A framework for the expansion of protected areas in Europe



Executive Summary

- European countries must strengthen and expand their protected area network to help put **biodiversity on a path to recovery**.
- In the NaturaConnect project, we use integrated spatial planning to identify the most important areas for protecting 30% of European land (incl. 10% under strict protection), restoring 20% of ecosystems, and for sustainable management of green infrastructure in Europe.
- This document describes relevant data and criteria for finding these top priorities.
- Our approach illustrates how European countries could best close gaps in coverage of underprotected habitats and species of conservation concern. Our **initial results*** confirm that EUwide conservation planning and transnational cooperation lead to higher conservation gains for species and habitats compared with national-level planning.

* The results are still preliminary because they do not include all taxonomic groups and ecosystem service data, and will be updated during the course of the project.





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Protected areas in Europe

Protected areas in the EU cover 26% of the land. Around 18% are Natura 2000 sites, and 3% are strictly protected areas (IUCN categories I and II). On average, less than 30% of bird species distributions (Annex I, Birds Directive) are protected, and less than 35% of species distributions (Annex II, Habitats Directive). With many species still declining, threatened, or in unfavourable conservation status, space must be found to close conservation gaps for species that are insufficiently represented in the EU network of protected areas.



Figure 1: Most recent data on the European continent protected areas. Natura 2000 sites (blue) and other protected areas (green).

Supporting the EU Biodiversity Strategy for 2030

NaturaConnect aims to support countries in planning protected areas to meet several policy targets of the EU Biodiversity Strategy at the same time. The analyses extend to neighbouring countries in Europe, and are designed to support protected area designations across all of Europe. The targets that inform our overall project work include:

Target 1: Legally protect a minimum of 30% of the EU's land area and a minimum of 30% of the EU's sea area, and integrate ecological corridors, as part of a Trans-European Nature Network (TEN-N).**

Target 2: Strictly protect at least a third of the EU's protected areas, including all remaining EU primary and old-growth forests.

Target 4: Habitats and species show no deterioration in conservation trends and status; at least 30% reach favourable conservation status or show a positive trend.

Target 5: The decline of pollinators is reversed.

Target 6: The risk & use of chemical pesticides is reduced by 50%, and the use of more hazardous pesticides is reduced by 50%.

Target 7: At least 10% of agricultural area is under high-diversity landscape features.

Target 8: At least 25% of agricultural land is under organic farming management, and the uptake of agro-ecological practices is significantly increased.

We develop scenarios for expanding the terrestrial European network of protected areas to reach 30% of protected area coverage by 2030, including one-third (i.e., 10% of the EU) under strict protection. Using **integrated spatial planning**, we identify those areas that would most efficiently maximise benefits for the greatest number of species and habitats of conservation concern.

^{**} TEN-N is defined as a strategically planned network of protected sites and corridors, building on the existing Natura 2000 network and other protected areas, as well as natural and semi-natural areas that build on other green infrastructure.



Planning approach

NaturaConnect is funded by the EU Commission and runs until June 2026, building on the knowledge of over 100 experts from over 20 institutions, working across various disciplines and themes.

The project aims to support joint strategic efforts across EU Member States to facilitate effective biodiversity protection through the Trans-European Nature Network (TEN-N) and meet several EU BDS targets.

Different possible configurations of the TEN-N will have different implications for the environment, society and economy. These are influenced by the choice of data and scientifically-informed assumptions made during the prioritisation.

Integrated Spatial Planning (ISP) is an established planning framework that identifies efficient solutions for the integration of different conservation objectives with other socio-economic considerations.

The NaturaConnect project builds on the ISP framework to identify priority areas that best complement the existing European network of protected areas to close gaps in coverage of underprotected habitats and species efficiently. ISP approaches are a state-of-the-art tool for identifying spatial conservation priorities (Jung et al., 2021; Kukkala & Moilanen, 2013) and have been widely applied in Europe (Jung et al., 2024).

In NaturaConnect, we apply ISP at pan-European and national levels. The results shown in this brief are purely illustrative and based on a coarse subset of design criteria and data, which we will ultimately use. We highlight that the approach is shaped by engagement with stakeholders and will be improved as the project develops in the coming years.

1. Using relevant data in the spatial planning process

The type of data inputs listed below represent some of the foundational datasets commonly used in ISP approaches. This list will be expanded over the course of the project to integrate more data inputs also considering stakeholder feedback and priorities and considerations. Our current data inputs for the spatial analyses include:



Protected areas: All Natura 2000 and nationally designated sites (NatDa), to identify priorities that best complement existing protected sites. This information will be updated with the new version of the Natura 2000 dataset and National designations dataset.



Species and habitats: All (terrestrial) species and habitats of conservation concern (Articles 12 of the Birds Directive and Article 17 of the Habitats Directive; global, European and national IUCN Red List of Threatened Species; European Red List of Ecosystems). Spatial distributions for species and habitats reported by the EU MS under Articles 12 and 17, and data available in the Global Biodiversity Information Facility (GBIF) and IUCN to refine species distribution estimates.



Old-growth and primary forest: All remaining primary and old-growth forests as mapped by Sabatini et al., 2021. In the prioritisation these are by default included as proposed or existing strictly protected areas. This is in line with policy guidance, which states that "all remaining primary and old-growth forests should be placed under strict protection".

Moving forward, additional data inputs will be incorporated to the spatial analyses including those identifying areas within and outside the TEN-N that may have a role for improving **ecological connectivity and restoration, climate resilience, and other socio-economic values**.

2. Defining targets and weights that will drive priorities



Setting targets for species and habitats: Targets represent the proportion of the spatial distribution of each species or habitat that should at minimum be protected. Currently, we set the targets as follows:

- For species and habitats that are threatened or in unfavourable conservation status (U1/U2), the target is to protect 100% of their range.
- For other species and habitats, the target is to minimize the distance to extinction risk based on IUCN Red List criteria, building on previous work (Jung et al., 2021; Mogg et al., 2019).
- All old-growth and primary forests are included by default.

Moving forward, we will use Favourable Reference Ranges (developed within NaturaConnect) as species population targets to ensure species populations have enough habitat to remain in good condition or recover to that state.



Prioritising species and habitats: Because not all species and habitat targets can be met in 30% of land area, priorities must be set. In order to do that, we assigned higher weights to more threatened species and habitats at the global, European, and national levels, as assessed in Red List assessments for species. Building on previous work (Jung et al., 2021), we assigned the following weights:

5 for Critically Endangered (CR) and/or bad conservation status (U2)
4 for Endangered (EN)
3 for Vulnerable (VU) and/or inadequate conservation status (U1)
2 for Near-Threatened (NT)
2 for data-deficient (DD) (Borgelt et al., 2022)
1 for Least Concern (LC) and Favourable conservation status (FV)

We then average the weights across the global, European and national levels of Red List assessments (Arponen et al., 2005). This ensures that, everything else equal, areas hosting threatened species will be given higher priority as potential additions to the current protected area network.

3. Prioritisation

We use the 'prioritizr' package in the software R to identify priority areas that most contribute towards achieving species and habitats conservation targets, taking into consideration existing protected areas and species and habitats weights.

We formulated the problem as a minimum shortfall objective to get as close as possible to the representation target for as many species and habitats as possible, given the area budget (i.e., 30% of protected area coverage across Europe, and 10% under strict protection).



For protected areas counting towards the 30% target, we explored various burdensharing scenarios, with a maximum area target of 30% of protected areas per EU Member State or other geographic areas of interest, e.g., bioregion. When the proportion of existing protected areas already exceeded the target in a bioregion, (e.g., more than 30% of the Alpine bioregion is already protected), no new protected areas could be added to this bioregion.



Figure 2: Conceptual diagram of the workflow for testing the prioritisation to find top priorities for 30% protected area coverage at European and national levels.



Strict protection is a new concept in the toolbox of conservation strategies in the European Union. The concept leaves room for different priorities and interpretations to allow Member States to come to meaningful outcomes they cannot achieve through conventional conservation planning and management.

The EU guidance on protected area designations underscores that strictly protected areas should be conserving or restoring "the integrity of biodiversityrich natural areas with their underlying ecological structure and supporting natural environmental processes. Natural processes are therefore left essentially undisturbed" (European Commission, 2022). The document further clarifies that while in most cases this requires non-intervention (e.g. in oldgrowth forests and raised bogs), there might be cases where "strict protection may also be relevant for areas which are critical for certain habitats or species, such as relic sites or areas which are essential for the life or reproduction of endangered species".

In NaturaConnect, we are working on an analysis that explores the trade-offs in quantitative benefits and priorities between these approaches. A clear understanding of what could be achieved and what could be lost, depending on how national and sub-national authorities apply the concept of strict protection, will help decision-makers achieve the most additional conservation outcomes for Europe's biodiversity.

Planning at the European level leads to higher conservation gains than national prioritisations

Compared to national planning, a European-wide planning results in priority areas that are more cost-effective, complementary and irreplaceable at the European level, with higher gains for conservation in the same amount of area. EU-wide collaboration between Member States will be critical for achieving the best conservation outcomes.



Figure 3 (above): Example outputs from the prioritisation. Priorities differ when planning at the level of EU Member States (left), at the European scale with burden sharing (centre), and without burden sharing (right). Priority areas tend to cluster around the borders of countries in national planning (left) because it prioritises nationally rare species, even though they may be common elsewhere.

Figure 4 (right): Cross-border coordination is key for high conservation outcomes. The barplots show the potential conservation gains in each scenario, and the panels show the groups of species of conservation concern. Represented in grey is the amount of biodiversity currently protected in Natura 2000. In green would be the potential biodiversity gained when planning separately for each EU Member State. In light blue, the amount of biodiversity that would be gained by planning at the European level, with 30% of conservation area in each Member State. In dark blue, the amount of biodiversity that would be gained by planning at the European level, with unequal distribution of conservation areas among Member States. Preliminary results suggest that prioritisation within Member States leads to lower gains for European biodiversity.



The scenario for EU-wide priorities without burden-sharing constraints could more than double the amount currently protected for threatened species, Article 17 species and species in unfavourable conservation status (U1/U2). But the uneven distribution across EU Member States raises concerns about feasibility. Scenarios for EU-wide priorities that balance burden-sharing between Member States provide a good compromise, with larger gains for biodiversity than in the 27 separate national prioritisations, and a fair distribution of areas.

EU-wide priorities for the 30%

Planning at the European level and with transnational coordination is more effective, i.e., it leads to higher gains for biodiversity in the same amount of area in our results, confirming results from previous studies (Kukkala et al., 2016; Eckert et al., 2023).



Scenarios for achieving 30% protected area coverage: In our initial analysis, we examined priority areas for new designations across six scenarios, with clear differences across the results (Figure 5). Each scenario was a combination of the following assumptions and constraints:

Protected areas are expanding on (i) Natura 2000 sites only (left column) or (ii) both Natura 2000 and other nationally designated sites (NatDa) (right column).

The 30% terrestrial area under protection is achieved (i) at the EU level (bottom row); (ii) in each biogeographical region (middle row); (iii) in each Member State.





Figure 5: Different scenarios for protected area expansion. In each map, the priority areas in pink expand on the protected areas in grey. Scenarios vary in the constraints to distribute conservation areas equally across EU Member States (top row), biogeographic regions row), (middle or without constraints, i.e., anywhere in Europe (bottom row). Scenarios also vary in the protected areas considered as a starting point Natura 2000 sites only (left column) or all protected areas, including Natura 2000 sites and other nationally designated (NatDa) sites (right column).



Conclusions

Our analyses show that planning for conservation at the European level ensures far better gains for species and habitats, than when planning within national boundaries (Eckert et al., 2023; Kukkala et al., 2016; Pouzols et al., 2014).

Why is EU-wide planning more cost-effective? When the planning is performed at the national or biogeographic level, it introduces the risk of diverting limited conservation resources to protect species or habitats in a given country at the margin of their range. However, this can mean they are nationally rare but widespread outside the country. If these species are prioritised, this comes at the expense of species and habitats that might be nationally common, but continentally threatened or endemic. Coordination between EU Member States is thus key to achieving the best conservation outcomes.

In line with global and European conservation policy, we propose using scenarios that optimise for conservation at the European scale while ensuring a fair share of conservation areas across EU Member States and biogeographic regions.

Next steps

NaturaConnect will deliver scenarios such as those described in this brief to explore the trade-offs among different key objectives addressing environmental, social and economic values. The project can assist EU Member States and the European Commission in exploring options to best resolve these trade-offs. **Going forward, we will continuously improve these scenarios as part of the NaturaConnect project.**

- We will include a selection of ecosystem services, especially to guide identification of multifunctional Green Infrastructure that would connect and buffer protected areas against anthropogenic disturbances. These include regulating ecosystem flood control, pollination, air quality regulation, agricultural pest control, seed dispersal, carrion elimination, disease regulation, medicinal plants, and cultural ecosystem services (heritage landscapes, nature tourism, wildlife watching, evolutionary heritage, and wild foods).
- Targets for features will be based on Favourable Reference Range developed within NaturaConnect.

- Costs and socio-economic constraints, including current and future land use and land cover, will be added to capture the implementation feasibility. Costs are particularly relevant for strict protection, where human activities will be more restricted.
- We will account for climate change scenarios to identify priority areas that are resilient and well-connected spatially, by including the current and future distributions of species and habitats.
- We will use the pledges of EU Member States to select the protected areas set to be considered as part of the 30% target.
- Protected areas are only one element of a TEN-N; it is essential to ensure these are connected via multifunctional corridors. Priorities for enhancing connectivity will be included in the spatial planning exercise of the project.
- We will explore the implications of different definitions of strict protection.
- The code for the analysis will be as reproducible as possible, given data, computational constraints and setup, and will be made publicly available.



NaturaConnect Prioritisation

Figure 7: Conceptual diagram of the complete workflow from inputs to outputs to produce priority maps to meet the EU Biodiversity Strategy for 2030 targets that inform our work (see page 02).

Please get in touch with us if you are interested in shaping the details of the scenarios we run with more data and finer resolution **naturaconnect@iiasa.ac.at**

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