The impact of protected areas on biodiversity conservation for combined climate and land use change projections

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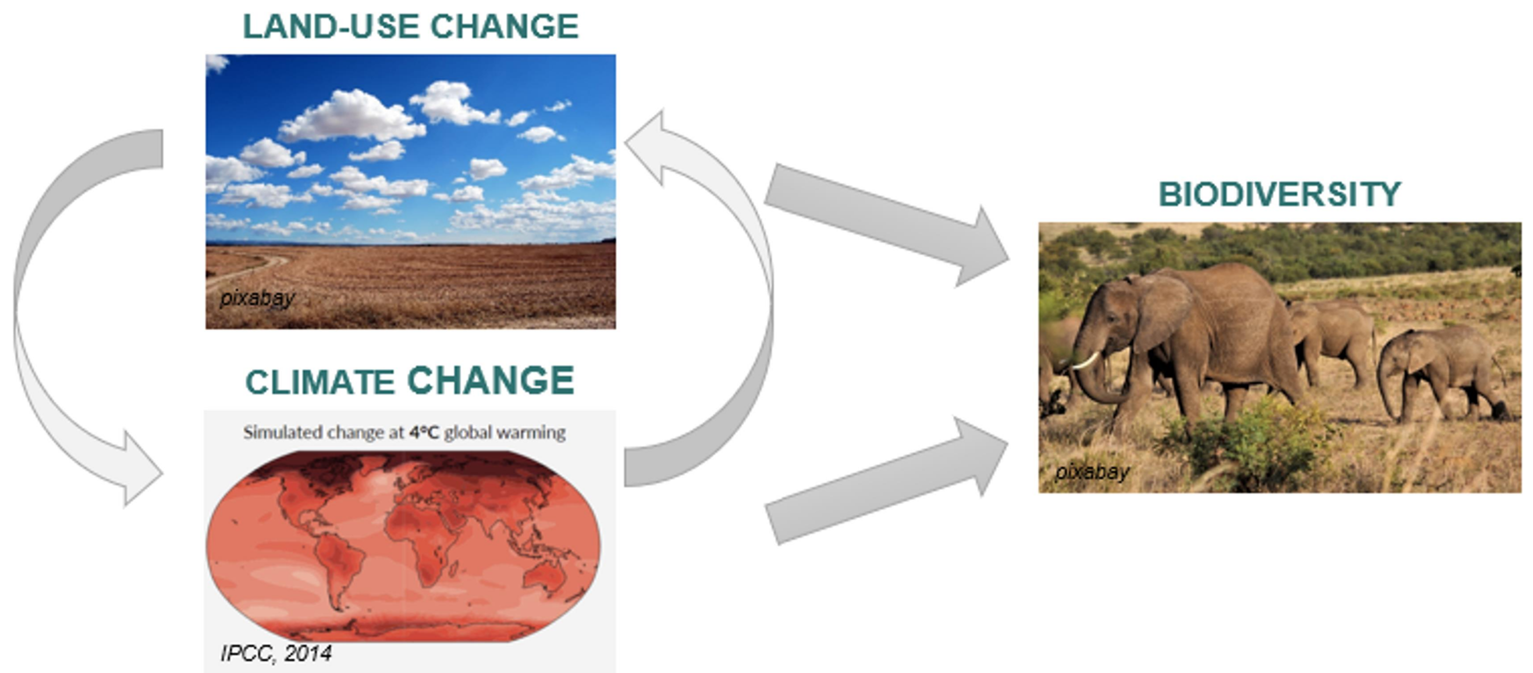
1 Context

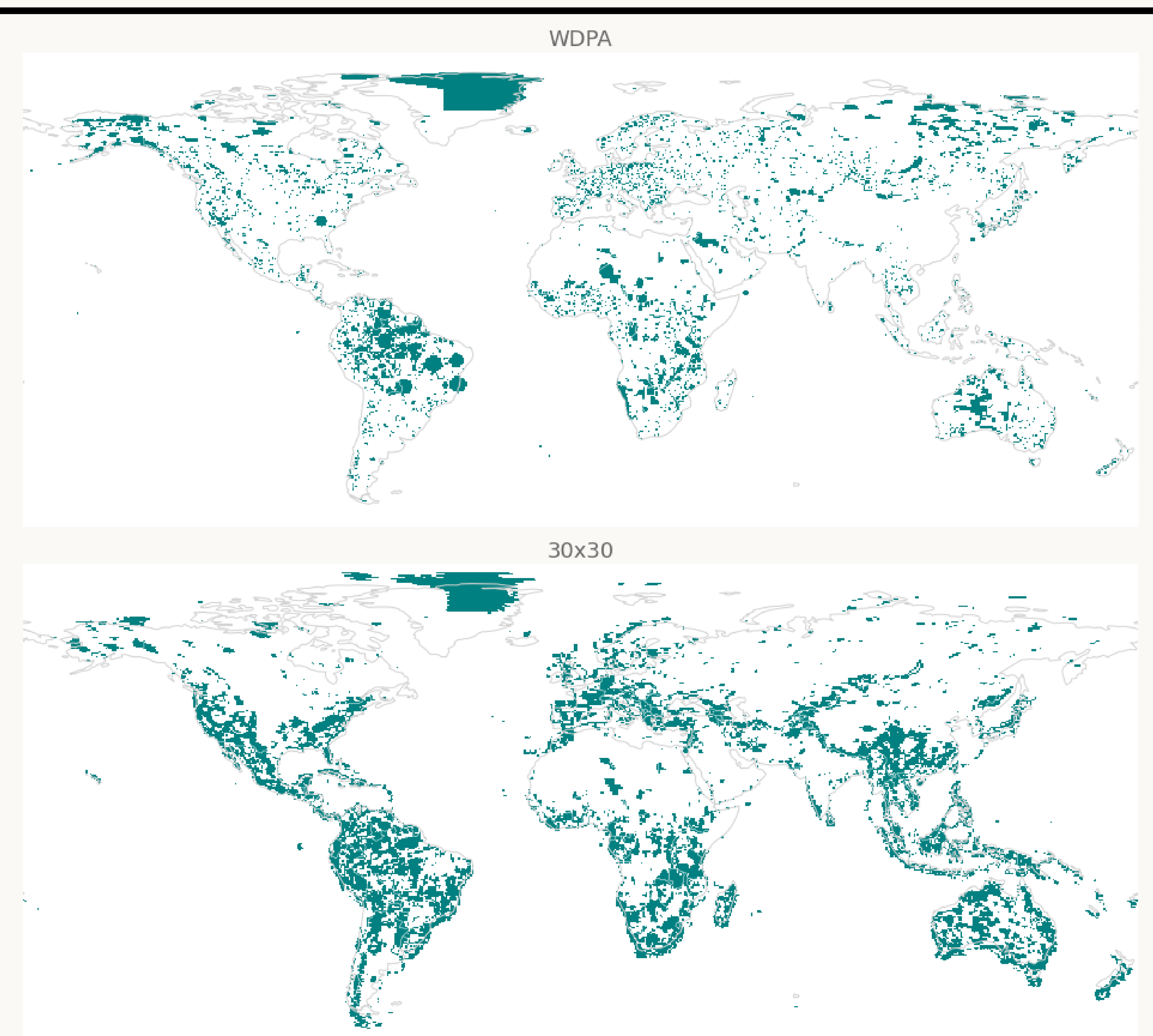
The impacts of **climate change and land use change** on **biodiversity** are likely to intensify in the future. Future projections of biodiversity impacts need to include climate change and **land use change**.



2 Aim

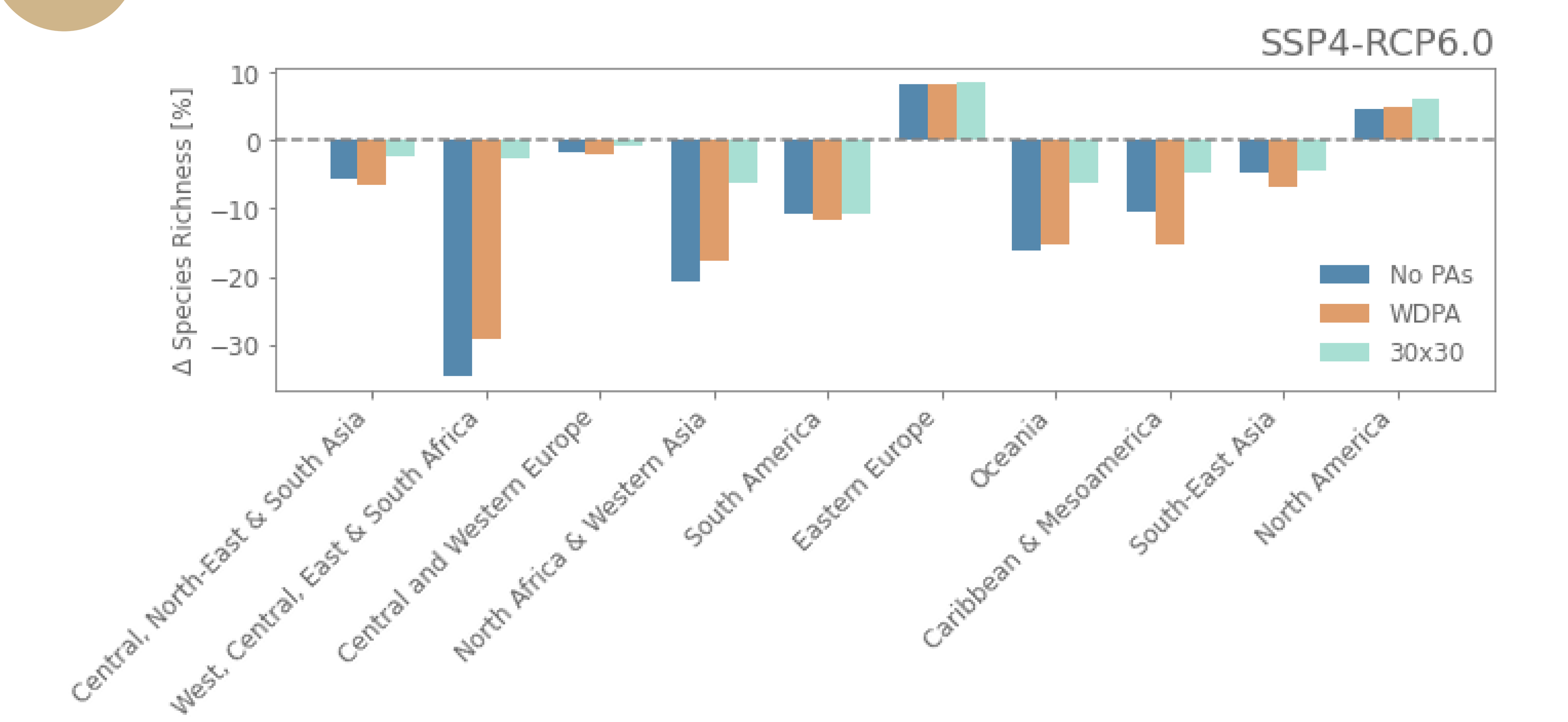
We aim to combine climate change and land use change scenarios **to assess their impacts** on terrestrial biodiversity and test the climate resilience of protected areas (PAs).

3 Protected Area Masks



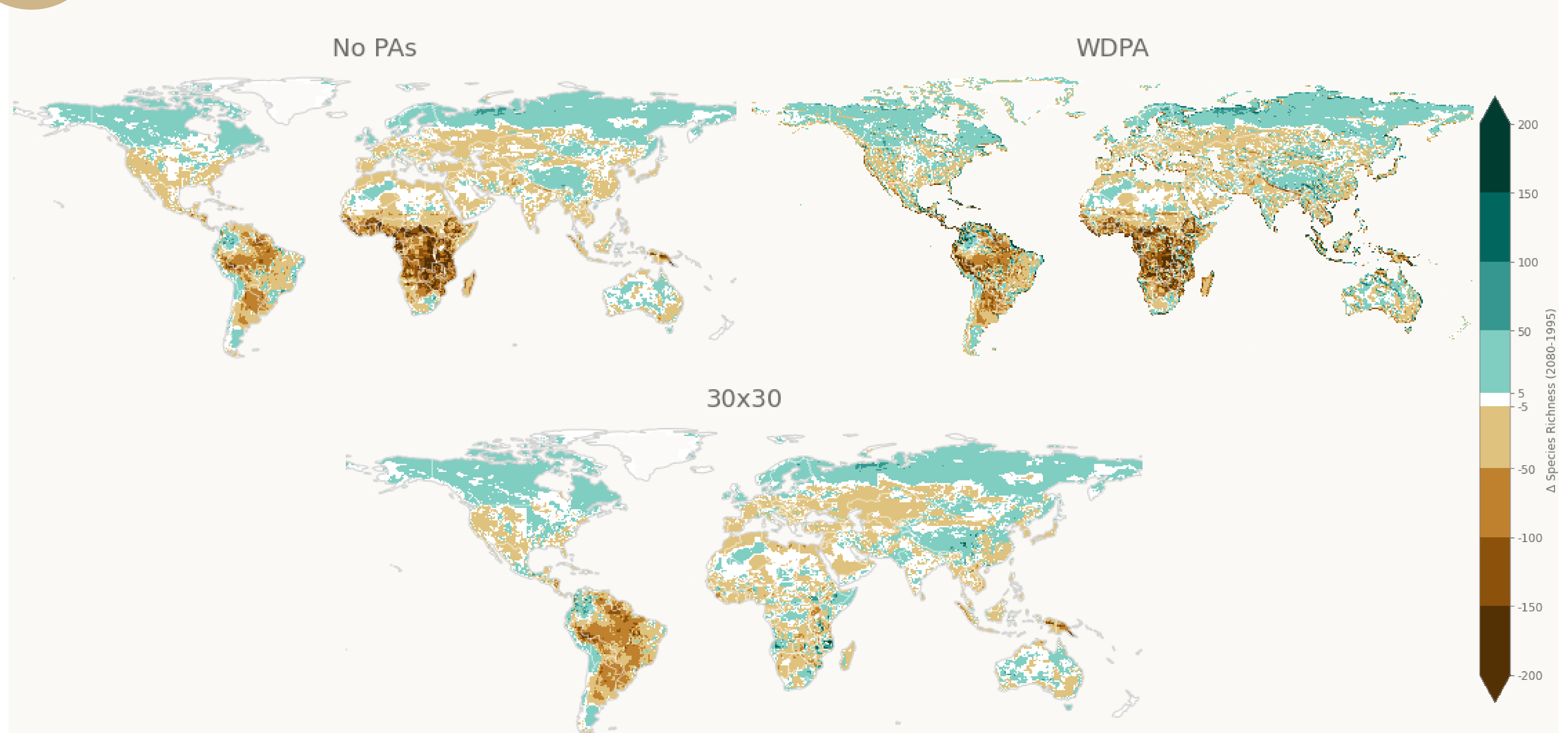
Binary protected area scenario masks. The protected area masks are generated based on current protected area network (WDPA 2023) and a "30x30" scenario (Jung et al. 2021).

4 Regional Relative Change



Relative change in species richness from 1995 to 2080 per region. The total climate and land use change impact per protected area scenario. The relative species richness was derived from species distribution model output (SDM) based on four general circulation models (GCMs; MIROC5, GFDL-ESM2M, HadGEM2-ES, and IPSL-CM5A-LR) and two SDMs (GAM and GBM) combined with land use data from the Land Use Harmonization 2 v2 (LUH2). The species richness was calculated as summed probabilities of occurrences from which the latitudinal weighted mean was derived and used for the relative change calculation.

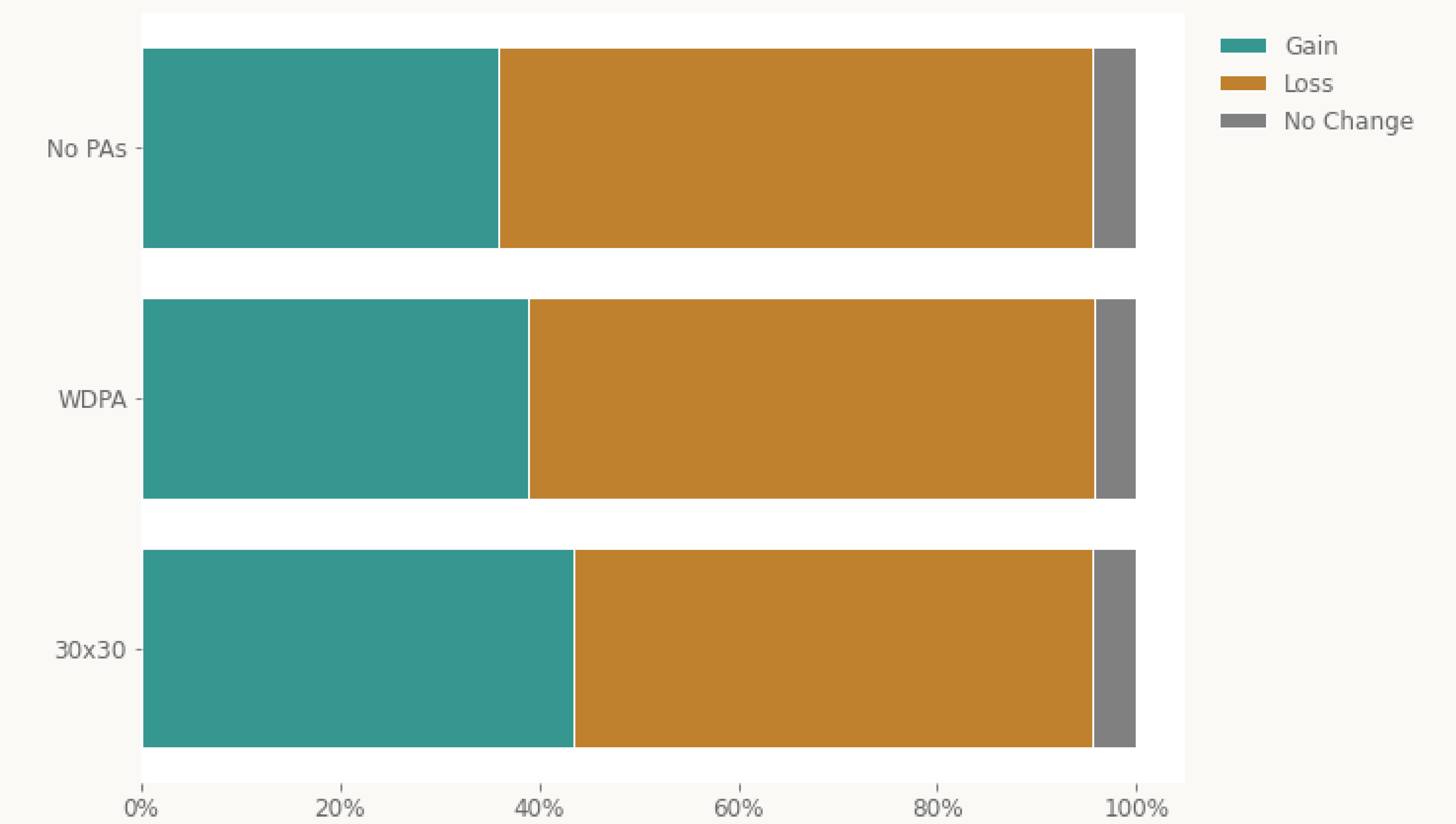
5 Species Richness Change in 2080 from 1995



Total climate and land use change impacts on future species richness for SSP4-RCP6.0. Projected species richness for the year 2080 relative to 1995 for different scenarios of protected areas. Species richness is calculated as the summed probabilities of occurrence over all species of the taxa mammals, birds, and amphibians. The probabilities of occurrence are aggregated latitudinal weighted means for each combination of GCM and SDM per grid cell.

- The combined climate and land use change impacts lead to biodiversity loss in the future in most regions of the lower latitudes, especially sub-Saharan Africa, South America, and South-West Asia.
- An increase in species richness is mainly projected to occur in the higher latitudes.
- Freezing land use change in grid cells that are part of the currently existing protected area network based on the World Database on Protected Areas (WDPA) leads to a reduced species richness loss in most regions.
- Species richness loss is further decreased when including the "30x30" conservation target of protected areas with substantially lower losses in West, Central, East & South Africa.

6 Comparison of Land Area Change



Climate and land use change driven land area change. The proportion of the total land area (excluding Antarctica) affected by species richness gain or loss over all taxa for SSP4-RCP6.0 and three different scenarios of protected areas. The proportion of area affected was based on species richness calculations per grid cell.

- Implementing the "30x30" conservation target mitigates species richness loss with significant gains in protected land area compared to the current WDPA scenario.
- Land area change without the inclusion of protected areas is projected to experience the greatest species richness loss, emphasizing the critical role of protected areas in biodiversity conservation.

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Key Literature

1. Hof, C., Voskamp, A., Biber, M. F., Böhning-Gaese, K., Engelhardt, E. K., Niamir, A., Willis, S. G., & Hickler, T. 2018: Bioenergy cropland expansion may offset positive effects of climate change mitigation for global vertebrate diversity. Proceedings of the National Academy of Sciences of the United States of America, 115(52), 13294–13299.
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