Forest biodiversity under changing climate and forest structure

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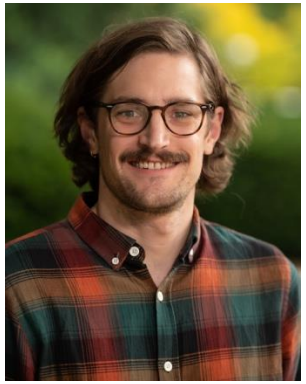
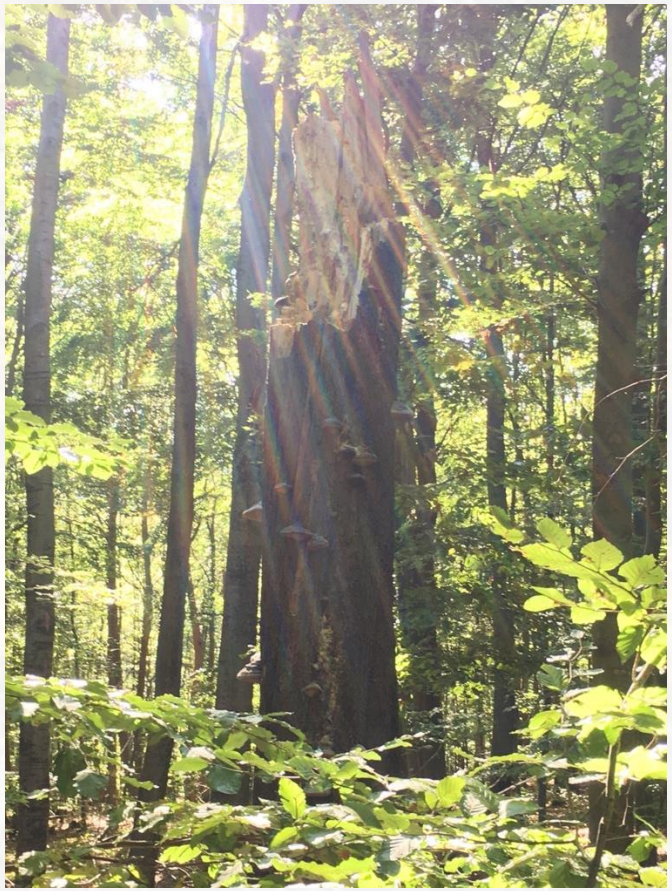


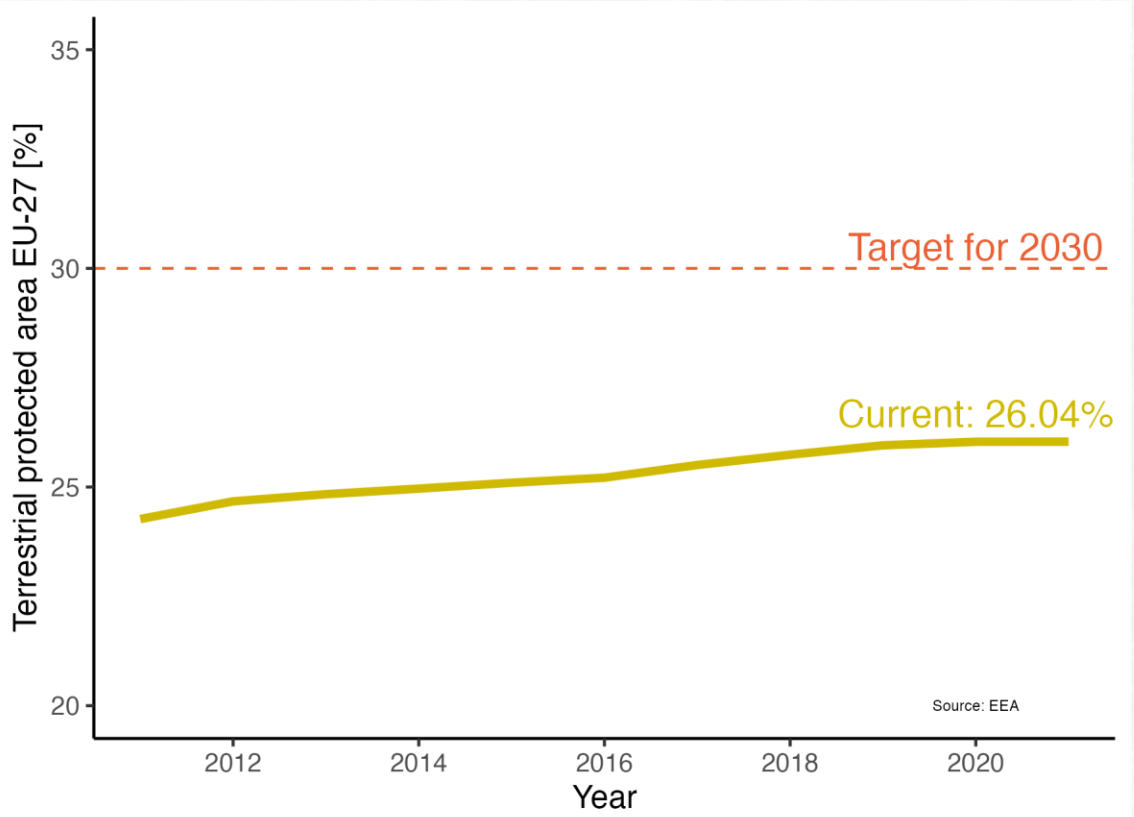
Funded by the European Union

Forests and biodiversity in the EU

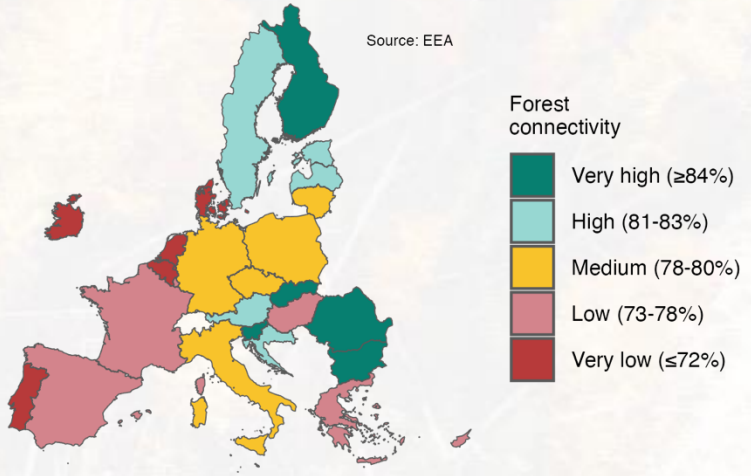


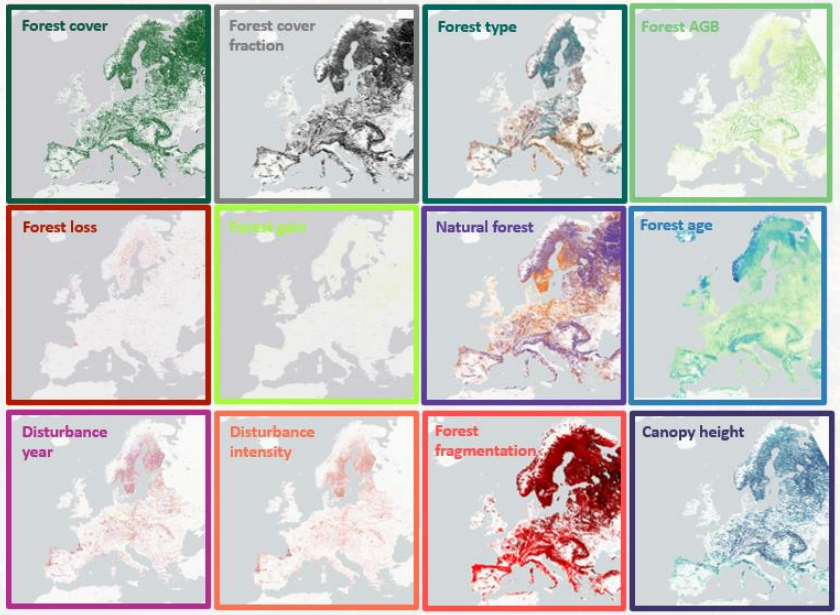
- Key role to reach climate neutrality by 2050
- EU Biodiversity Strategy for 2030
  - Protect > 30% of land and sea area
  - Strictly protect > 10% area incl. primary and old-growth forests
  - Manage protected areas using conservation objectives incl. closer-to-nature management
- Nature Restoration Law
  - Re-establishing biodiverse habitats
  - Reversing pollinator decline
  - Increase deadwood, uneven-aged structure, connectivity, abundance of forest birds, stock of organic carbon

Current forest status



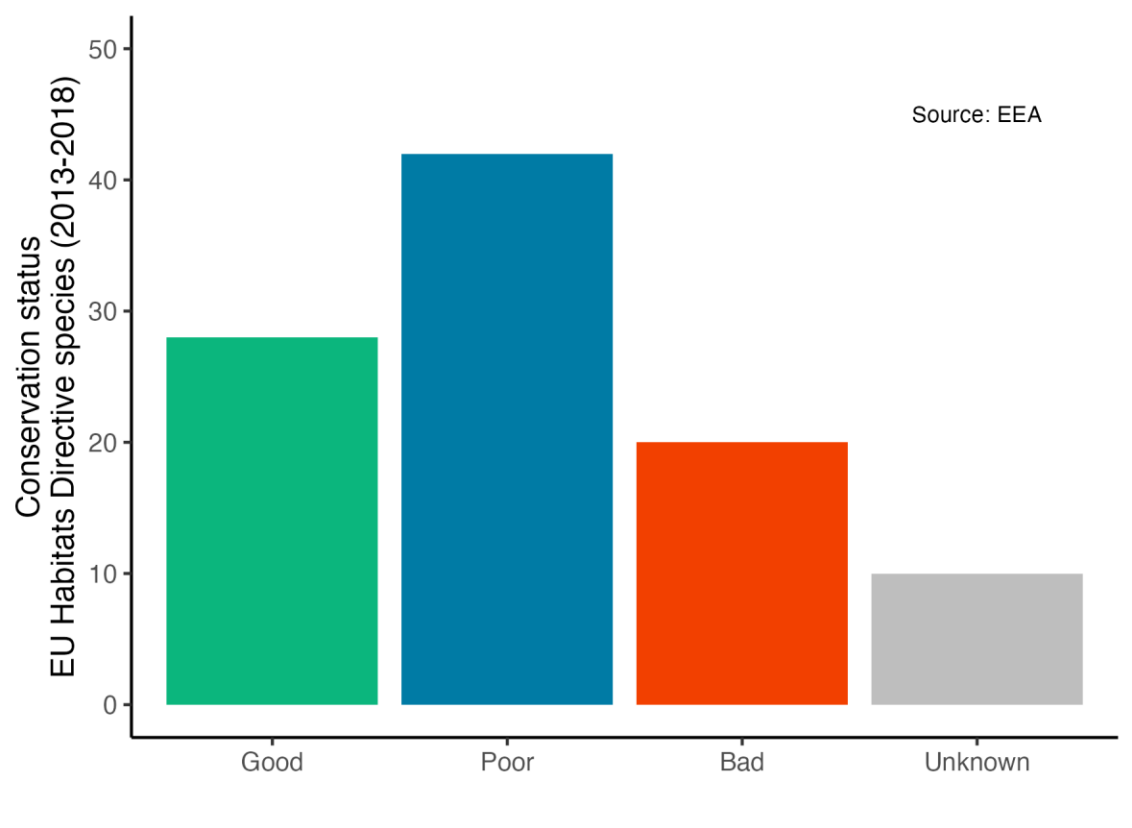
Natura 2000 sites	18.6%
Other national designations	7.4%
Total	**26.0%**

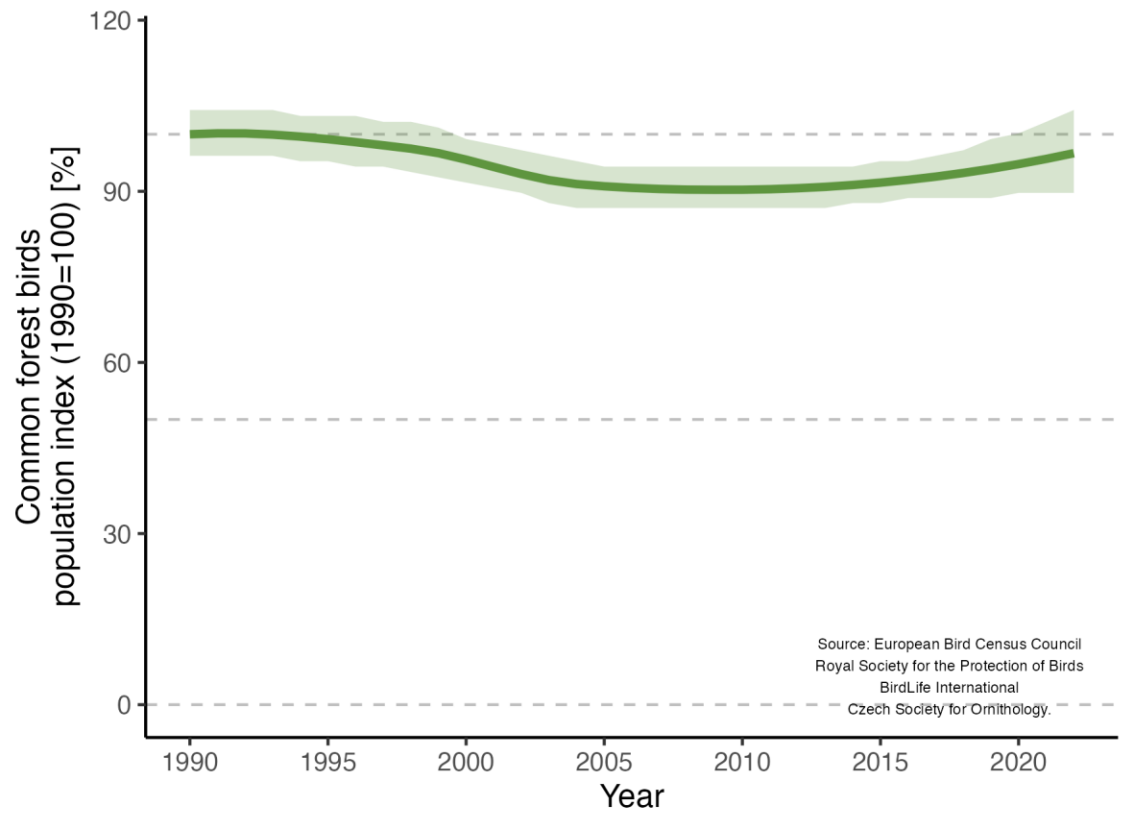




Forest4Model datacube

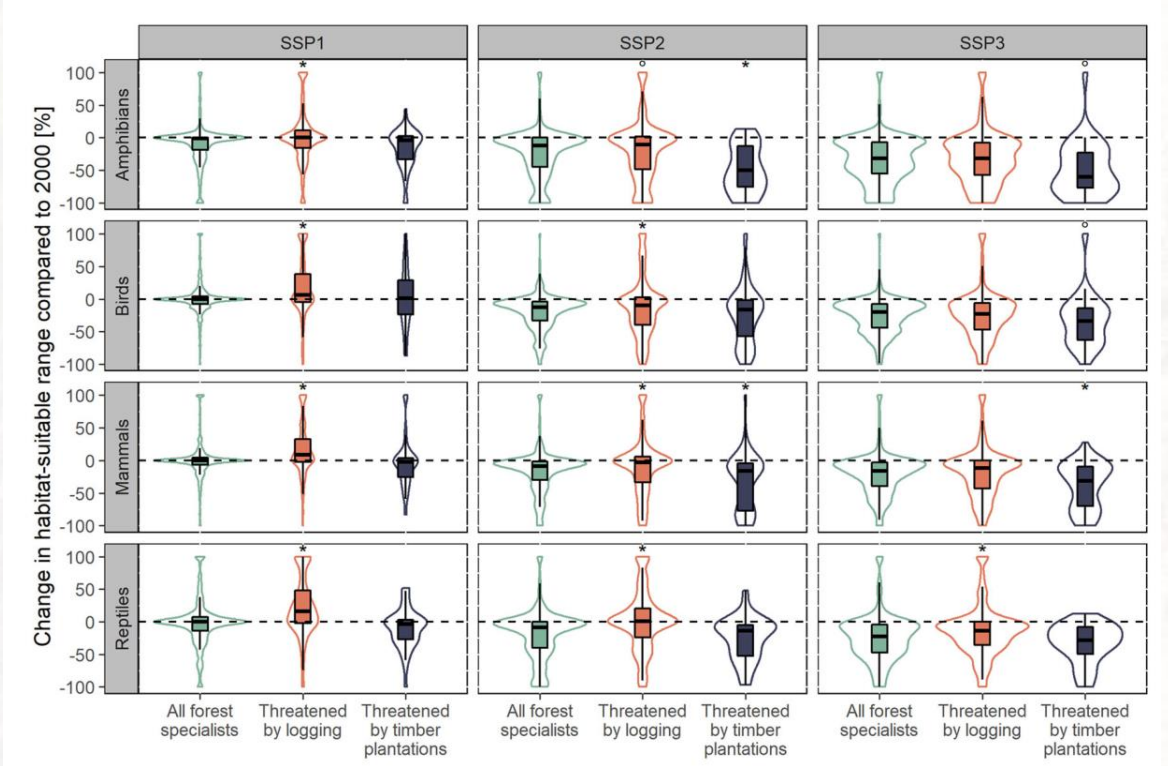
Current biodiversity status





Future projections

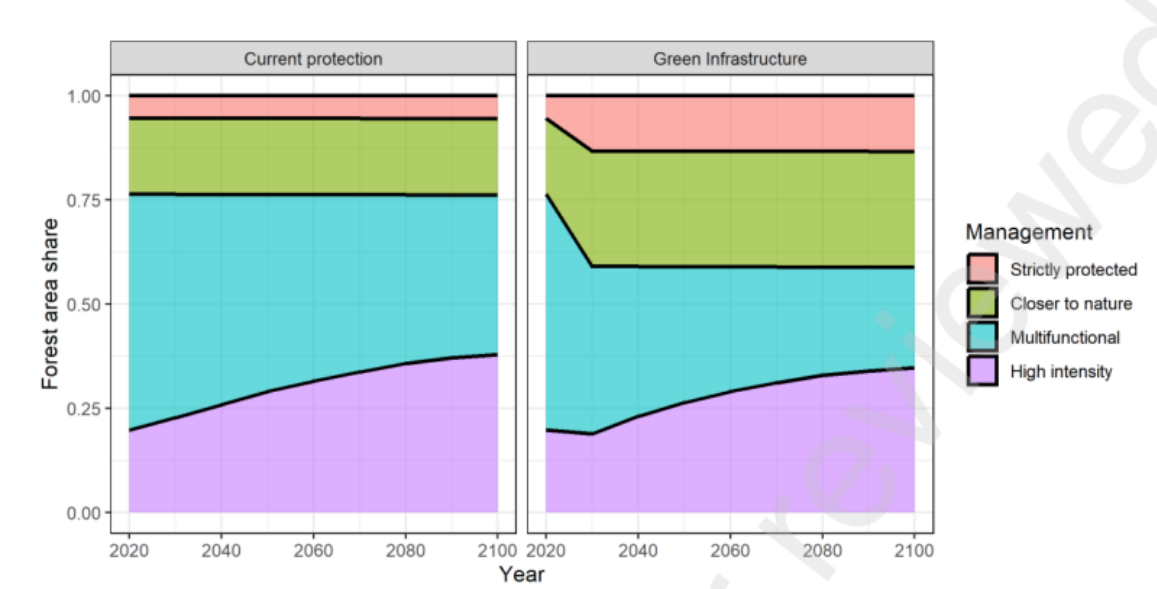
- Limited research on climate change and forest management impacts on projected biodiversity within EU



Schulze et al. 2020. The impact of accounting for future wood production in global vertebrate biodiversity assessments. Environ. Manage. 66, 460–475. https://doi.org/10.1007/s00267-020-01322-4

Potential EU Biodiversity Strategy scenarios

Scenario Name	Description
Current protection	Maintains current EU protection areas
EU	Distributed to land where it has the least economical impact
BioGeo	Objectives are achieved for EU biogeographical regions
Country	Objectives are achieved for EU countries
Country BioGeo	Objectives are achieved for EU biogeographical regions and countries
Country Productivity	Within EU countries so that protected/unprotected forests have the same country-level mean productivity
Green Infrastructure	Distributed to rebuild the EU green infrastructure and facilitate dispersal and migration of species



Di Fulvio et al. 2024. Impact of the EU biodiversity strategy for 2030 on the EU wood-based bioeconomy. https://doi.org/10.2139/ssrn.4718363

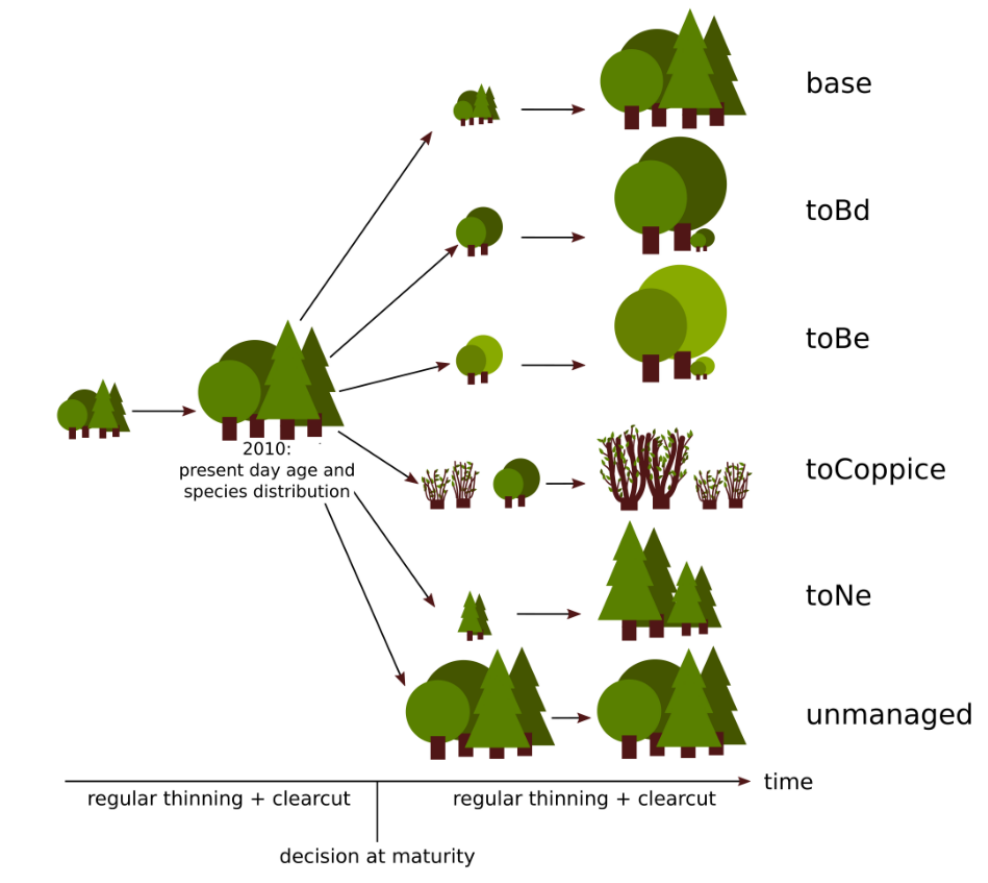
Potential EU Biodiversity Strategy scenarios

EU Biodiversity Strategy Objective	Moderate Scenario	Intensive Scenario
Protect > 30% of land and sea area	• Natura 2000 sites • Natural forest development sites	• Natura 2000 sites • All other legal protection categories
Strictly protect > 10% area incl. primary and old-growth forests	• Natural forest protection development sites • Primary and old-growth forest negligible	• National parks core zones • Biosphere reservations • Primary and old-growth forests in stands older than rotation period

Manage and monitor protected areas using conservation objectives	• Management schemes of Natura 2000 sites implemented at
	  • 45% of FFH sites
	  • 50% of SPA sites
		Management schemes of Natura 2000 sites at all protected sites

Schier et al. 2022. Assessment of possible production leakage from implementing the EU biodiversity strategy on forest product markets. Forests 13, 1225. https://doi.org/10.3390/f13081225

Potential EU Biodiversity Strategy scenarios



- Replanting same species composition
- Converting to:
  - Needle-leaved evergreen
  - Broad-leaved deciduous
  - Broad-leaved evergreen
  - Coppice forests
- Leaving forest unmanaged

Gregor et al. 2024. Reconciling the EU forest, biodiversity, and climate strategies. Global Change Biol. 30, e17431. https://doi.org/10.1111/gcb.17431

The *ForestNavigator* project

- Quantify climate change and forest management impacts on forest biodiversity
  - Annexes I/II of Article 12/17
  - European Red Lists of Species

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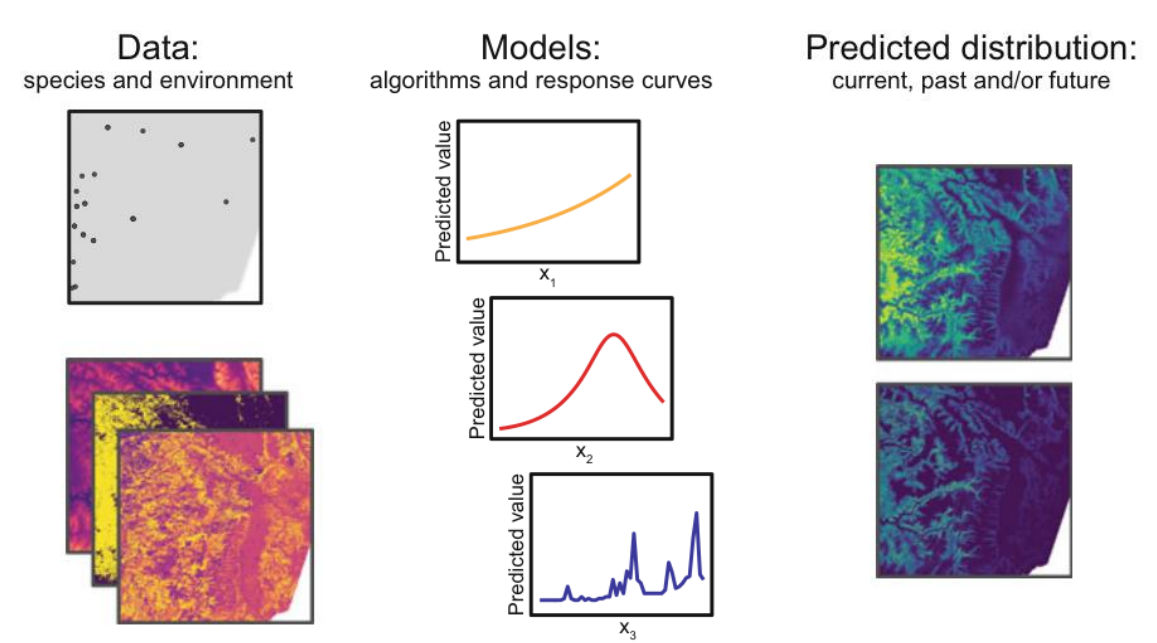
Species distribution modelling

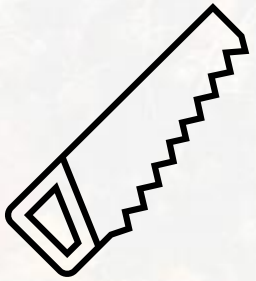
- Data requirements
  - Species occurrence data
  - Environmental and forest structure data
- Various statistical models
- Predict current and future distributions
- Future distributions according to climate change and forest management scenarios



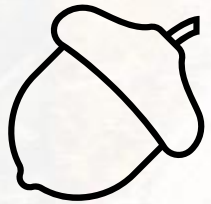
Fletcher, R., Fortin, M.-J., 2018. Spatial ecology and conservation modeling. Applications with R. Springer International Publishing, Basel, CH.

Current future scenarios *ForestNavigator*

RCP 2.6
RCP 7.0
RCP 8.5



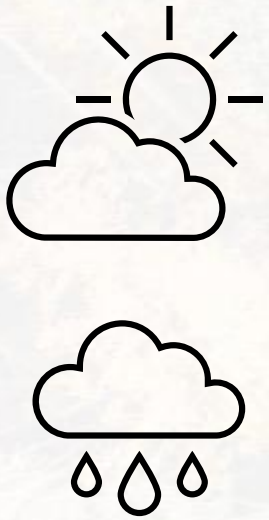
Baseline
Increased management
Decreased management
No management



Maintaining species composition
Admixing climate-adapted species

Climate and structural forest variables

Climate variables MPI-ESM1-2-HR / IPSL-CM6A-LR / GFDL-ESM4 / UKESM1-0-LL (ISIMIP3b)



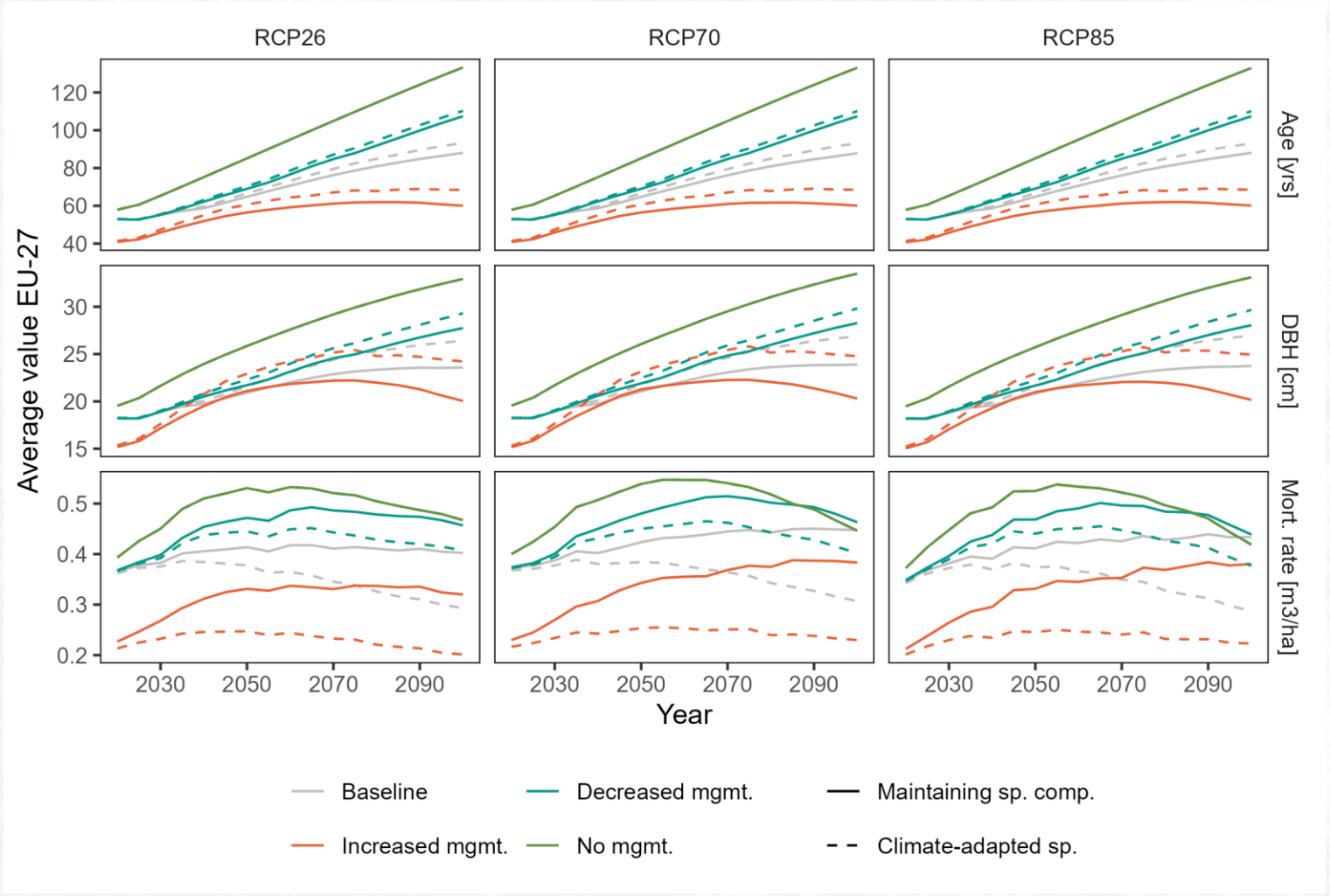
1	Precipitation
2	Average temperature
3	Minimum temperature
4	Maximum temperature

Forest structure variables G4M-X

1	Tree age
2	Tree height
3	Crown width
4	Crown length
5	DBH
6	Basal area
7	Volume
8	Tree density
9	GPP/NPP
10	LAI
11	Species composition
12	Litter
13	Tree mortality
14	Deadwood

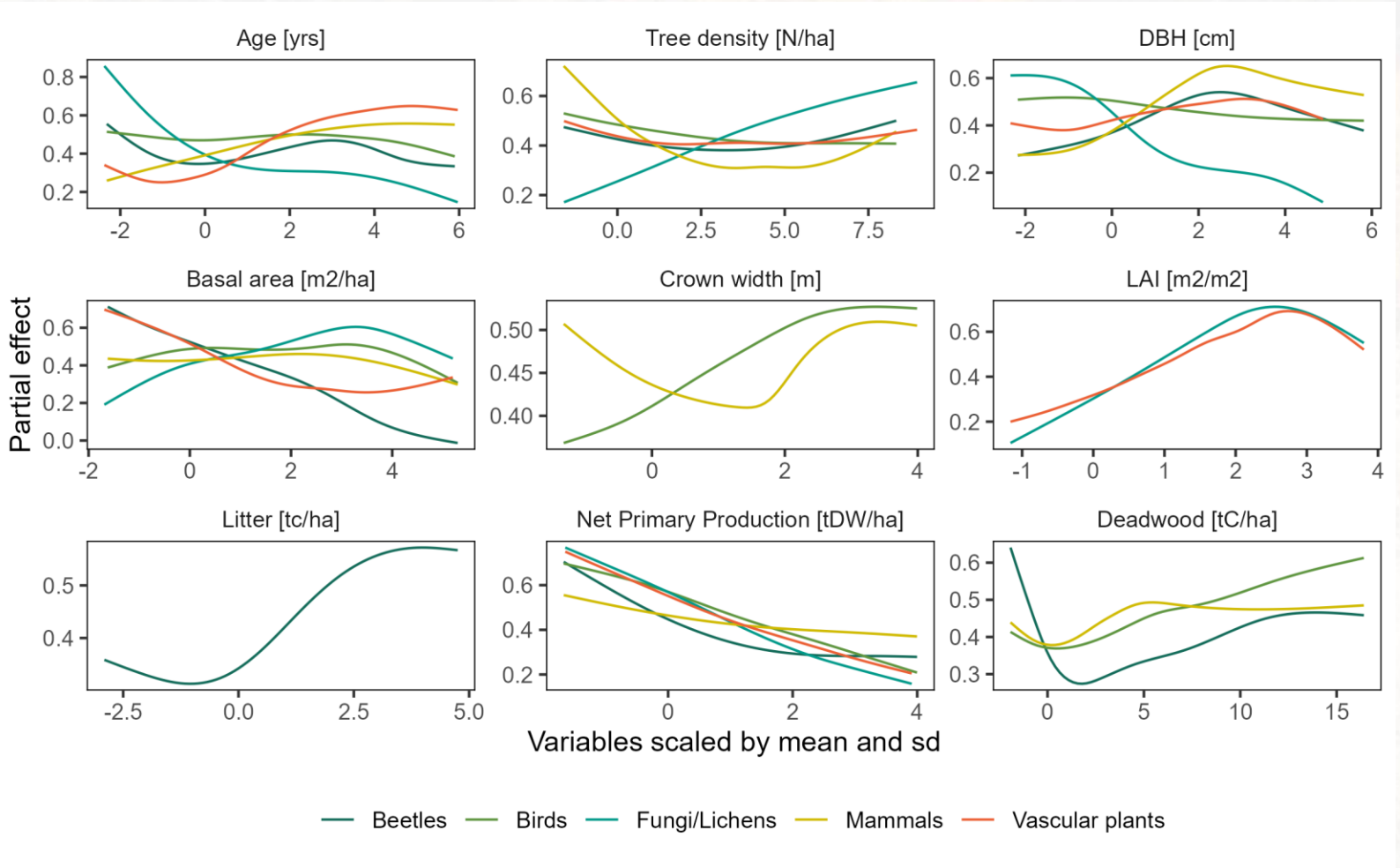
Forest management scenarios (preliminary)

- Baseline:
  - Following historical patterns
- Increased management:
  - Higher thinning intensity
  - Shorter rotation period
  - Shorter thinning interval
- Decreased management:
  - Lower thinning intensity
  - Longer rotation period
  - Longer thinning interval
- No management:
  - No harvesting

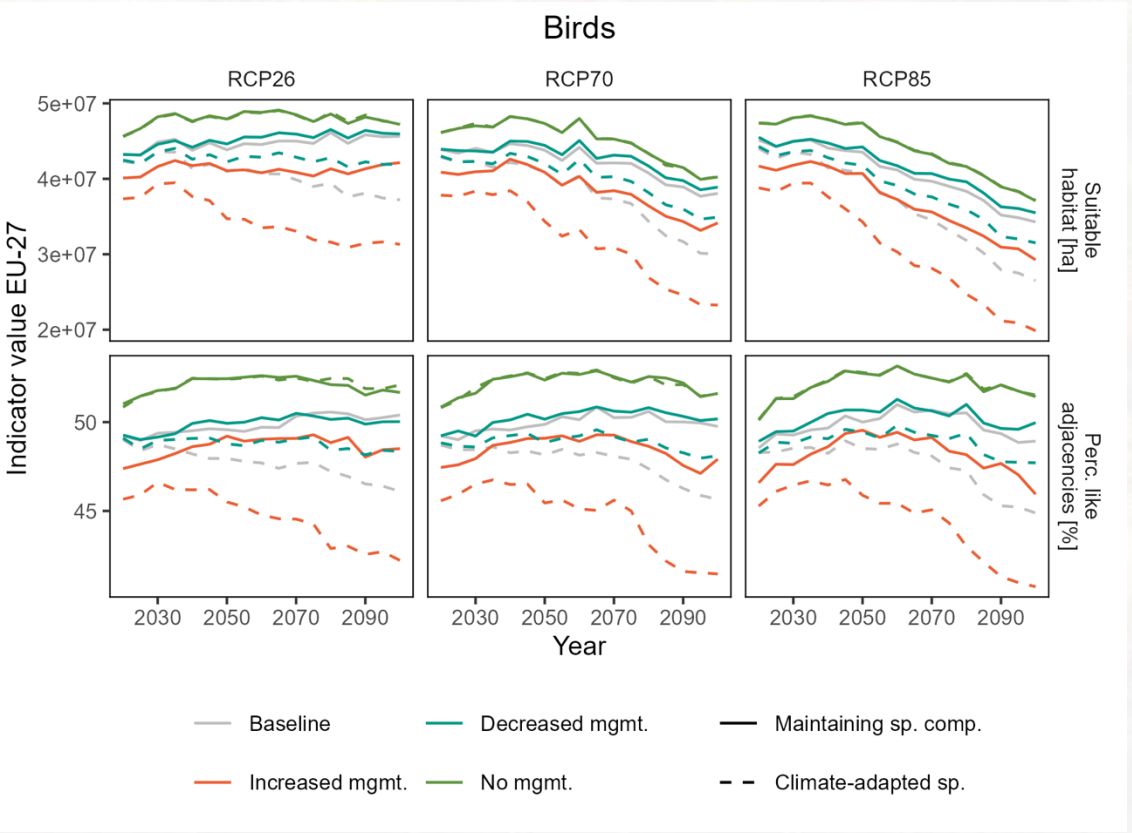


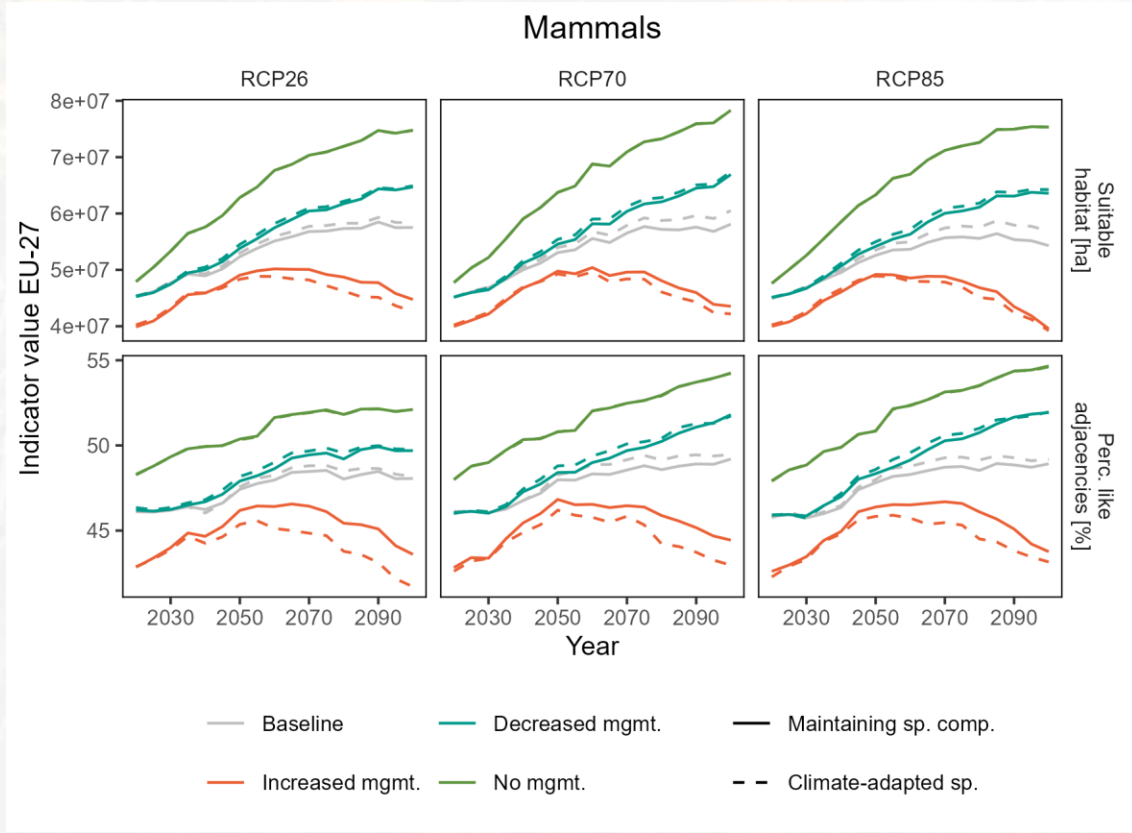
Averaged partial response functions

(sub-selection of species groups; preliminary)

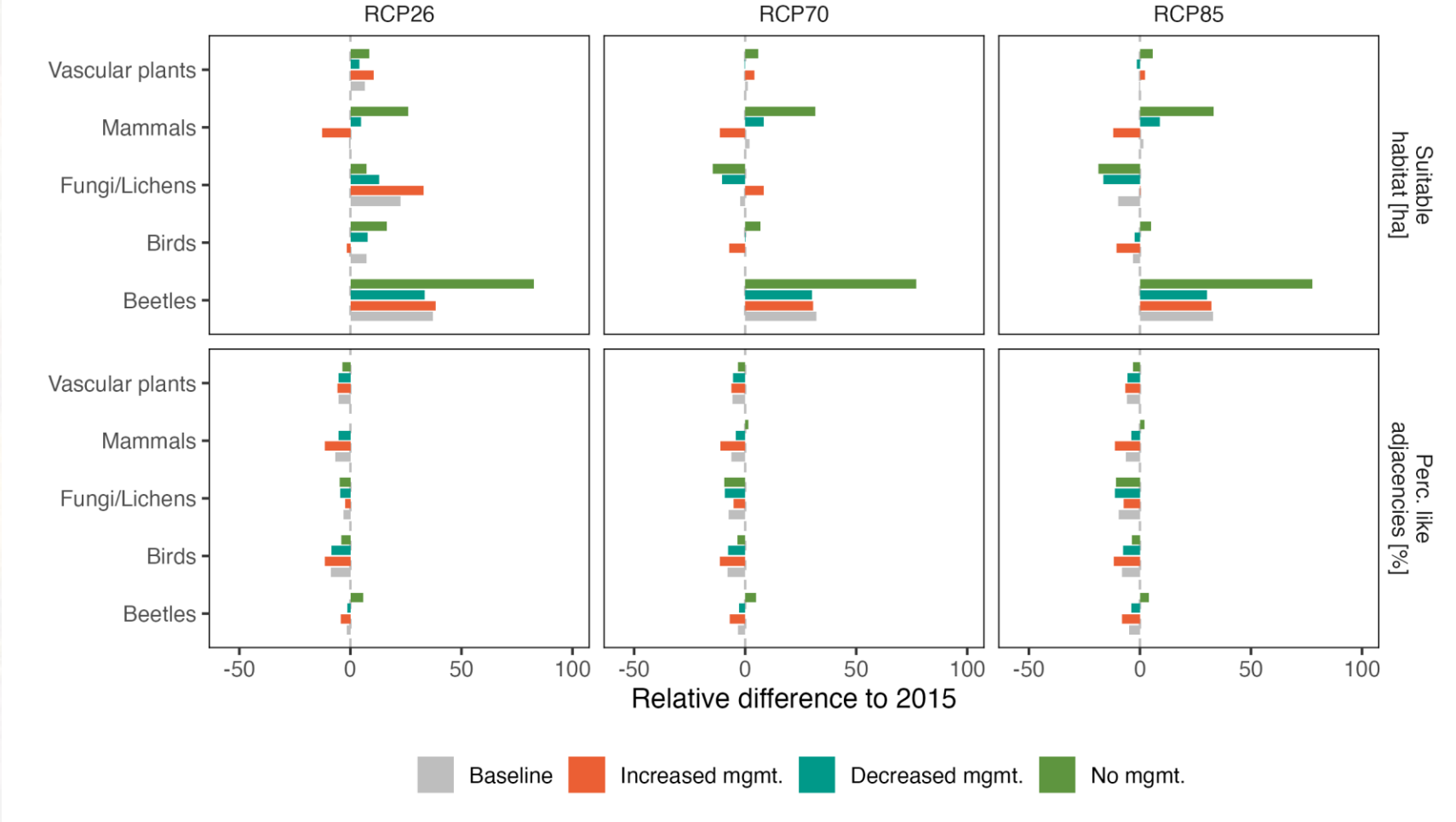


Change of suitable habitat (preliminary)





Aggregated change of suitable habitat
(preliminary)



Questions for breakout session

- How can the EU Biodiversity Strategy and Nature Restoration Law be translated into biodiversity scenarios?
- How can forest (management) characteristics be translated into biodiversity scenarios?
- What taxa, species, and indicators are of interest for forest biodiversity?

Thank you for your attention

Questions?

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