

Using models and scenarios

Monitoring progress and evaluating pathways to success

Tom Mason, Samantha Hill

A scenic view of a lush green forest with a waterfall cascading down a rocky cliff. The forest is dense and vibrant green, covering the hillsides. The waterfall is a prominent feature, falling from a high cliff into a pool of water below. The sky is blue with some clouds.

Structure

i. COOP4CBD Task 3.3

ii. Background to models and scenarios

iii. Pilot methodology

iv. Next steps

COOP4CBD Task 3.3

Develop technical capacity in the use of models and scenarios to review progress and assess pathways to success

Deliverables

1. Piloted assessment methodology to review progress and ambition under the KMGBF
2. Guidance on using models and scenarios to review progress and ambition



Models and scenarios: your perception and experience

Go to menti.com
Input code **5734 2145**



Models and scenarios

Models

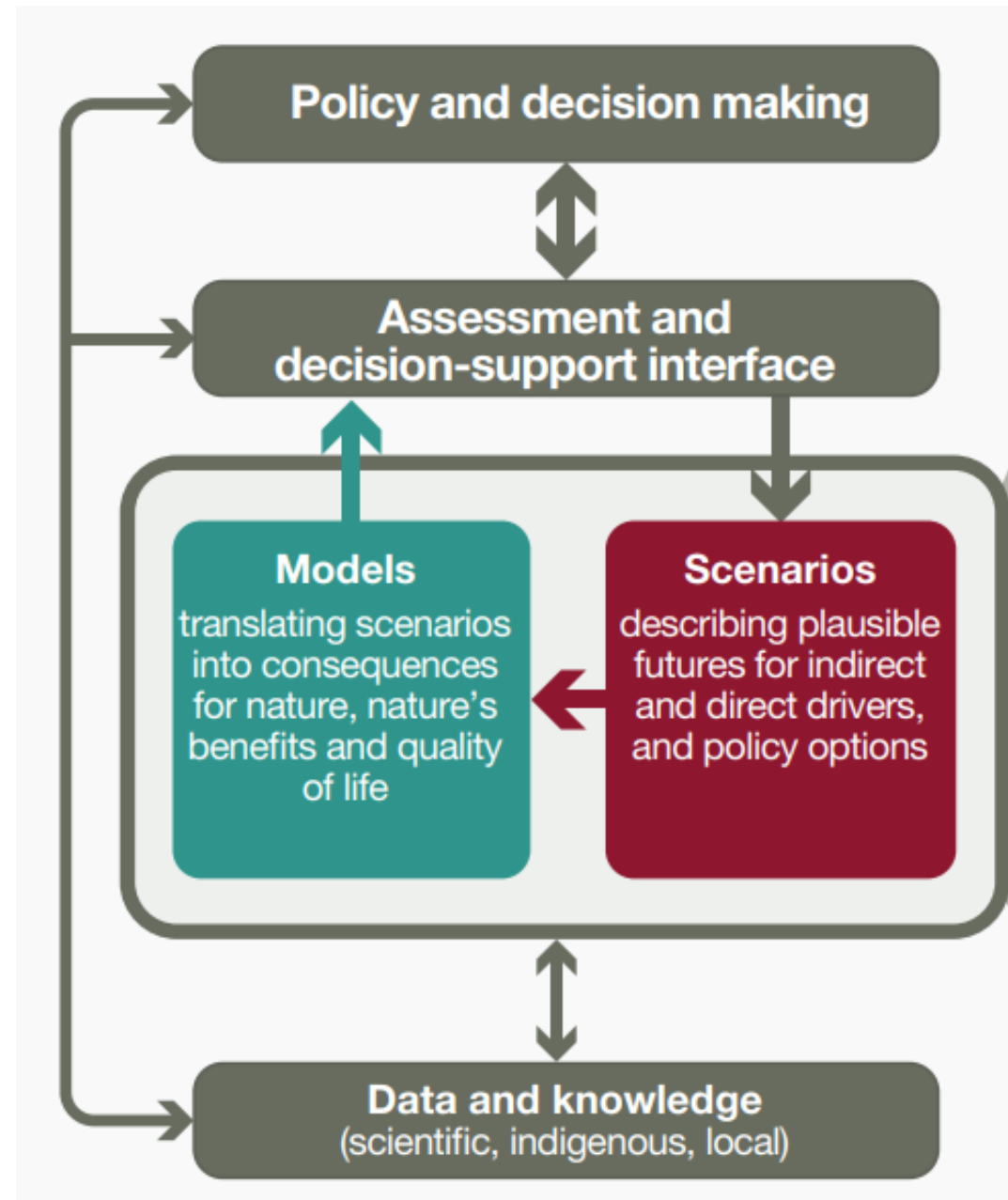
Qualitative or quantitative representations of a system and of relationships between components

Scenarios

Plausible futures for indirect or direct drivers, or to policy interventions targeting these drivers

Models + scenarios

Consequences of scenarios on systems (e.g., nature) can be evaluated using models



Relevance to KMGBF

1. Monitoring progress towards targets

- Are actions being implemented?

2. Evaluating pathways towards goals

- Are implemented actions sufficient?

Most relevance to:

- Goals A and B
- Targets 1-12

Goal/Target	Relevance of models & scenarios	Examples
Goal A – Biodiversity outcomes	Very high	Models of state of biodiversity
Goal B – Sustainable use	High	Ecosystem service models
Goal C – Benefit sharing	Moderate	Socio-economic scenarios to explore benefit flows
Goal D – Implementation means	Moderate	Economic models to explore investment needs
Target 1–3 (spatial planning, restoration, conservation)	Very high	
Target 7–10 (pollution, climate, invasive species)	High	
Target 14–16 (mainstreaming, sustainable consumption)	Moderate	
Target 18–19 (finance, capacity)	Moderate	

Models

1) Correlative

- Empirical data used to estimate parameters
- No predefined ecological meaning

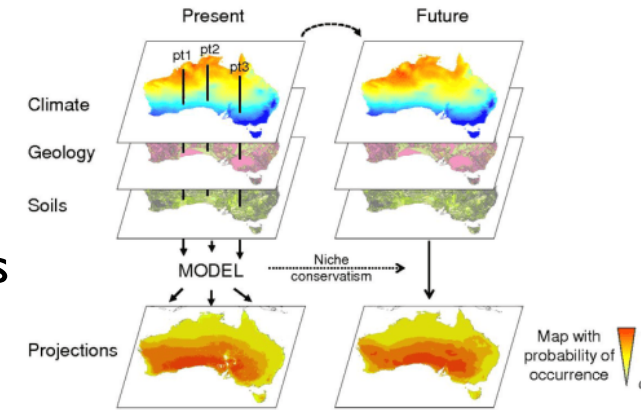
2) Process-based

- Relationships explicitly-stated processes
- Parameters have predefined interpretation

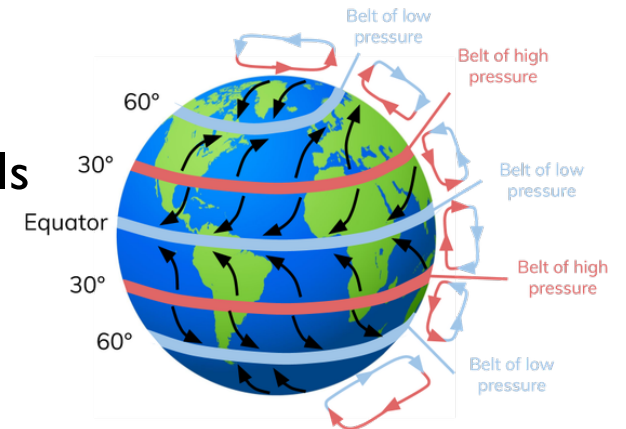
3) Expert-based

- Relationships described using experience of experts and stakeholders

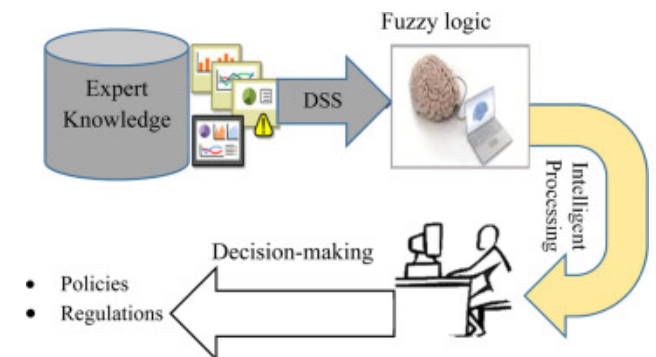
e.g., Species Distribution Models



e.g., General Circulation Models



e.g., Decision support models



Models and indicators

Two types of biodiversity indicator:

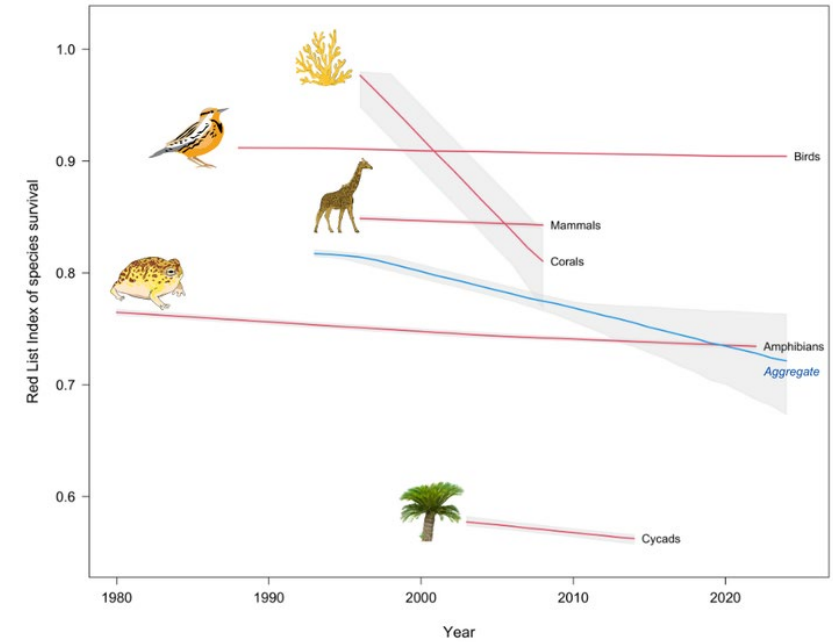
Compiled indicators

- Trends determined from data on biodiversity
- May incorporate some modelling e.g., gap-filling, correcting biases, smoothing

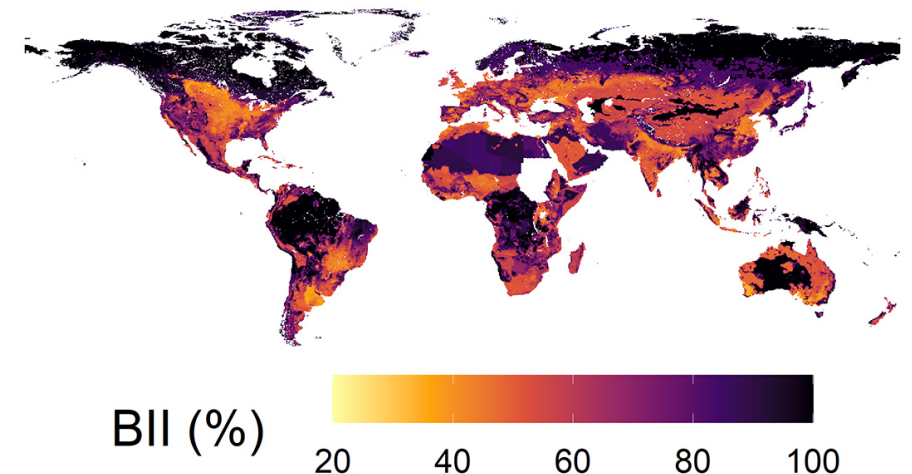
Model-based indicators

- Trends estimated from models that incorporate drivers of change
- Can project whether a set of proposed actions are expected to be sufficient to achieve goals

A.3 Red List Index



Biodiversity Intactness Index



Models as a 'satnav' for nature

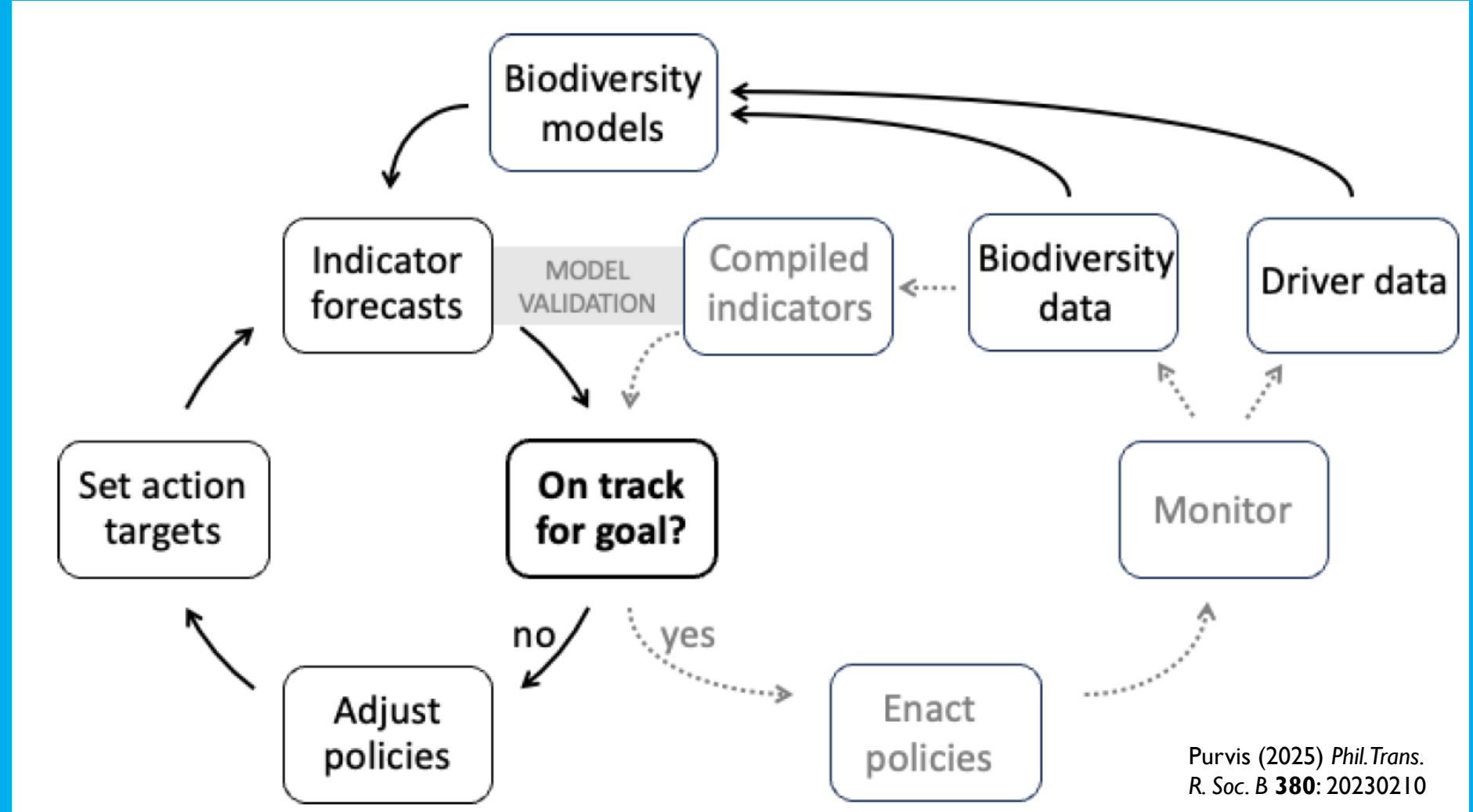
- i. Models to predict expected future outcomes of today's choices
- ii. Rapid feedback from monitoring to enable course corrections and model improvement

Without this, we will have to find our way to the goals by looking in the rear-view mirror (eg from periodic review of available headline indicators)



Models as a 'satnav' for nature

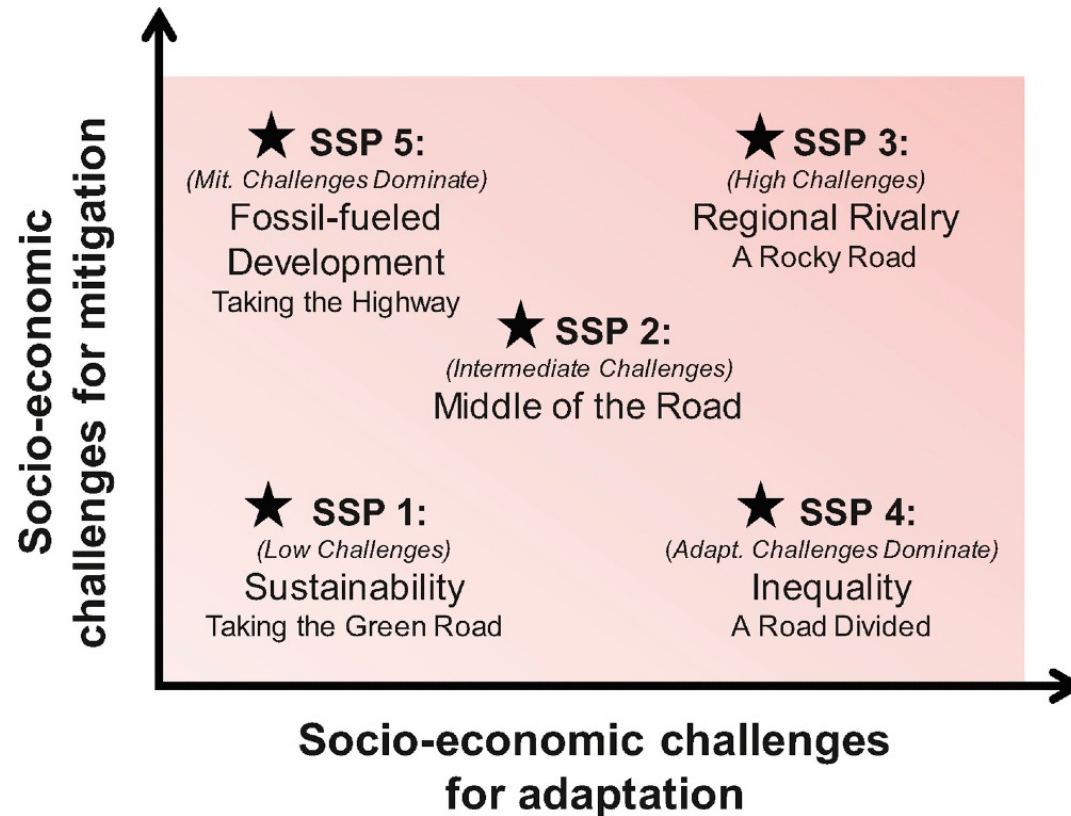
Models link indicators, goals, targets and policies



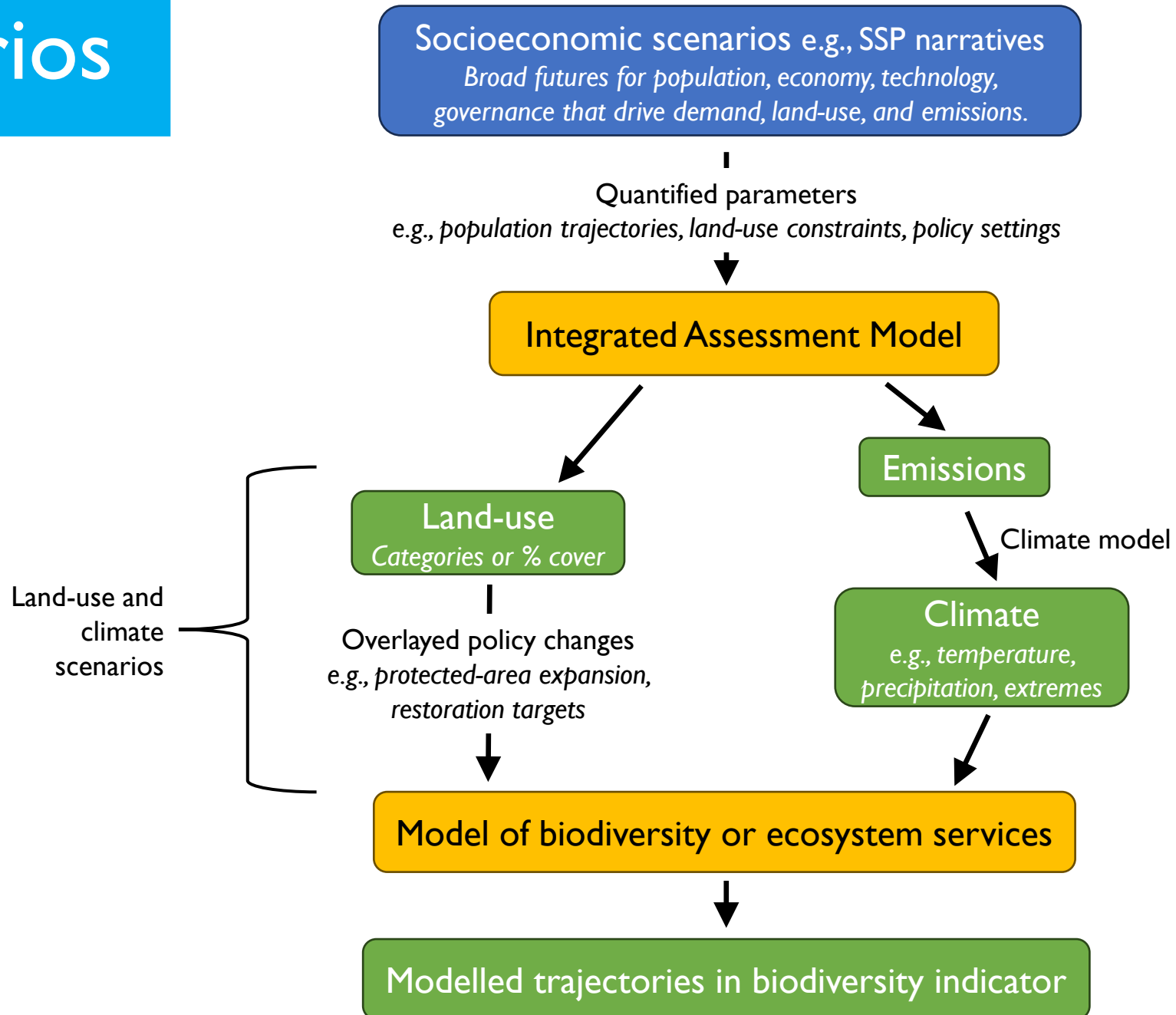
Scenarios

Socioeconomic scenarios e.g., SSP narratives

Broad futures for population, economy, technology, governance that drive demand, land-use, and emissions.

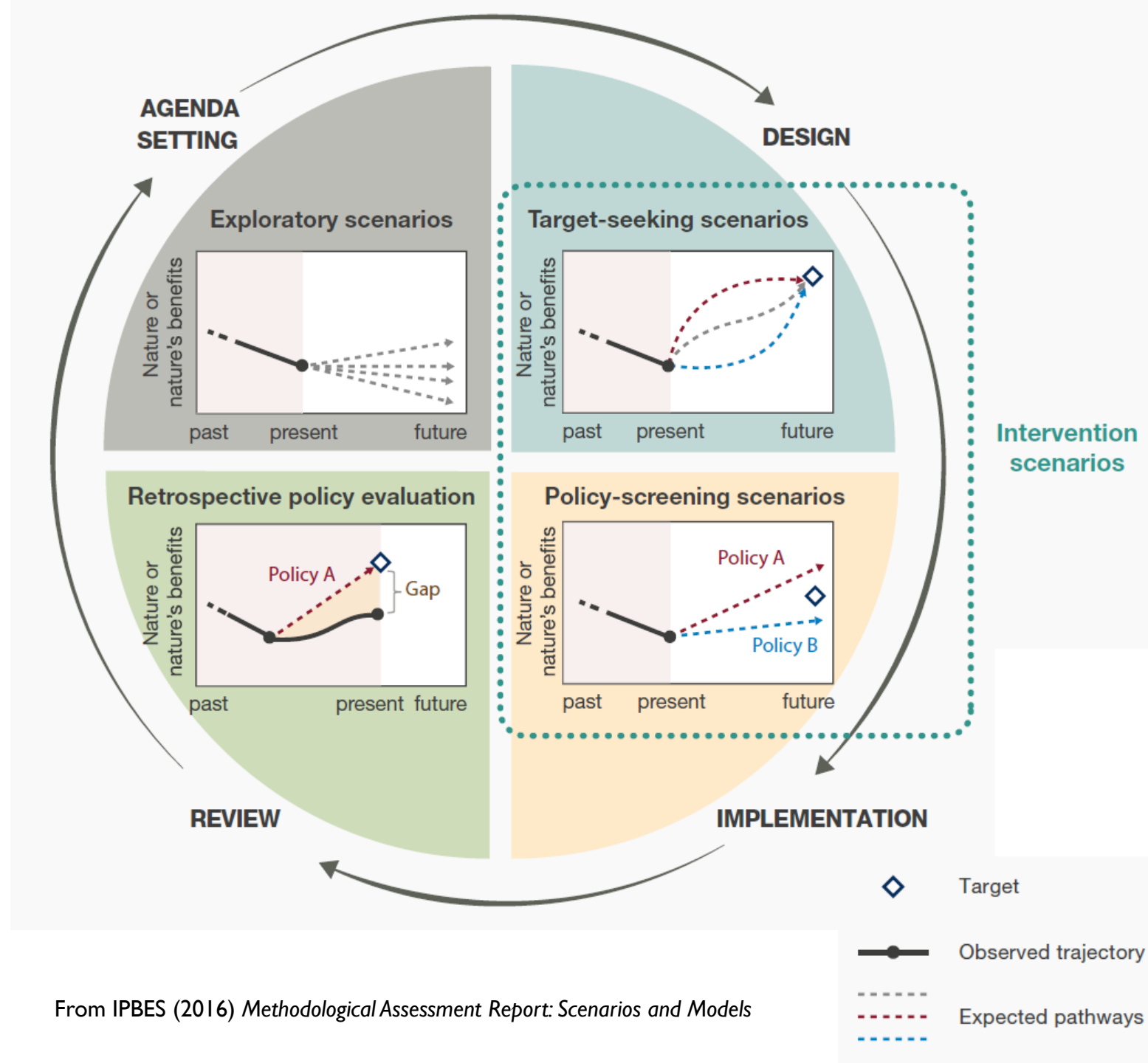


Scenarios



Scenarios

Different roles depending on phase in policy cycle



From IPBES (2016) *Methodological Assessment Report: Scenarios and Models*

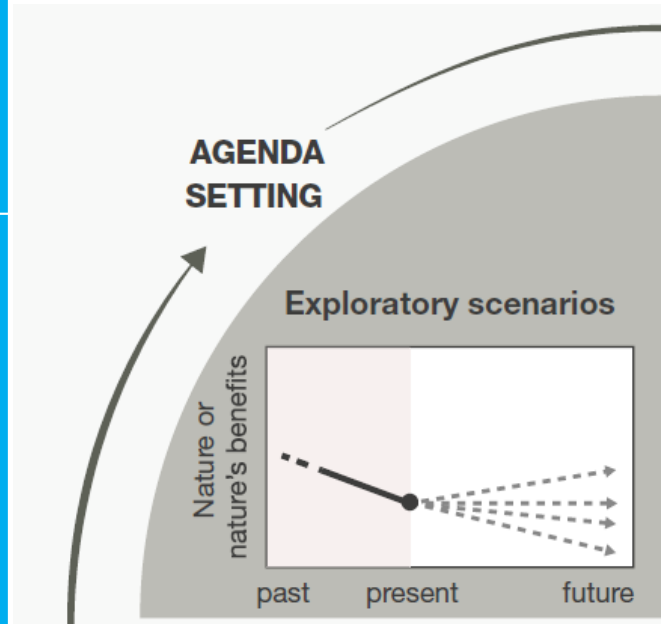
Scenarios

Exploratory scenarios

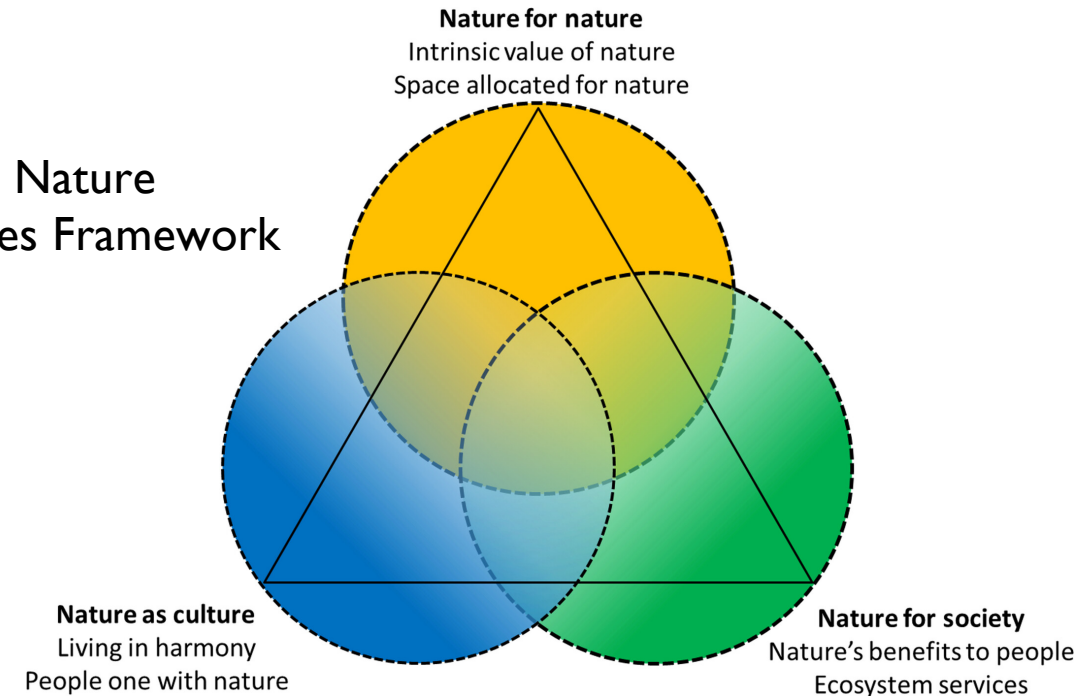
- Examine range of plausible futures based on potential trajectories of drivers
- Indirect (e.g. sociopolitical) or direct drivers (e.g. habitat conversion)

“What could happen to nature and society under different possible futures?”

Examples: Millennium Ecosystem Assessment, Global Environment Outlooks



IPBES Nature Futures Framework



Scenarios

Exploratory scenarios

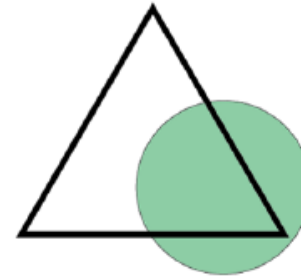
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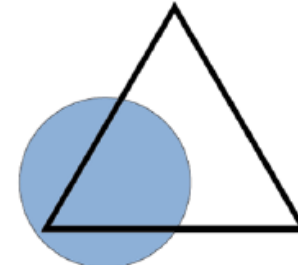
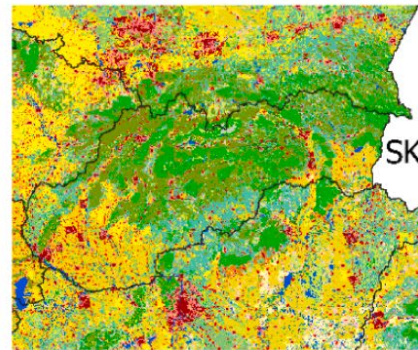
Examples: Millennium Ecosystem Assessment, Global Environment Outlooks

Nature Futures Framework scenarios for Europe

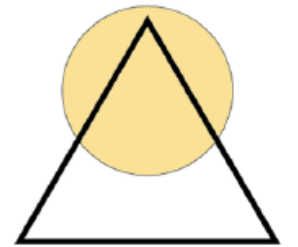
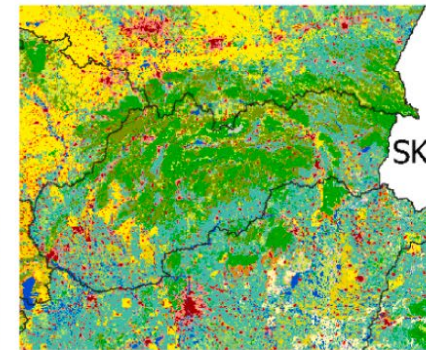
e.g., Dou et al. (2023) *Global Environmental Change*



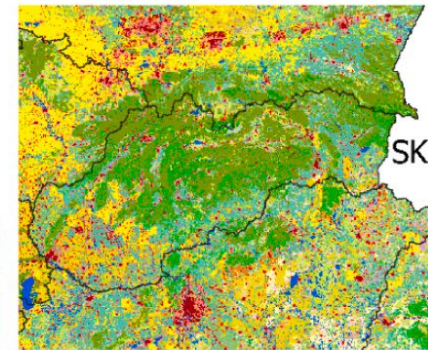
Nature for Society



Nature as Culture



Nature for Nature



Scenarios

Intervention scenarios

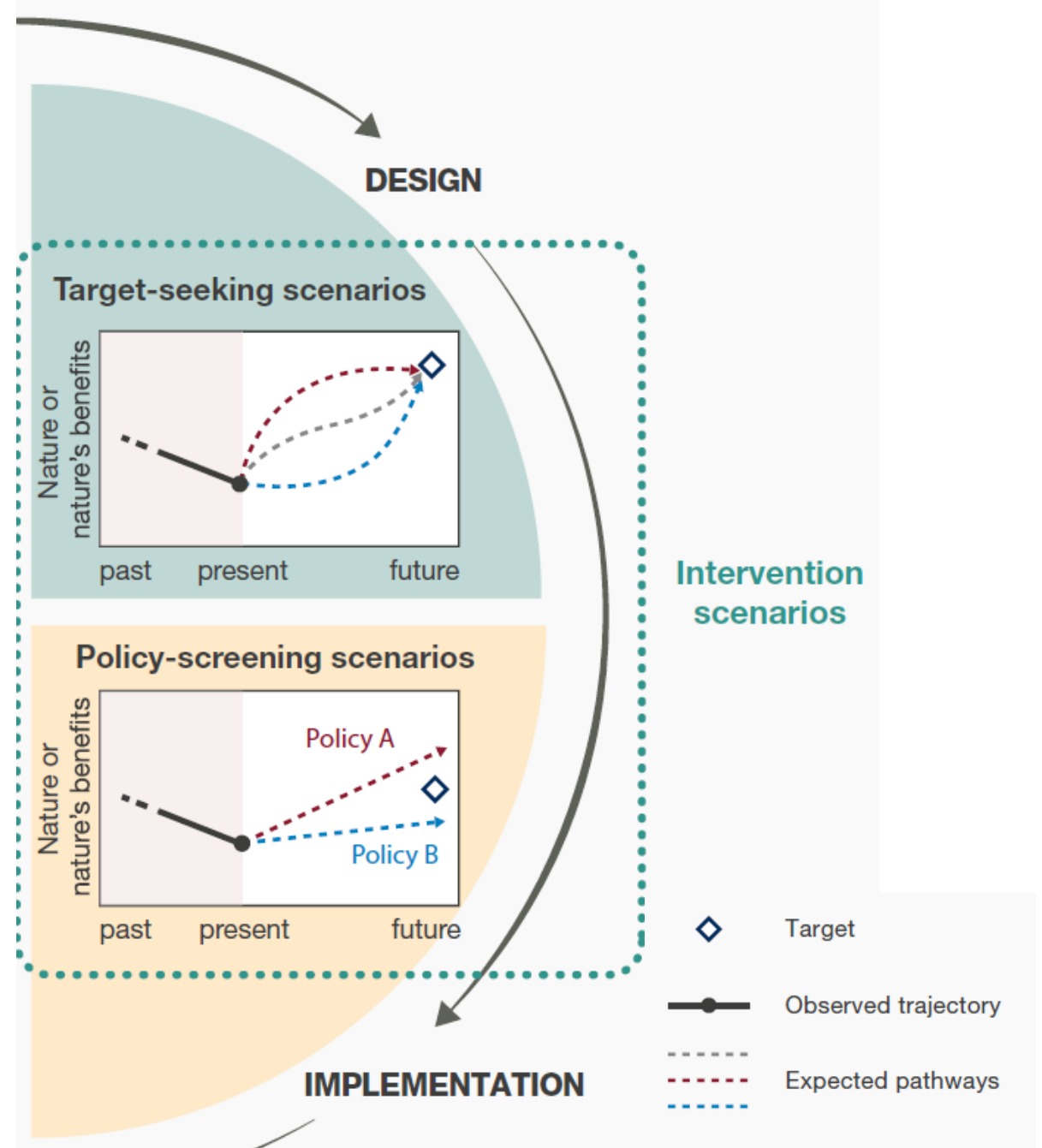
- Evaluate alternative policy or management options
- “What should we do to achieve a desired target or goal?”

Policy screening

“Where are we heading under current policies?”

Target seeking

“What additional actions are needed to get where we want to go?”



Scenarios

Intervention scenarios

- Evaluate alternative policy or management options
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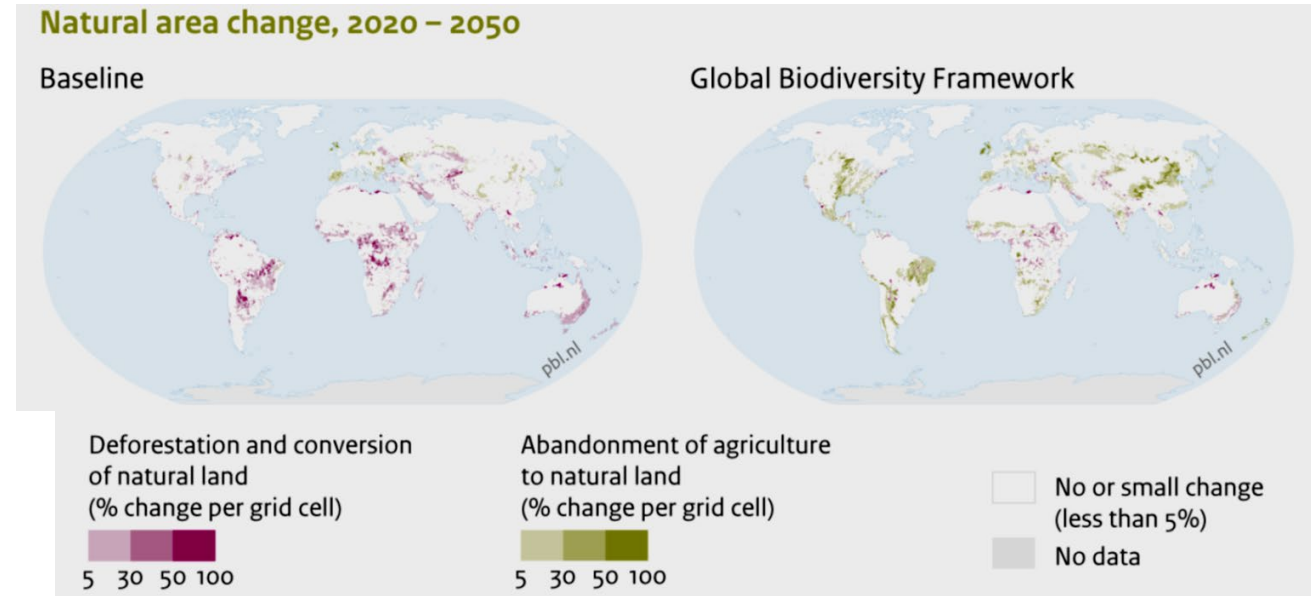
Policy screening

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Kok et al. (2023) *Prospective evaluation of the ambition of the KM-GBF*



Incorporates KM-GBF Targets 1, 2, 3, 7, 8, 10, 11, 16

Examples

Target 1: total agricultural land is not allowed to increase after 2030

Target 2: restoration is achieved by natural regeneration of abandoned agricultural areas and by reducing pressures

Scenarios

Intervention scenarios

- Evaluate alternative policy or management options
- “What should we do to achieve a desired target or goal?”

Policy screening

“Where are we heading under current policies?”

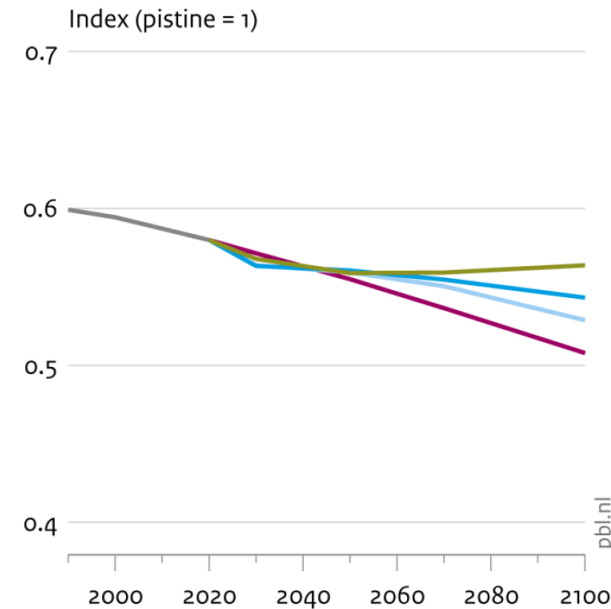
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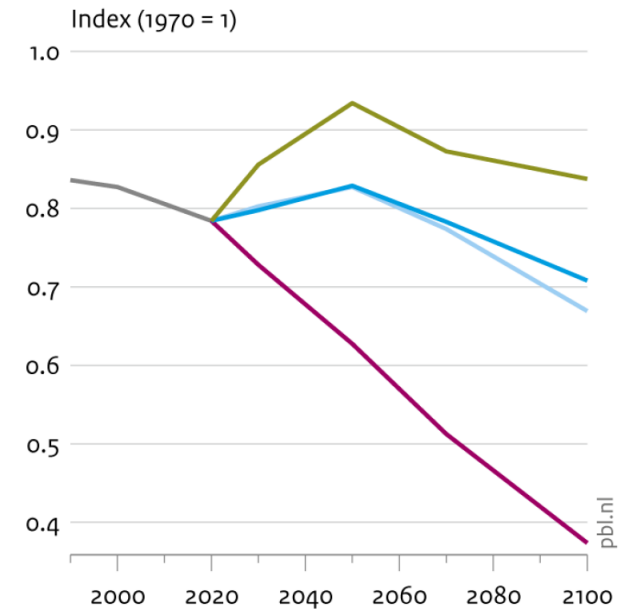
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State of biodiversity

Mean Species Abundance (MSA)



Living Planet Index (LPI) for mammals



— Historic data

Scenario

— Baseline

— Global Biodiversity Framework

— Global Biodiversity Framework + National Determined Contributions

— High Environmental Ambition

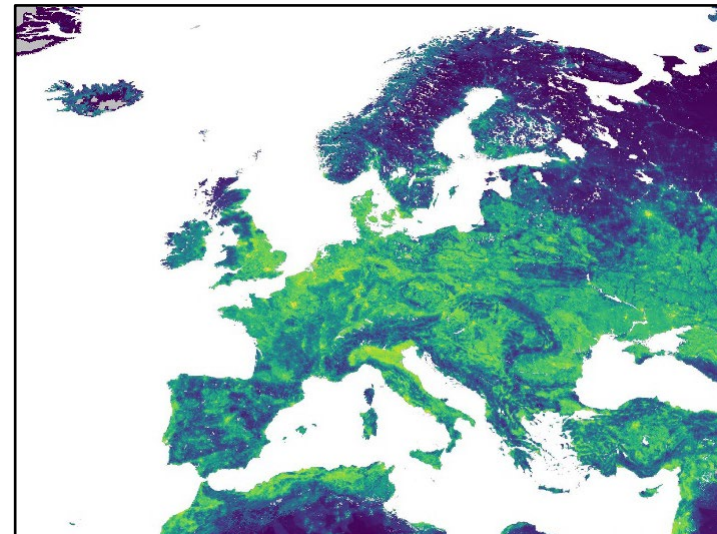
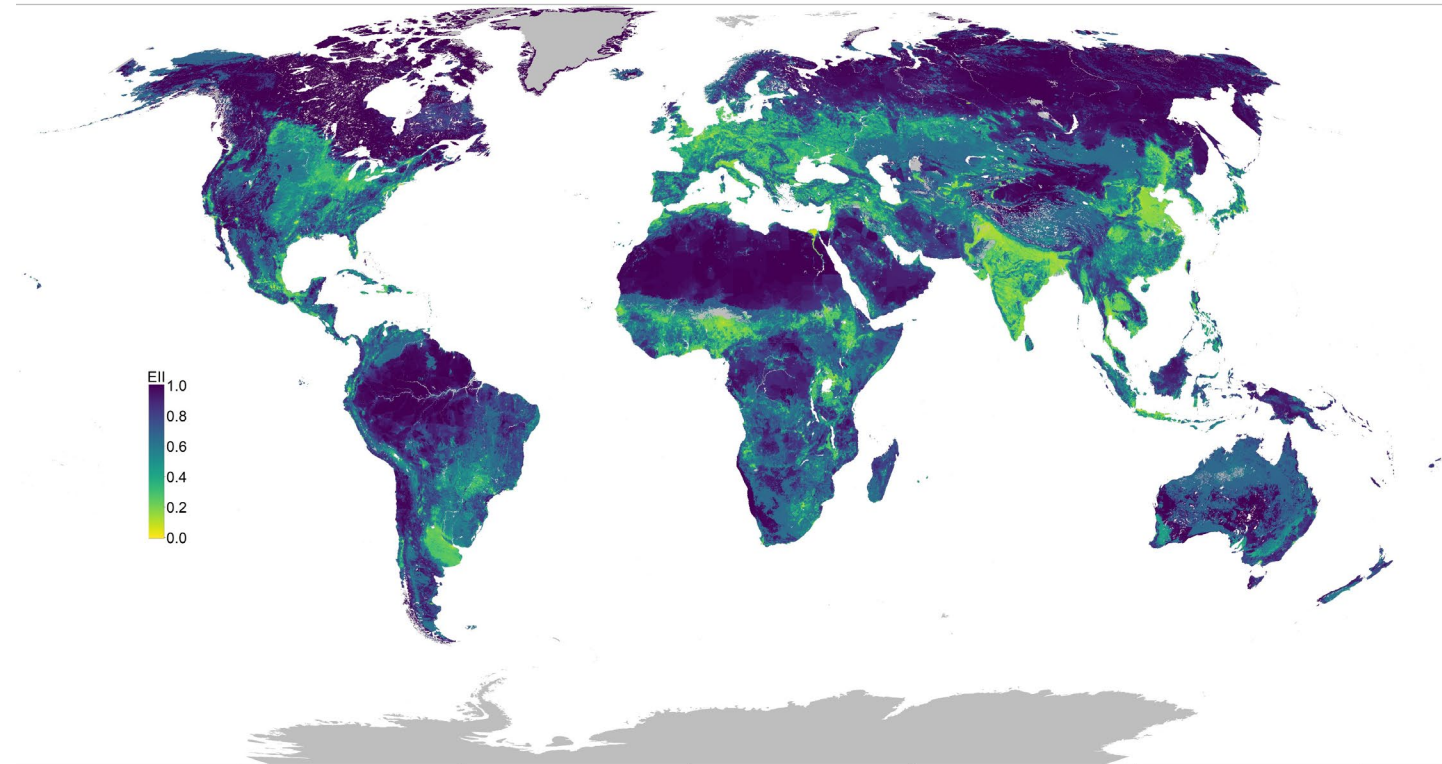
Case study: Ecosystem Integrity Index

The extent to which the composition, structure, and function of ecosystems fall within their natural range of variation

Model-based indicator; 1km² across global terrestrial ecosystems

Component indicator of Goal A

Strong links to Targets 2 & 3:
condition and effectiveness



Hill et al. *In review*
<https://www.biorxiv.org/content/10.1101/2022.08.21.504707v2>

Case study: Ecosystem Integrity Index

Composition

Information
on land-use,
intensity



PREDICTS
biodiversity
models



Structure

Human
modification of
landscapes



Landscape structural
intactness model



Function

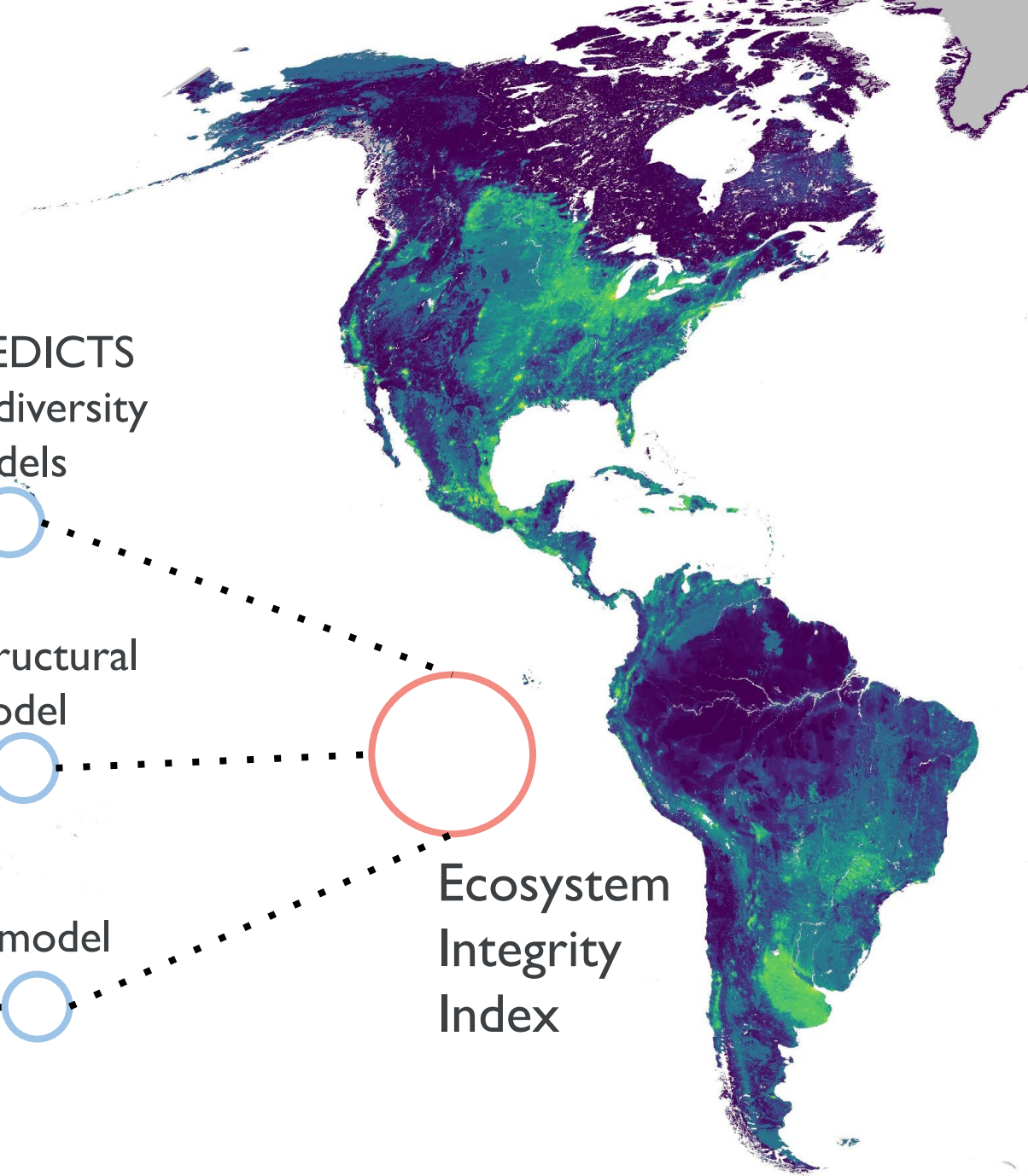
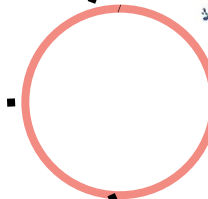
Modeled potential and
observed primary
productivity



Functional
intactness model



Ecosystem
Integrity
Index

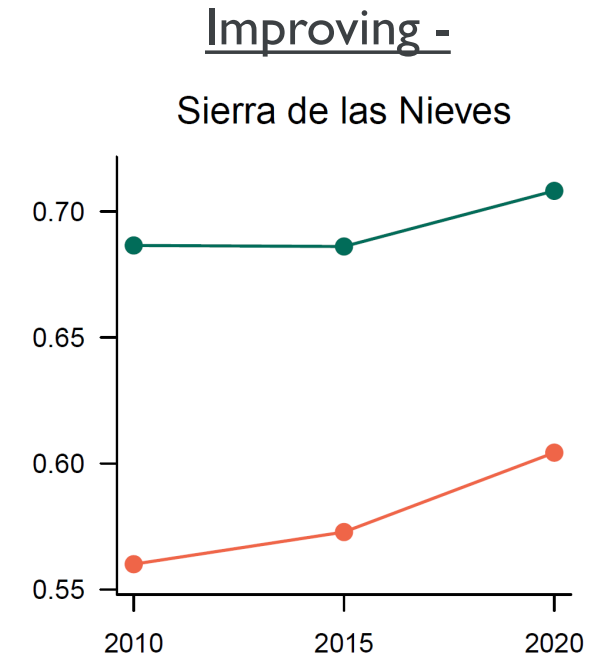
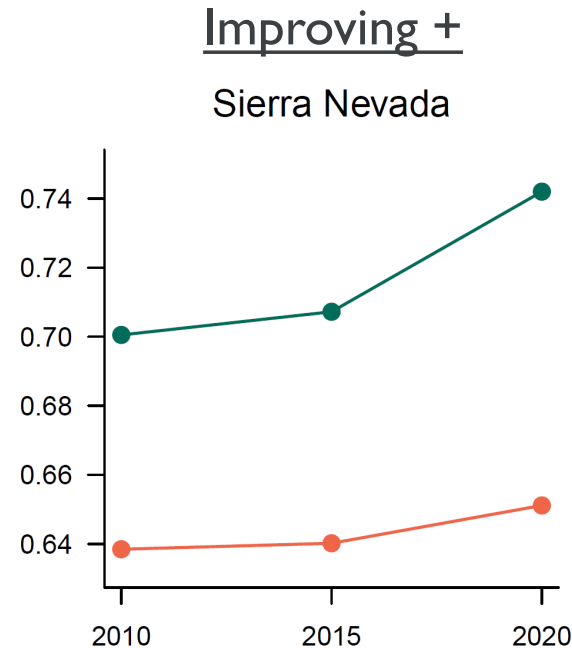
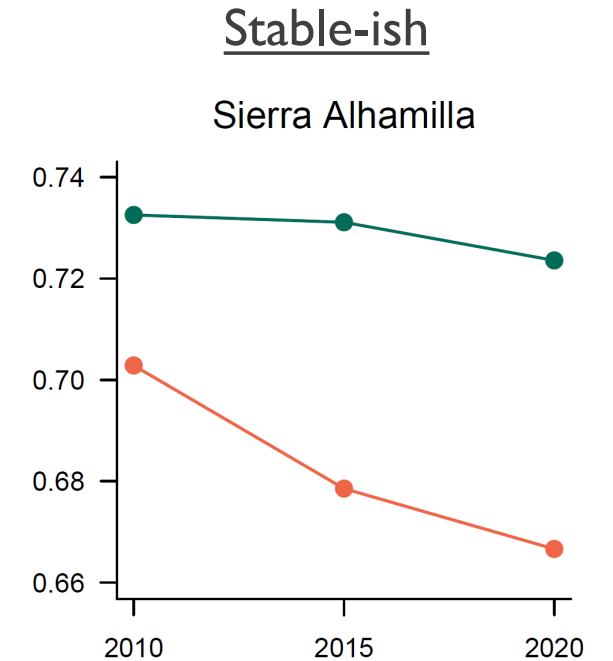
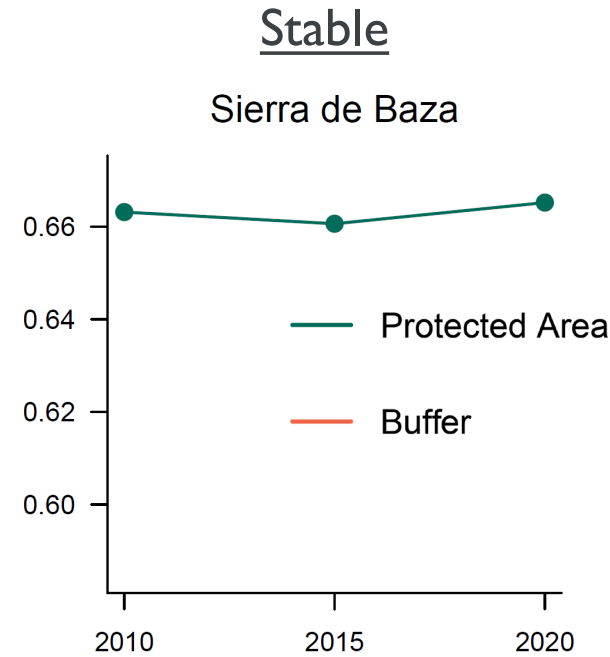


Case study: Ecosystem Integrity Index

I. Monitoring progress

Monitoring condition of protected areas using historic EII time series

Understanding effectiveness:
comparison with surrounding
landscape



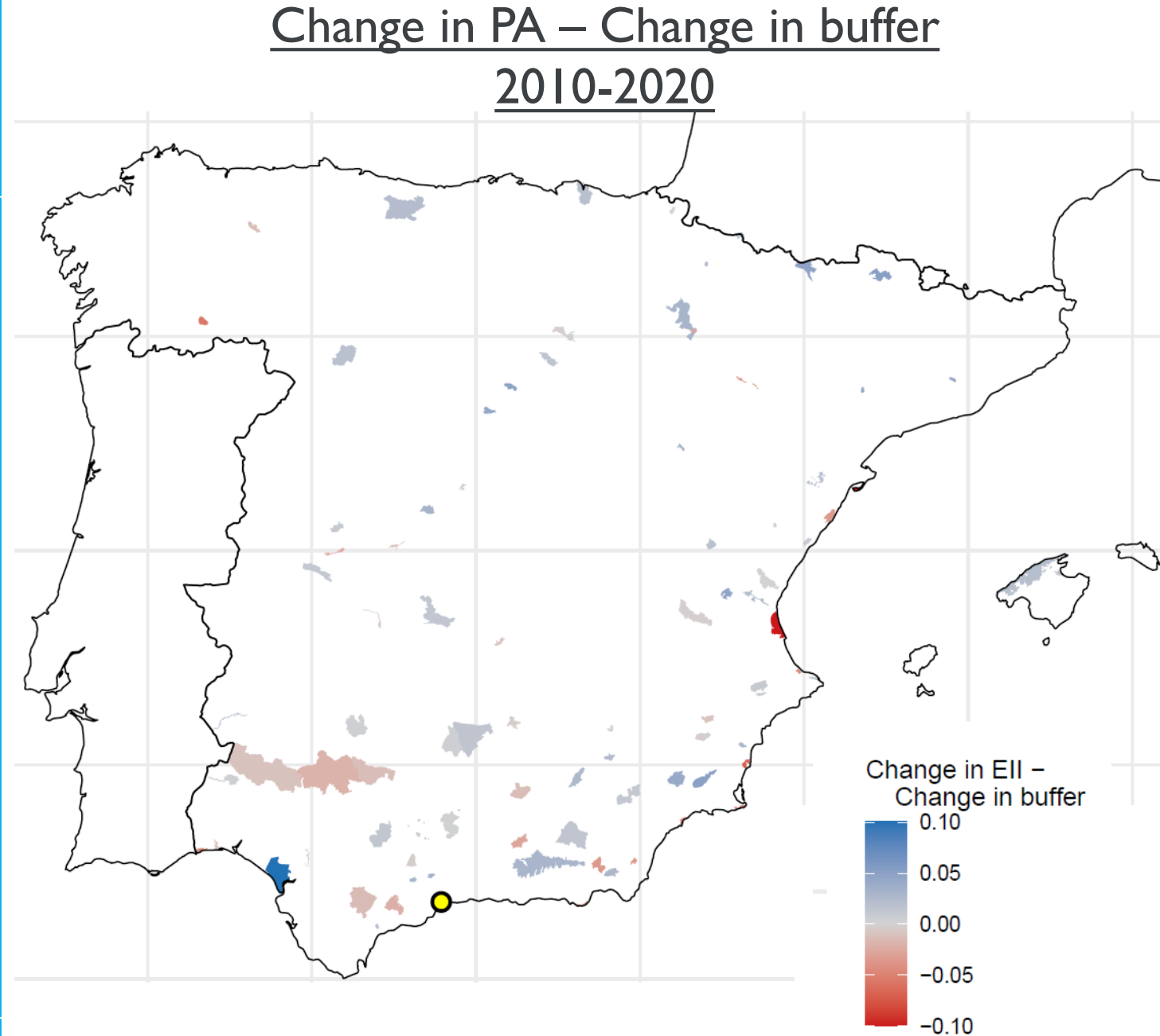
Case study: Ecosystem Integrity Index

I. Monitoring progress

Monitoring condition of protected areas using historic EII time series

Understanding effectiveness:
comparison with surrounding landscape

Importance of ground truthing: site-level assessments

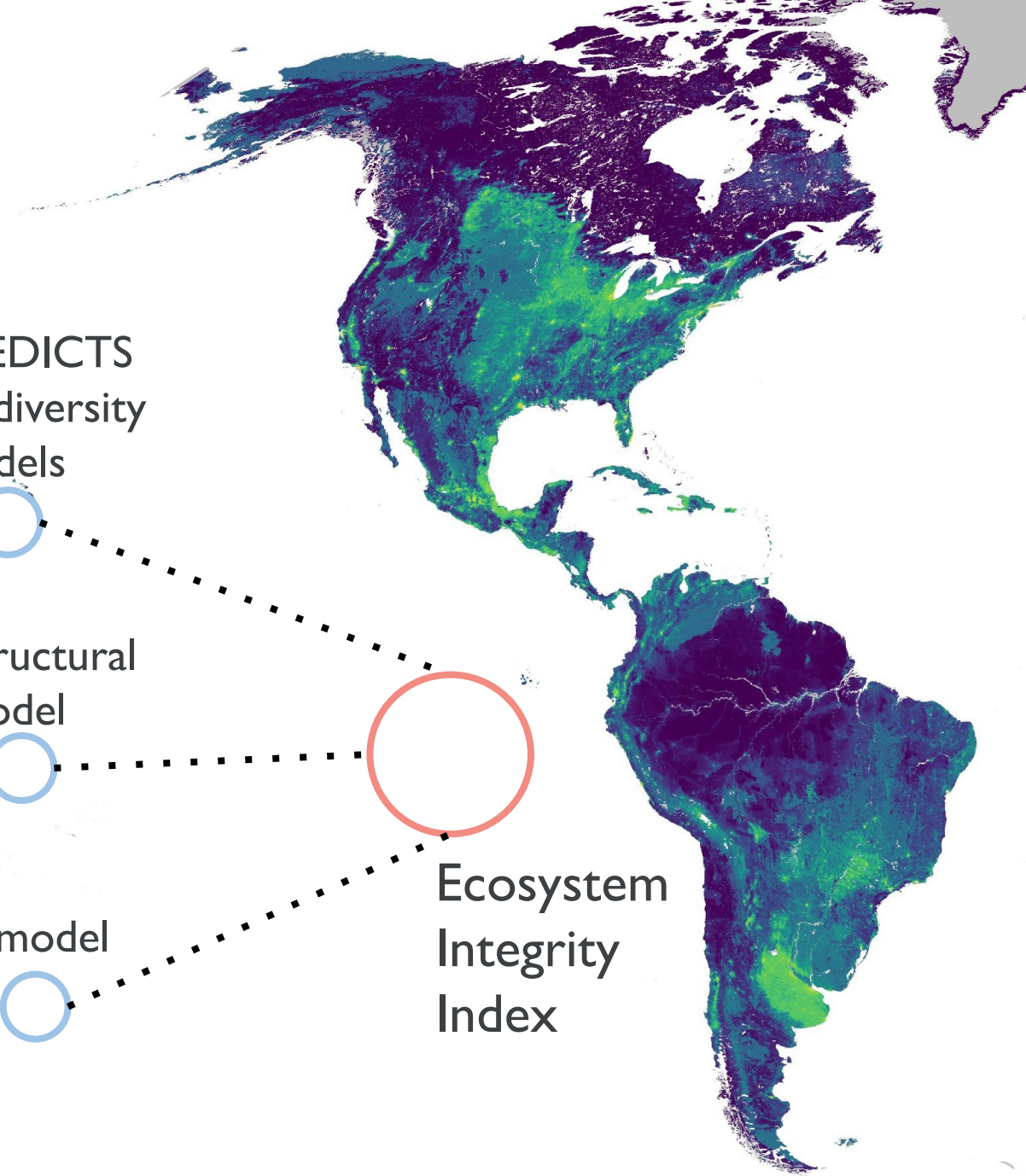
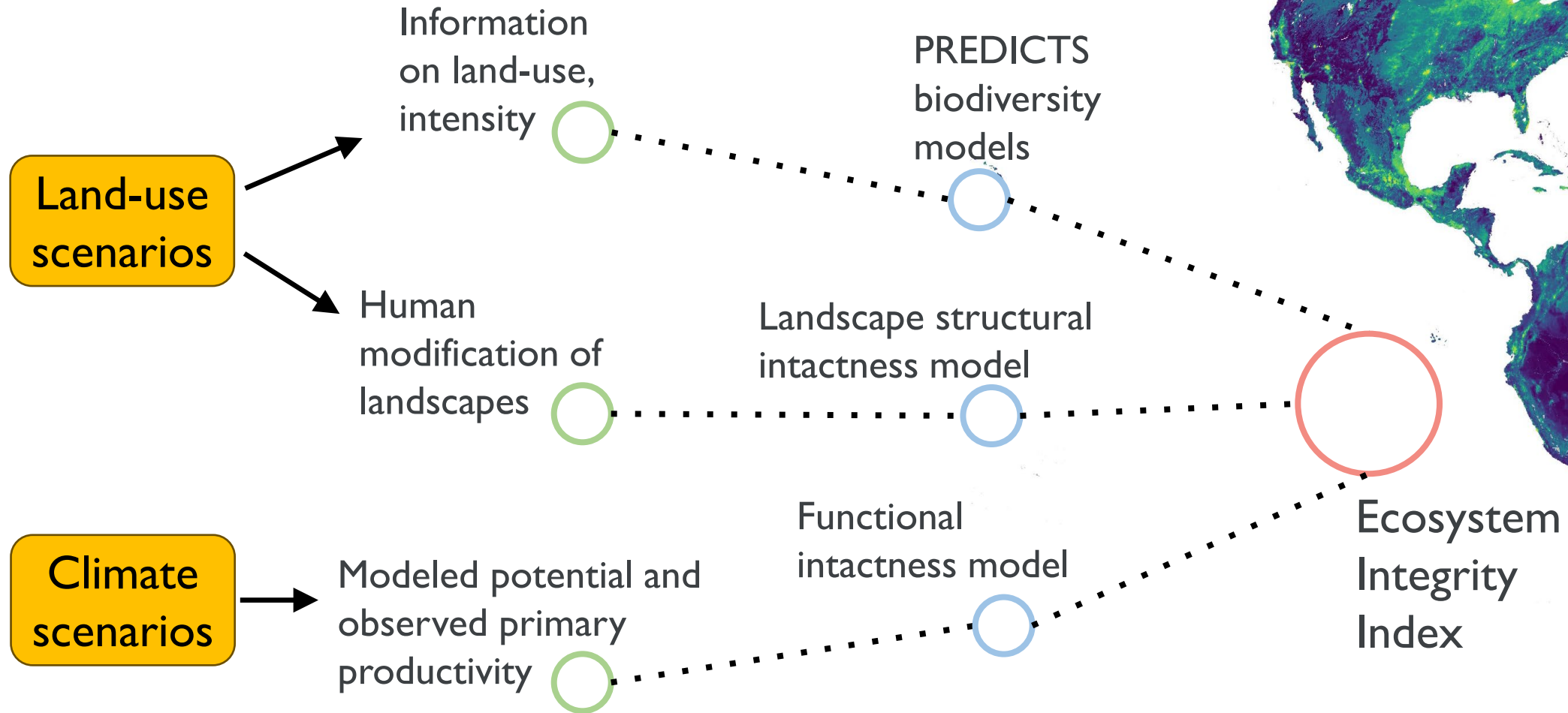


Case study: Ecosystem Integrity Index

2. Evaluating pathways

Data pipeline to feed in scenario
outputs

Case study: Ecosystem Integrity Index



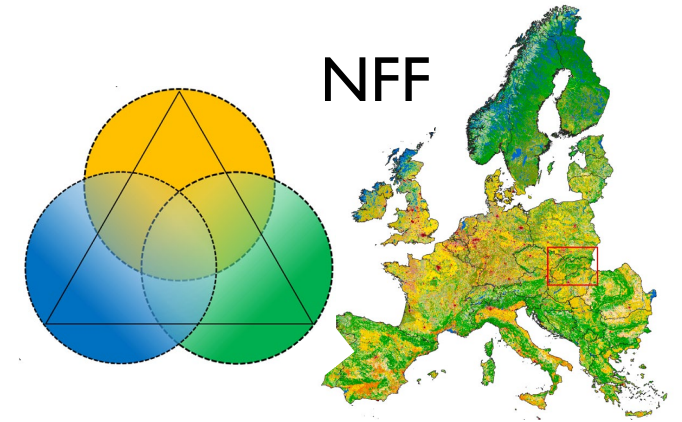
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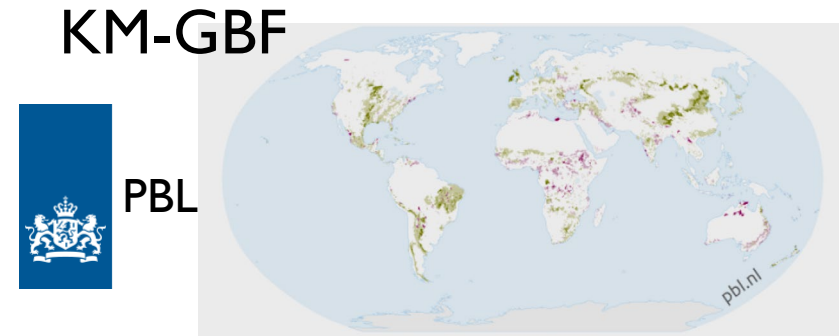
Data pipeline to feed in scenario outputs

Scenario projections in progress

i. Exploratory
Europe

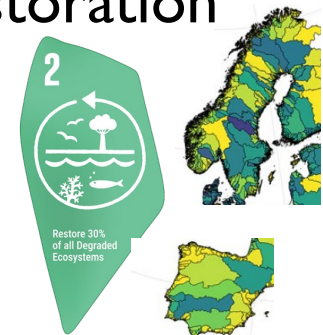


ii. Intervention
Europe



iii. Intervention
National

Restoration



COOP4CBD Task 3.3

Deliverables

1. Piloted assessment methodology to review progress and ambition under the KMGBF
2. Guidance on using models and scenarios to review progress and ambition
 - Guidance document, including examples using methodology
 - Webinars



Useful resources

Guidance materials

IPBES (2016) *The methodological assessment report on scenarios and models of biodiversity and ecosystem services*

https://files.ipbes.net/ipbes-web-prod-public-files/downloads/pdf/2016.methodological_assessment_report_scenarios_models.pdf

Biodiversa (2020) *Handbook on biodiversity scenarios for decision-making*

<https://www.biodiversa.eu/2023/07/13/handbook-on-biodiversity-scenarios-for-decision-making/>

Useful resources

Scenarios

Dou et al. (2023) Using the Nature Futures Framework as a lens for developing plural land use scenarios for Europe for 2050 *Global Environmental Change*

<https://www.sciencedirect.com/science/article/pii/S0959378023001322>

Kok et al. (2024) *A prospective evaluation of the ambition of the Kunming-Montreal Global Biodiversity Framework goals and targets*

<https://www.pbl.nl/en/publications/a-prospective-evaluation-of-the-ambition-of-the-kunming-montreal-global-biodiversity-framework-goals-and-targets>

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