Directive and the EU Habitats Directive in 26 EU Member States (EU26). However, they concluded that there was a deficit of 3.02 million hectares of Natura 2000 sites in the EU26 to include at least one viable population of each modelled species.

Pellissier et al. (2014) concluded from bird community indices that there is a higher occurrence of bird species in Natura 2000 sites in comparison to the adjacent bird sites within 15 km distance for the period 2000–2012. The modelled results were less clear for butterflies. Analysis was based on Pellissier et al. (2013) who showed a significant positive population trend of 54 bird species, which were also positively related to a habitat specialisation index in French Natura 2000 sites.

Santini et al. (2016) concluded from population distribution models that the Natura 2000 network contributes considerably to the habitat protection of the brown bear (*Ursus arctos*), the Eurasian lynx (*Lynx lynx*), and the grey wolf (*Canis lupus*), listed in Annex II of the EU Habitats Directive, in contrast to more limited nationally protected areas. Many of the Natura 2000 sites, however, were too small to support viable metapopulations of these three carnivore species.

Donald et al. (2007) modelled significantly higher population trends of Annex I bird species in 15 EU Member States from 1990 to 2010; Gamero et al. (2017) obtained similar results after modelling trends for 39 farmland bird species in 25 Member States from 1981 to 2012.

At national level the positive impact of Natura 2000 sites was confirmed by species distribution and habitat suitability models to enlarge the coverage of nationally protected areas for selected taxa, species of Community interest and birds (D'Amen et al., 2013; Hernández-Manrique et al., 2012; Maiorano et al., 2007; Rubio-Salcedo et al., 2013; Sánchez-Fernández et al., 2008; Sanderson et al., 2015; Sandór and Domşa, 2012).

Similar generally positive results are derived from modelling at a regional level for the coverage of species by Natura 2000 sites (Abellán et al., 2011; Dimitrakopoulos et al., 2004; Hermoso et al., 2014; Lisón et al., 2013). Orlikowska et al. (2016) provided a literature review of Natura 2000 assessments at regional, national, and EU scale.

However, the modelled calculations vary depending on the threshold applied to the area covered by the selected species within Natura 2000 sites. Generally, there is only grid cell data available. Suitable habitats within an area are widely modelled and do not necessarily reflect empirical data on the real population distribution. Data on the abundance of populations is usually absent. Nevertheless, they show the generally positive influence of Natura 2000 sites on the distribution of species of Community interest and birds in the EU territory.

Reporting by EU Member States provides a further opportunity to analyse the contribution of the Natura 2000 network for achieving a favourable conservation status. The EU Member States are asked to report on empirical data. This study provides further scientific evidence of the effectiveness of the Natura 2000 network as reported by the EU Member States, but also on the reporting scheme itself.

1.3. Knowledge gaps of the Natura 2000 network

There is still a gap in understanding the contribution of the Natura 2000 network as a whole in achieving a favourable conservation status for major taxa protected by the EU Habitats Directive. The EU Birds Directive designates Special Protection Areas (SPA) for bird species listed in Annex I of the Directive and also includes migratory bird species (EC, 2009). Together with the Special Areas of Conservation (SAC) of the EU Habitats Directive they shall form a coherent European ecological network (EC, 1992). Presently, it is unclear to what extent the major taxa of species of Community interest and birds are connected between Natura 2000 sites to form a real network of metapopulations. In addition, the particular habitat conditions and the conservation value of the Natura 2000 sites are still unknown for many of these species. Furthermore, it is crucial to know the main pressures that have a negative effect on the major taxa of species of Community interest and birds in Natura 2000 sites in relation to their protection and management.

1.4. Analysis of the Natura 2000 network official database as reported by the 28 EU Member States

The EU Member States are legally obliged to submit data about of the species of Community interest listed in Annex II of the EU Habitats and Annex I of the EU Birds Directive. The reporting of the overall conservation value of each Natura 2000 site for a species must include an assessment of the degree of conservation of the structure and functions of their habitat, their population size and isolation, as well as their possibilities for restoration. In practice, the EU Member States do not report continuous quantified data, but classified ordinal figures by ticking boxes in the standardised Standard Data Form (EC, 2011a).

For this study, the official public database of 27312 Natura 2000 sites was analysed (EC, 2016a). Five elements were considered from the reported data:

(a) To what extent the Natura 2000 network spatially covers major species taxa of Community interest and birds.
(b) The habitat quality for these species in Natura 2000 sites.
(c) The degree of isolation of their populations in Natura 2000 sites.
(d) The overall conservation value of the Natura 2000 sites for the major taxa of Community interest and birds.