POLICY BRIEF | BIODIVERSITY

INTEGRATED SOLUTIONS TO ADDRESS HIGH LEVELS OF CLIMATE CHANGE

We are not yet on track to meet the Paris goal to keep global mean temperatures below 2°C (and ideally below 1.5°C) above pre-industrial levels. IMPRESSIONS modelled the impacts of higher levels of climate change (above +2°C) on biodiversity across Europe under different socio-economic scenarios, including the interactions with agriculture, forestry, water and urban development.

Key Messages

- **Climate change poses severe risks to biodiversity** across Europe, especially under the hotter and drier conditions likely in southern Europe. Species will need to move their range (or stay and adapt, or die), but the rate of climate change will exceed the ability of many species to keep up through dispersal.
- **Combined climate and socio-economic changes increase the threat to biodiversity,** as competition between different land uses, especially agriculture, forestry and urban areas, affects habitat availability.
- **Urgent targeted interventions are needed** to avoid a serious loss of biodiversity, including extending networks of protected areas and habitats across Europe to enable species to migrate in response to climate change, but these will not be enough.
- **Co-ordinated action at the landscape scale is the key,** bringing together the agriculture, forestry, water, urban development and biodiversity sectors to exploit synergies and minimise trade-offs. Integrated strategies such as promoting the use of nature-based solutions can provide multiple benefits for biodiversity, climate adaptation and mitigation.

How will climate change affect biodiversity?

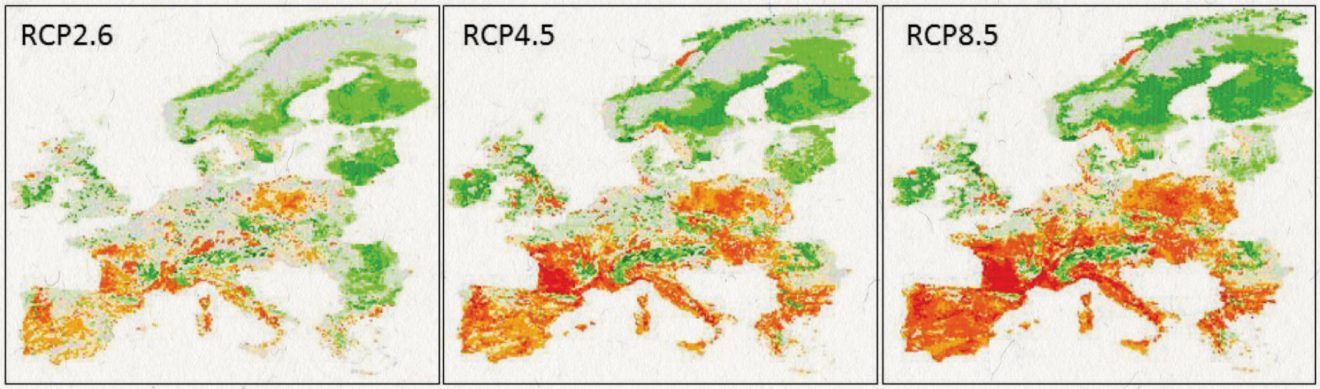
In Europe, a warming climate will force many species to shift northwards and/or to higher altitudes, or to stay and adapt to the new conditions or die. Survival for many organisms will thus depend on their dispersal capabilities, the availability of suitable habitats and the presence of connected habitat networks to enable migration.

IMPRESSIONS modelled the availability of suitable climate space for 111 species (68 plants, 15 birds, 14 insects, 12 mammals and 2 amphibians), selected to represent farmland, grassland, forest, wetland and heathland habitats, as well as Mediterranean and Alpine regions. Even under lower-end scenarios of climate change (RCP2.6; approximately 1.5 - 2°C warming across Europe), by the 2050s more than five of these species are lost in 13% of Europe, increasing to 28% in RCP4.5 (~ 2 - 3°C) and 36% under RCP8.5 (~ 4 - 6°C). Impacts vary strongly across Europe. In southern Europe, the hotter and drier conditions associated with high levels of climate change could lead to major habitat transformations and severe impacts on biodiversity, whilst in northern Europe some species may be able to adapt or gain access to new areas of appropriate climate and habitats. However, this modelling does not take into account CO_2 effects on the species, changes in lifecycle timings, dispersal ability, availability of host plants or spread of pests and diseases.

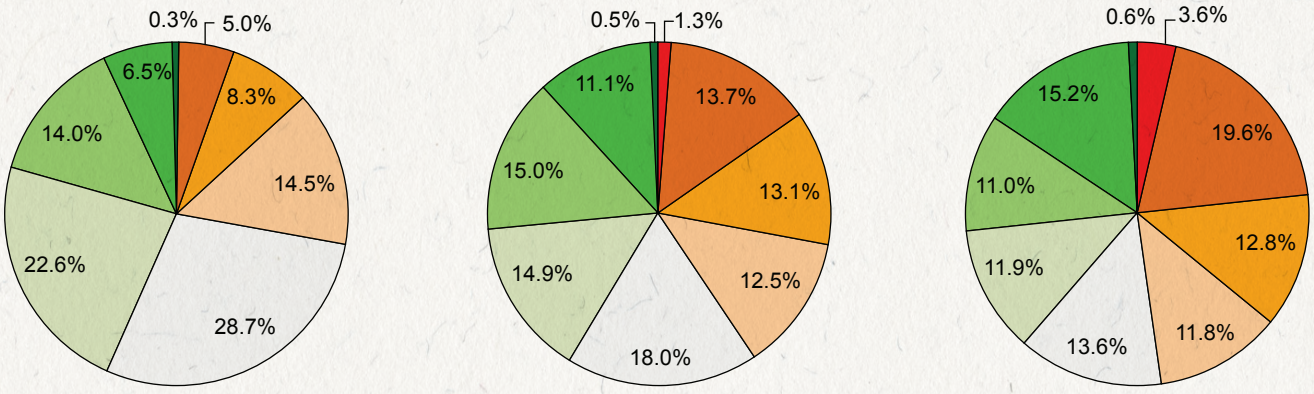
With high emissions scenarios the rate of climate change could exceed the ability of species to disperse to new climate space, even if suitable habitat and networks are available. If the climate stabilises, species may be able to catch up, but models suggest that species with small climatic ranges would be at risk of local/regional extinction if there is no remaining habitat in a suitable climate zone.

Number of species lost or gained (out of 111 species modelled)

over 25 loss | 10 to 25 loss | 5 to 10 loss | 1 to 5 loss | 1 loss to 1 gain | 1 to 5 gain | 5 to 10 gain | 10 to 25 gain | over 25 gain



Area of Europe with different levels of species loss or gain (%)

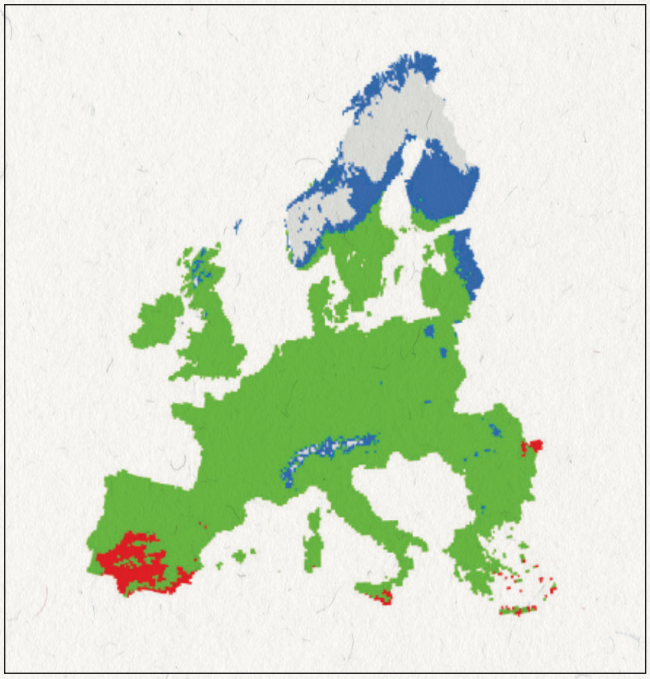


Change in climate and habitat suitability in the 2050s under increasing levels of climate change

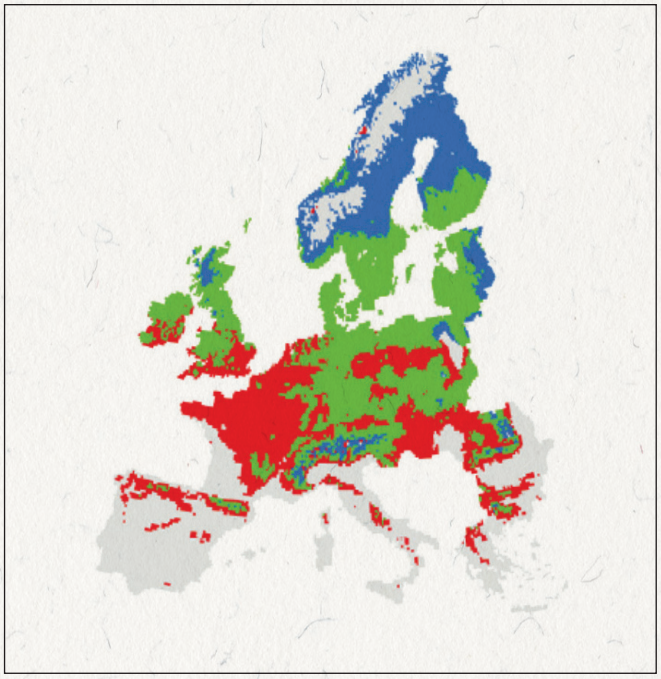
Socio-economic factors also have a major impact on biodiversity, as habitat for wildlife has to compete strongly with land needed for food production, commercial forestry, urban development and infrastructure. For example, a scenario with reduced food imports (SSP1) leads to agricultural expansion or intensification in Europe, at the expense of forests. However a scenario with high levels of conflict and social instability (SSP3) leads to abandonment of agricultural land, with negative impacts on farmland species, but benefits for some grassland and woodland species.

Urban development also has a major impact. Under a resource-intensive scenario with high levels of urban sprawl (SSP5), sealed surfaces grow to cover 9% of Europe, compared to 4% in other scenarios. This would have further negative impacts on biodiversity (beyond those modelled in IMPRESSIONS) as habitats become increasingly fragmented, while infrastructure, such as roads, poses a major hazard to the movement of many animal species, reducing their ability to disperse.

The combined effects of these climate and socio-economic changes make a loss of biodiversity across Europe highly likely, with major consequences for the supply of ecosystem services. For the service of pollination, for example, modelling of nine key crop pollinator species projected that eight would lose suitable climate space in the Mediterranean region and, in some cases, in France, southern Britain, southern Ireland and Central Europe. The pollination service these species provide could be at risk unless they adapt to the new climate, or other (not modelled) species are more resilient, or new pollinator species become available. Conversely, a projected expansion of arable crops in southern Scandinavia is unlikely to be limited by the availability of pollinators providing that the pollinator species are able to adapt by moving with the climate.



Buff-tailed bumblebee (*Bombus terrestris*)



Mining bee (*Andrena caratonica*)

potential new suitable climate space

lost suitable climate space

overlap between current and future suitable climate space

Changes in suitable climate space for two pollinators due to high climate change (RCP8.5)

What adaptation and mitigation pathways are possible?

Urgent action is required to prevent a serious decline in biodiversity in Europe as a result of combined climate and socio-economic change. Targeted interventions are needed to strengthen habitat networks, especially in the northern and southern extremes of Europe where both climate change and associated land use change is expected to be greatest, but these will not be enough. Transformative action at the landscape scale is the key, via an integrated approach that takes into account the interactions between agriculture, forestry, water, urban development and biodiversity.

Creating new protected areas or enlarging existing areas could help species to adapt, but may also lead to knock-on effects on land use elsewhere. For example, IMPRESSIONS modelling shows that doubling the area of protected forests in Europe could lead to intensive agriculture shifting into other habitats, leading to a 25% decrease in extensive grassland. This emphasises the need to consider trade-offs between land uses and between different sectoral policy interests. Climate change responses and policies in other sectors affect biodiversity, and also biodiversity policies (such as habitat restoration or protection) affect climate mitigation and adaptation in other sectors. Co-ordinated action across whole regions can find and harmonise positive land use synergies.

Strengthening the networks of connected habitats outside protected areas is vital, to create permeable landscapes that enable species to disperse to new areas. Green and blue infrastructure is particularly important for providing habitat connectivity in urban areas. Without these networks, species may become stranded in a protected area where the climate is becoming unsuitable.

Less intensive farming techniques, such as conservation or organic agriculture, or setting aside land for species-rich field margins, hedgerows, ponds and woodlands, can provide major benefits for biodiversity. However,

IMPRESSIONS modelling shows that if these techniques reduce yields per hectare, farmland area may expand at the expense of forests and semi-natural habitats. This conflict between less intensive 'land sharing' and more intensive 'land sparing' approaches could be reconciled by following integrated pathways, such as by combining:

- Research and investment into methods of improving yields per hectare from low-input agriculture;
- A shift towards plant-based diets to free up the large areas of land used for grazing and feed crop production;
- Increased use of nature-based solutions (such as buffer strips and beetle banks) on all farms;
- Continued emphasis on reducing the environmental impacts of intensive farming, e.g. through precision agriculture to limit agrochemical use.

Synergies with climate adaptation and mitigation can be exploited. Strong climate mitigation action is essential, because there are limits to adaptation. For example, even if the protected area of forests is doubled, the total area of forests is projected to fall by 30% compared to the present, due to climate change. Also, higher temperatures lead to greater land use change, habitat degradation and fragmentation, which will limit the potential for species to migrate to more suitable climates. Many actions offer multiple benefits for biodiversity, climate adaptation and mitigation. For example, organic agriculture increases soil organic carbon and conserves soil moisture, while reducing greenhouse emissions from fertilisers. However, there can also be trade-offs. For example, planting non-native tree species can help with adaptation and mitigation but could have adverse biodiversity impacts.

Policy Recommendations

- **Biodiversity policies need to be more closely integrated with other sectoral policies** (and vice versa) including agriculture, spatial planning, transport planning and forestry, to find and exploit synergies and minimise conflicts, including habitat loss and fragmentation.
- **The existing network of protected areas needs to be adapted** to cope with climate change, using species dispersal models as a guide, and new areas in more suitable climate zones may need to be created.
- **The connecting network of habitats outside protected areas must be strengthened** to enable species to migrate to suitable new habitats to cope with climate and land use change.
- **Further action is needed to reduce the adverse impacts of intensive agriculture** (through agri-environment schemes to improve on-farm habitats and reduce agrochemical pollution) together with research and investment into methods of improving yields per hectare from low-input agriculture, and encouraging a shift towards more plant-based diets to free up land used for intensive grazing and feed crop production.
- **Stronger planning policies are needed**, to protect semi-natural habitats from development and protect/create green corridors through urban and intensive agricultural areas. Clear planning guidelines and incentives are needed to encourage greater use of nature-based solutions and green infrastructure in both urban and rural areas, as they can provide benefits for biodiversity, climate adaptation and mitigation and other goals.

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Find out more: www.impressions-project.eu.