Science brief for policy and decision-makers

Exploring scenarios for the expansion of the Trans-European Nature Network (TEN-N)



Executive Summary

- EU Member States will make **policy decisions on areabased conservation pledges** in 2024. Discussions between Member States representatives and other policy and science conservation experts are ongoing as part of the Biogeographical Seminars organised through NADEG.
- This brief shows how the NaturaConnect project can assist European Member States in finding the most efficient solutions for the placement of the TEN-N, supporting them in their understanding of how their conservation plans can complement each other.
- Systematic conservation planning can provide significant improvements to conservation outcomes by **integrating plans across Europe**, compared to individual national planning.
- In particular, our method provides the ability to identify top priorities that maximize conservation benefits for over 1000 species and over 200 habitat types of conservation concern, given socio-economic constraints to conservation.





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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 European 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 EU Member States in increasing their conservation gains across Europe by providing an EU-wide strategic assessment to meet several targets of the EU Biodiversity Strategy for 2030 (EU BDS). The targets that inform our work are:

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 **multicriteria spatial conservation prioritization methods**, we identify top priorities that maximize conservation benefits for over 1000 species and over 200 habitat types of conservation concern, given socio-economic constraints to conservation.



Our method

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, targets, weights, and constraints in the prioritization.

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

In NaturaConnect, we are using the SCP framework to identify priority areas that would complement the existing European network of protected areas, while maximising biodiversity representation in a cost-effective manner. SCP 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 (O'Connor et al., 2021).

We apply SCP at pan-European and national levels. The preliminary analysis is done at a spatial resolution of 10x10 km² to match currently available data. The final analyses will be at 1km² resolution, using high-resolution data. Current analyses are based on the best available data by the end of 2023, but they will be improved based on the needs of interested stakeholders as the project progresses. The following describes the approach and data inputs in the NaturaConnect analyses.

1. Using relevant data in the spatial planning process

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



Protected areas: All Natura 2000 and nationally designated sites (CDDA), to identify priorities that best complement existing protected sites. Ultimately, this information will be updated based on information contained in the pledges of the EU Member States (EU MS).



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 prioritization, they are by default included in the solution alongside 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".



Ecosystem Services: Information on carbon sequestration. In the next step of the analysis, other ecosystem services will be added, including 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).



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).
- For carbon sequestration, the target is to protect 50% of the total carbon sequestration potential of European ecosystems. All old-growth and primary forests are included by default.

Moving forward, we will use Favourable Reference Ranges (developed within NaturaConnect) as targets, with the objective to minimise target shortfall for species not only across the 30% protected areas, but also 20% restored areas, and green infrastructure across Europe.



Assigning weights to species and habitats: A key element of SCP is to reflect relative importance by assigning specific weights. 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:

8 for critically endangered species (CR)	2
6 for endangered species (EN)	2
4 for vulnerable species (VU)	1

2 for near-threatened (NT)
2 for data-deficient species (DD) (Borgelt et al., 2022)
1 for Least Concern

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. Constraints

In the coming year, we will use linear penalties and constraints to account for socioeconomic costs, climate change risk and resilience, and spatial connectivity, which are all being developed and mapped within NaturaConnect. For example, socio-economic costs will be included as a proxy for the feasibility of implementing conservation across Europe. We will include costs as a linear penalty, to avoid selecting sites with a high cost.

4. Prioritisation

We use the 'prioritizr' package in the software R to prioritise the landscape with the aim to maximise benefits to conservation. It finds a solution for the TEN-N configuration that complements the existing protected areas and addresses the remaining gaps:

- To expand on existing protected areas, we consider the proportion of 10x10 km² grid cells currently protected (moving forward, the resolution will be 1 km²).
- 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 burdenwith sharing scenarios. а maximum area target of 30% of protected areas per EU Member State or other geographic areas of interest, bioregion. When the e.g., 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 combining data sets with targets and weights to derive priority maps for different scenarios.

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Finding priorities for the 10% strict protection target: The top priorities for reaching strict protection coverage are within the 30% protection and are designed to complement existing strict protected areas. Provisionally, we defined sites under IUCN categories I and II as strictly protected (Cazzolla Gatti et al., 2023). We focused on species and habitats listed as threatened or in unfavourable conservation status (U1/U2), which mostly need strict protection. We also included all documented primary and old-growth forests. Policy guidance indicates that the 10% can be freely distributed across EU Member States or bioregions. Furthermore, strictly protected areas but will be always counted towards the 30% target.

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

Compared to national planning, a European-wide planning selects 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): Priorities differ when planning at the level of EU Member States (left), at the European scale with burden sharing (centre), and at the European scale without burden sharing constraints (right). Priority areas tend to cluster around the borders of countries in national planning (left) because it prioritizes 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 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 area among Member States. Preliminary results suggest that prioritization 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. We will produce results for this intermediate scenario to help protect as much biodiversity as possible at the EU level while ensuring a fair distribution of protected areas between Member States.

EU-wide priorities for the 30% and 10%

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 (CDDA) (right column).

Boundaries are achieving targets within (i) 30% of the terrestrial area, in each Member State (top row); (ii) 30% of the terrestrial area, in each biogeographic region (middle row); (iii) 30% of the terrestrial area of the EU (bottom row).





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 area equally across EU Member States (top row), biogeographic regions (middle row), 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 (CDDA) sites (right column).



Scenarios for achieving 10% strict protection coverage: We ran the same scenarios for the 10% strict protection target. The scenario most aligned with European policy is the scenario for equal distribution between biogeographic regions (Figure 6). These priority areas for strict protection could yield very high conservation gains, with over 20% of species ranges on average that could be strictly protected, compared to the current situation of less than 5%

of species ranges. As an example, many islands are among the top priorities identified (Cyprus, Corsica, Macaronesia), reflecting the irreplaceable nature of the biodiversity in these islands, and the high levels of threats faced by species and habitats there.

Figure 6: Priorities for strict protection. On the map, the priority areas in pink expand on existing strict protected areas in grey. The map shows the top priorities for reaching 10% strict protected areas that are distributed within the 30% shared equally between biogeographic regions, aligned with the guidance documents to achieve Target 1 of the European Biodiversity Strategy.



Conclusions

Our preliminary analyses confirm 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. Justification for the distribution of protected areas across different countries and biogeographics needs to be factored into the planning to find politically feasible solutions.

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.

Perspectives

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.**

- The resolution will be higher (1km²) and we will include a broader set of taxa and essential ecosystem services.
- Targets for features will be based on Favourable Reference Rangers 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 consider as part of the 30% target.
- We will explore the implications of different definitions of strict protection. The choice of which species and habitats should be strictly protected in addition to old-growth and primary forests, and what type of management and activities are allowed, impacts the prioritisation results. For example, it might be more feasible to distribute new strictly protected areas evenly across EU Member States and/or biogeographic regions. We will propose criteria for the identification of species and habitats that need to be strictly protected, e.g., informed by the types of threats that can be mitigated by designation for strict protection.
- The code for the analysis will be as reproducible as possible given data, computational constraints and setup and publicly available.

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** © Ante Gugić / WWF

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).

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