Climate and Biodiversity: Synergies and trade-offs

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Expansion of human activity and environmental changes over the past 250 years

Human activities have greatly expanded along with modernization, which triggered environmental degradations.

* The horizontal axis is the year in AD (1750-2000), and the vertical axis is the unit for each indicator (e.g. Population in "people", GDP in "dollars")

Source: Steffen et al. (2011). Wheat production is from FAOSTAT (online).
Climate change is one of the major direct drivers of biodiversity decline

Terrestrial: Land use change > Direct exploitation > Climate change > Pollution > Invasive alien species
Freshwater: Land use change > Pollution > Direct extraction > Climate change > Invasive alien species
Marine: Direct exploitation > Sea use change > Pollution > Climate change > Invasive alien species

Controlling climate change and protecting biodiversity are interdependent and essential for sustainable futures and good quality of life

- If anthropogenic climate change continues, social-ecological systems will continue to be degraded
- Solving climate change requires consideration of biodiversity and vice-versa

Source: IPBES-IPCC (2021) Scientific Outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change
Meeting climate target will not halt the biodiversity decline.

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**Indicator**
- **Biodiversity**: Species richness
- **Provisioning services**: Food, feed, wood, bioenergy
- **Regulating services**: Nitrogen retention, soil retention, crop pollination, crop pest control, carbon sequestration

- “Global sustainability” has the smallest impact on biodiversity and ecosystem services across the globe
- Impacts and their differences are large in the “Regional competition” and “Economic optimism.”
- Provisioning services are greatest in the “Regional competition” scenario and “Economic optimism,” but at the expense of a decline in biodiversity and regulating services

Measures that focus only on climate change mitigation and adaptation may have negative effects on biodiversity.

Climate measures that could have unexpected negative impacts include

- Large-scale monoculture of trees and bioenergy crops
- Planting trees in ecosystems that were not originally forests
- Reforestation with non-native tree species
- Wind power, hydroelectric power, mega-solar power plants
- Mining of resources for renewable energy technologies, etc.

Effects of actions to mitigate climate change on actions to mitigate biodiversity loss

Source: IPBES-IPCC (2021) Scientific Outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change
Many biodiversity conservation measures are compatible with climate change measures.

- Protected areas, ecosystem management for conservation purposes (e.g., forest fire control, reintroduction of important species) often produce co-benefits
- Reduced per capita consumption, dietary changes, and sustainable use of natural resources will also contribute to addressing the biodiversity and climate crises

**Effects of actions to mitigate climate change on actions to mitigate biodiversity loss**

(※: Synergy, : Trade-off)

Source: IPBES-IPCC (2021) Scientific Outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change
Conservation, restoration, and sustainable management of ecosystems will produce co-benefits for climate mitigation/adaptation and biodiversity conservation.

Nature-based solutions (NbS) will be one of the keys

“actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” (IUCN)

- Avoidance of loss and degradation of terrestrial and marine ecosystems
- Building green infrastructure in cities
- Effective through long-term and planned implementation
- NbS will only be effective if there is an ambitious reduction in anthropogenic greenhouse gas emissions.

Source: IPBES-IPCC (2021) Scientific Outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change