ETH zürich

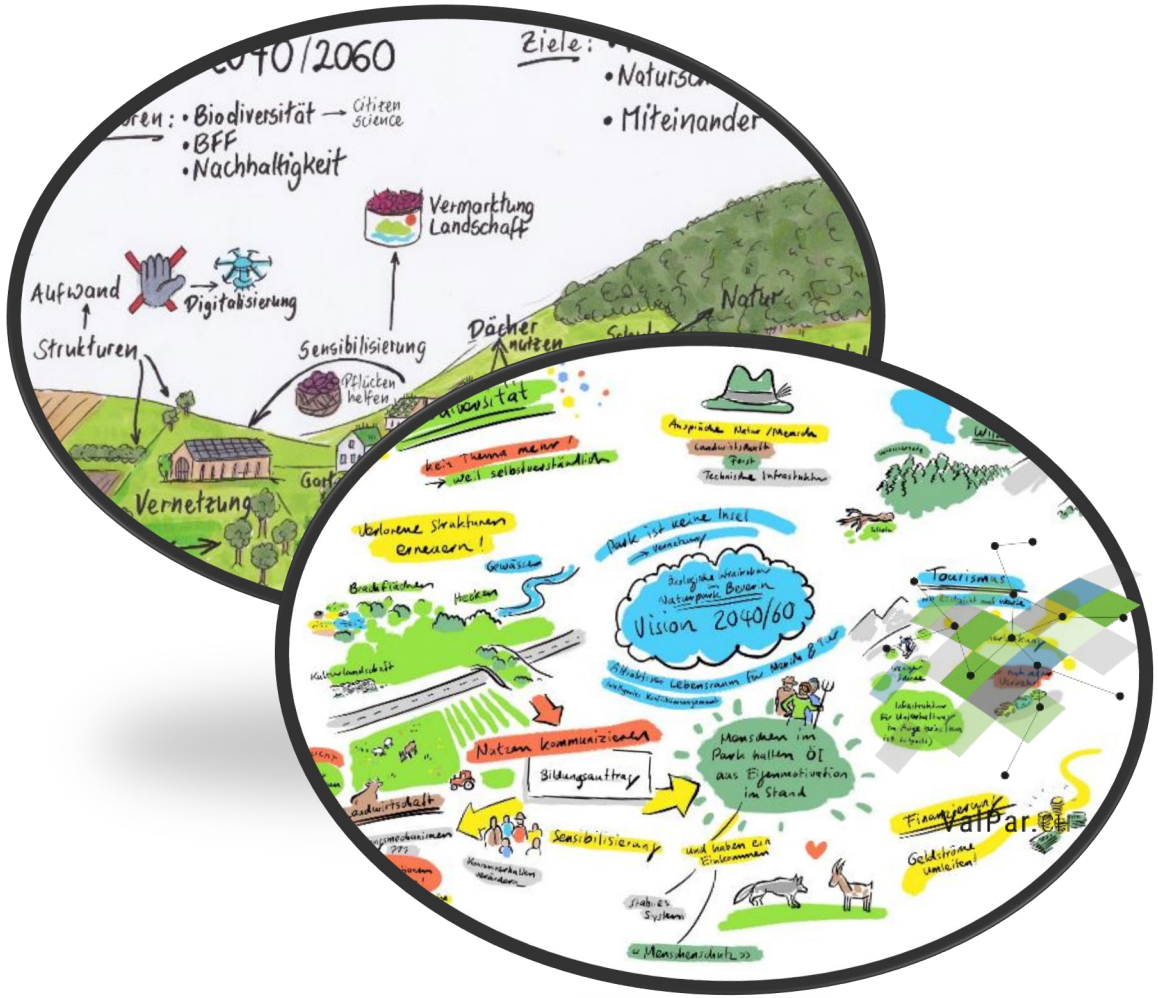
Planning of Landscape and Urban Systems

PLUS

Normative scenarios for effectively mitigating biodiversity loss

ValPar.CH

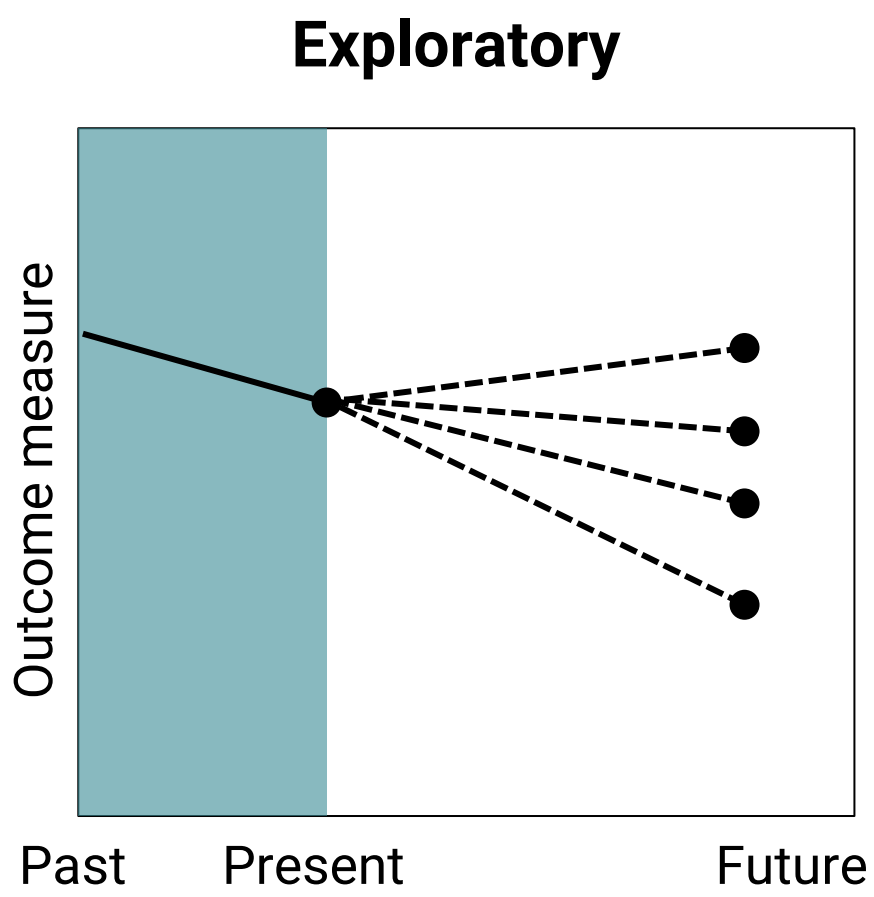
Ben Black, *Adrienne Grêt-Regamey, Paula Mayer*

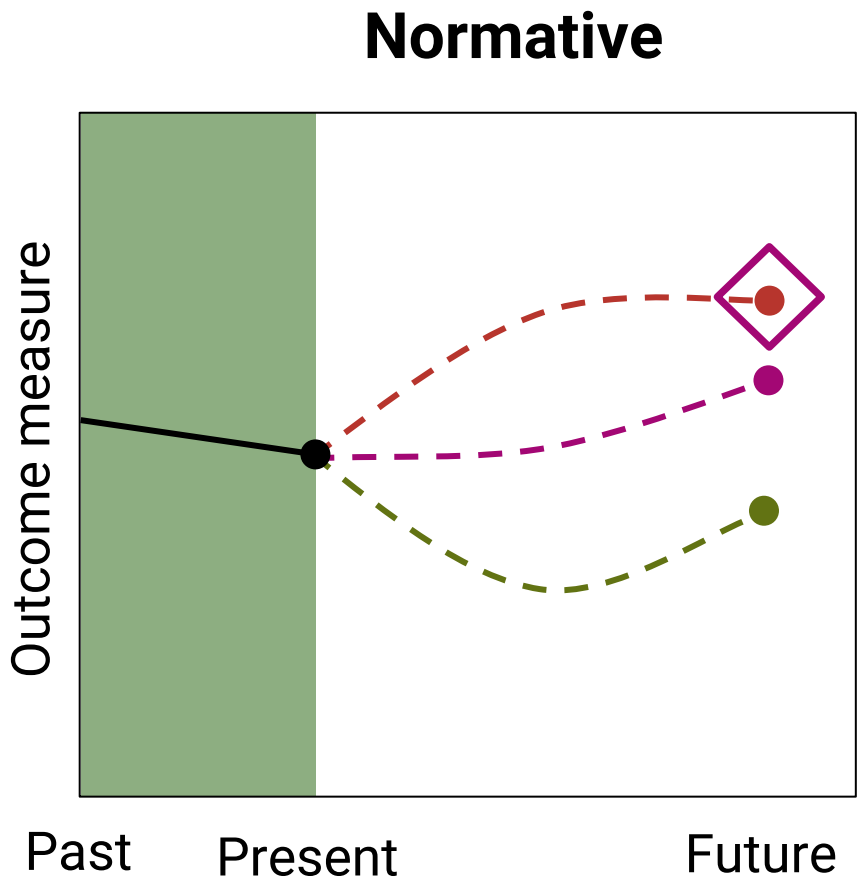


Which areas shall we protect for biodiversity?

chatgpt, 2024

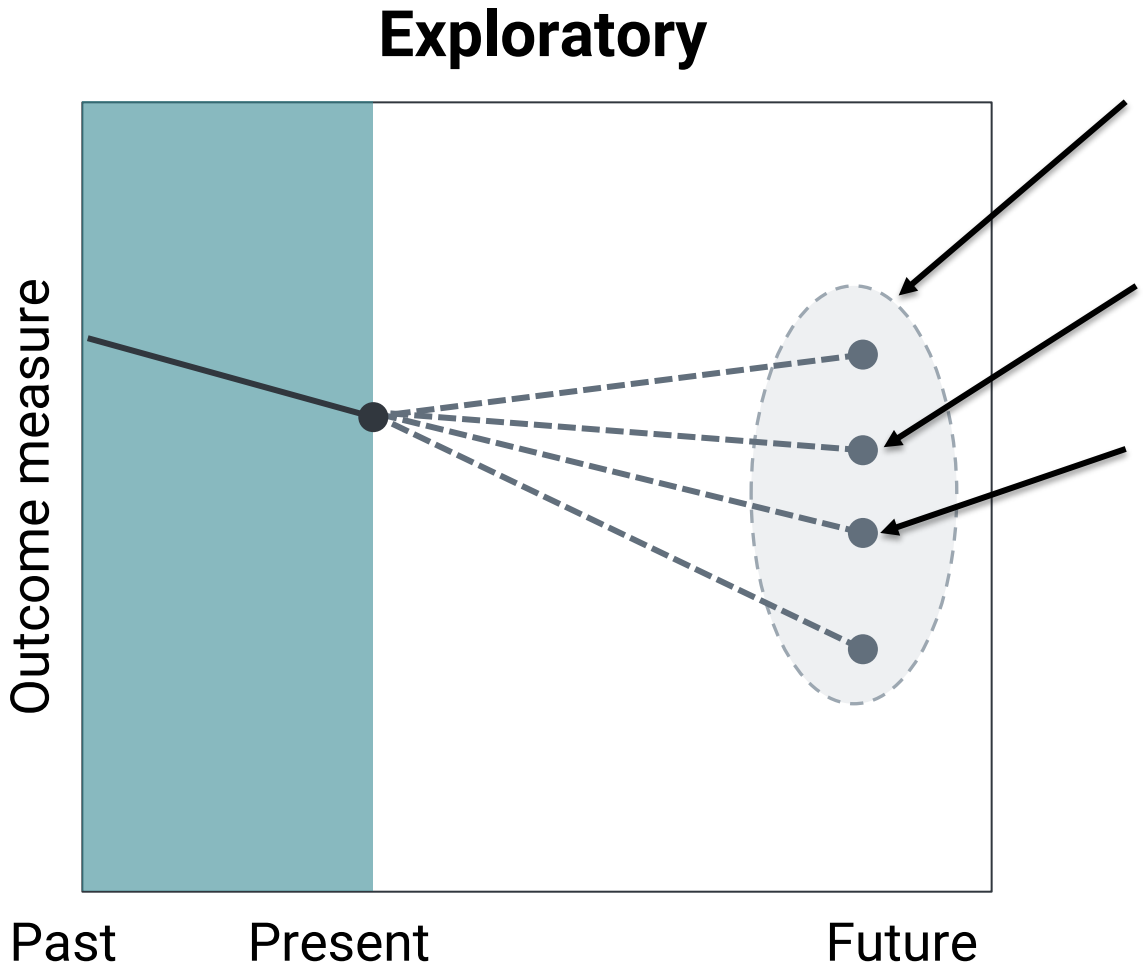
The future? Explorative vs. Normative scenarios





Adapted from IPBES 2017

The future? Explorative vs. Normative scenarios



Range of probable outcomes

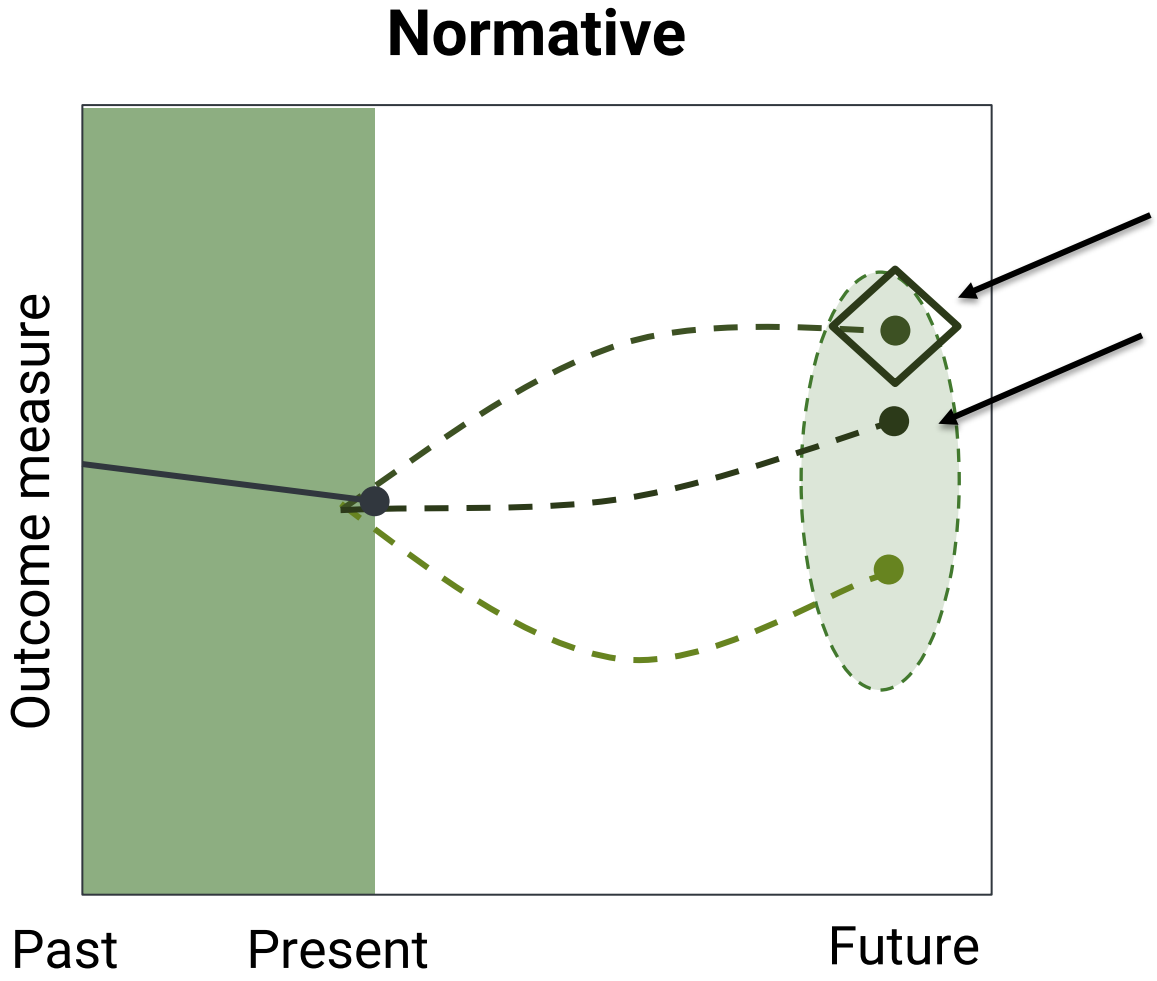
Business as Usual: Extrapolation of current trends

Increasingly predict negative outcomes

Often devised without participation = **No indication of societal desirability**

Adapted from IPBES 2017; Nassauer and Corry, 2004; Bennett et al., 2016; McPhearson et al., 2016; Luederitz et al., 2017; Iwaniec et al., 2020

The future? Explorative vs. Normative scenarios



Specify desirable end-points

Space to imagine transformative change

When devised with stakeholder participation:

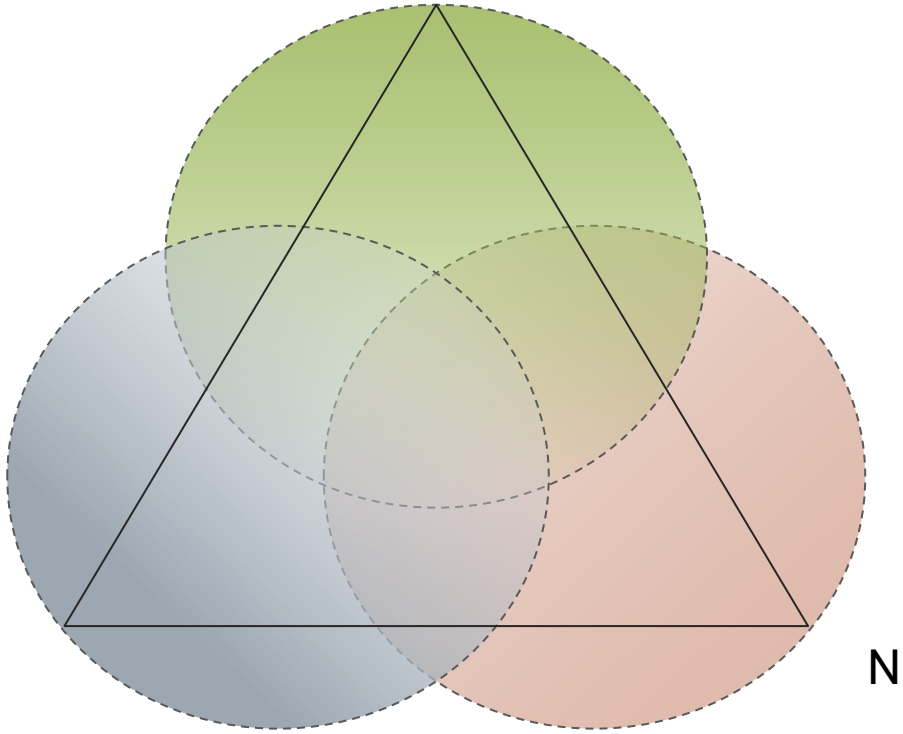
- **Inclusive of different value systems**
- **Mobilise actors and encourage stewardship.**

Adapted from IPBES 2017; Nassauer and Corry, 2004; Bennett et al., 2016; McPhearson et al., 2016; Luederitz et al., 2017; Iwaniec et al., 2020

The future? Explorative vs. Normative scenarios

IPBES Nature Futures Framework

Nature for Nature
Intrinsic value of nature
Space allocated for nature

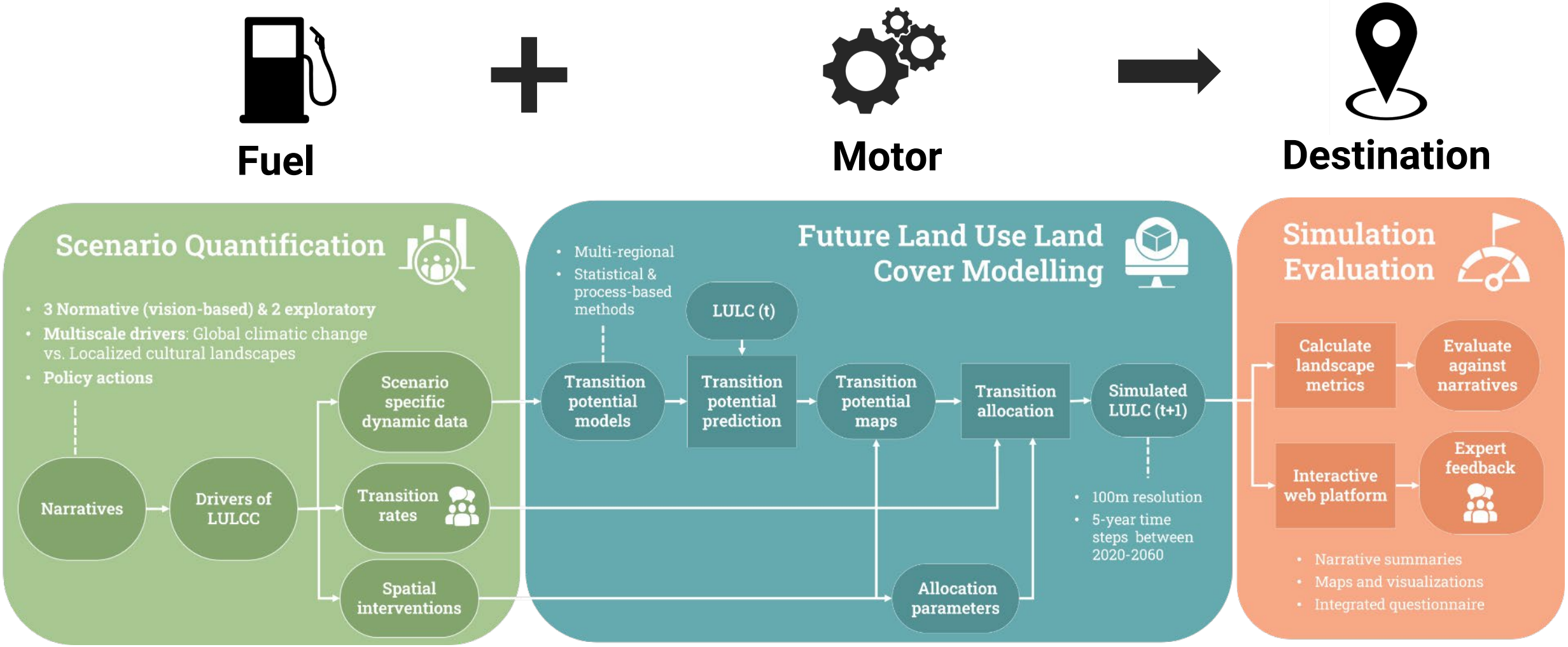


Nature as culture
Living in harmony
People one with nature

Nature for Society
Nature's benefits to people
Ecosystem services

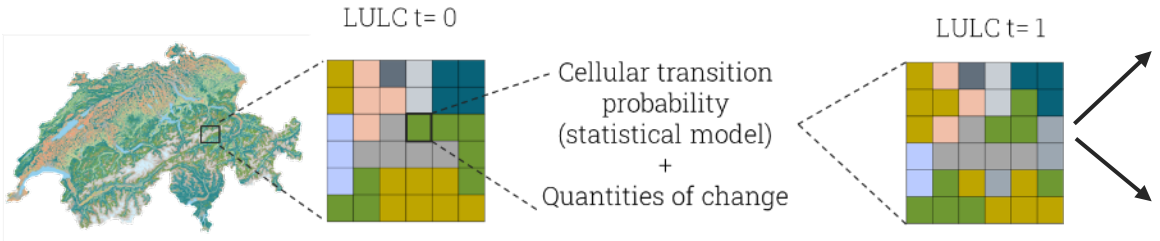
Adapted from PBL 2018

Which areas shall we protect for biodiversity? - Workflow



Black et al., Regional Environmental Change, 2024

Land use/land cover model



Ecosystem service models

Species distribution models

Scenario Quantification

- 3 Normative (vision-based) & 2 exploratory
- **Multiscale drivers**: Global climatic change vs. Localized cultural landscapes
- **Policy actions**

Narratives → Drivers of LULCC → Scenario specific dynamic data / Transition rates / Spatial interventions

Future Land Use Land Cover Modelling

- Multi-regional
- Statistical & process-based methods

LULC (t) → Transition potential models → Transition potential prediction → Transition potential maps → Transition allocation → Simulated LULC (t+1)

Allocation parameters

- 100m resolution
- 5-year time steps between 2020-2060

Simulation Evaluation

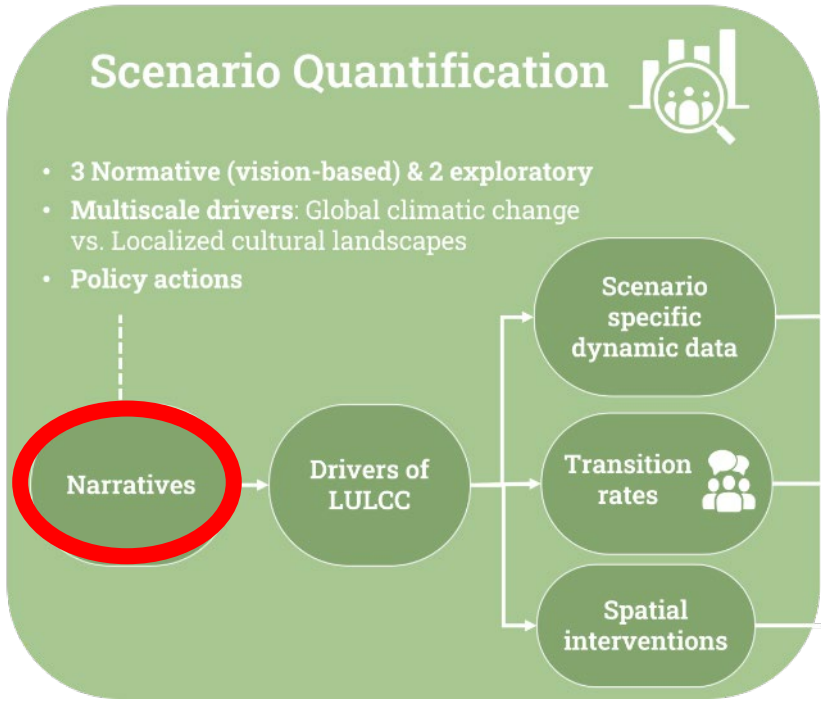
Calculate landscape metrics → Evaluate against narratives

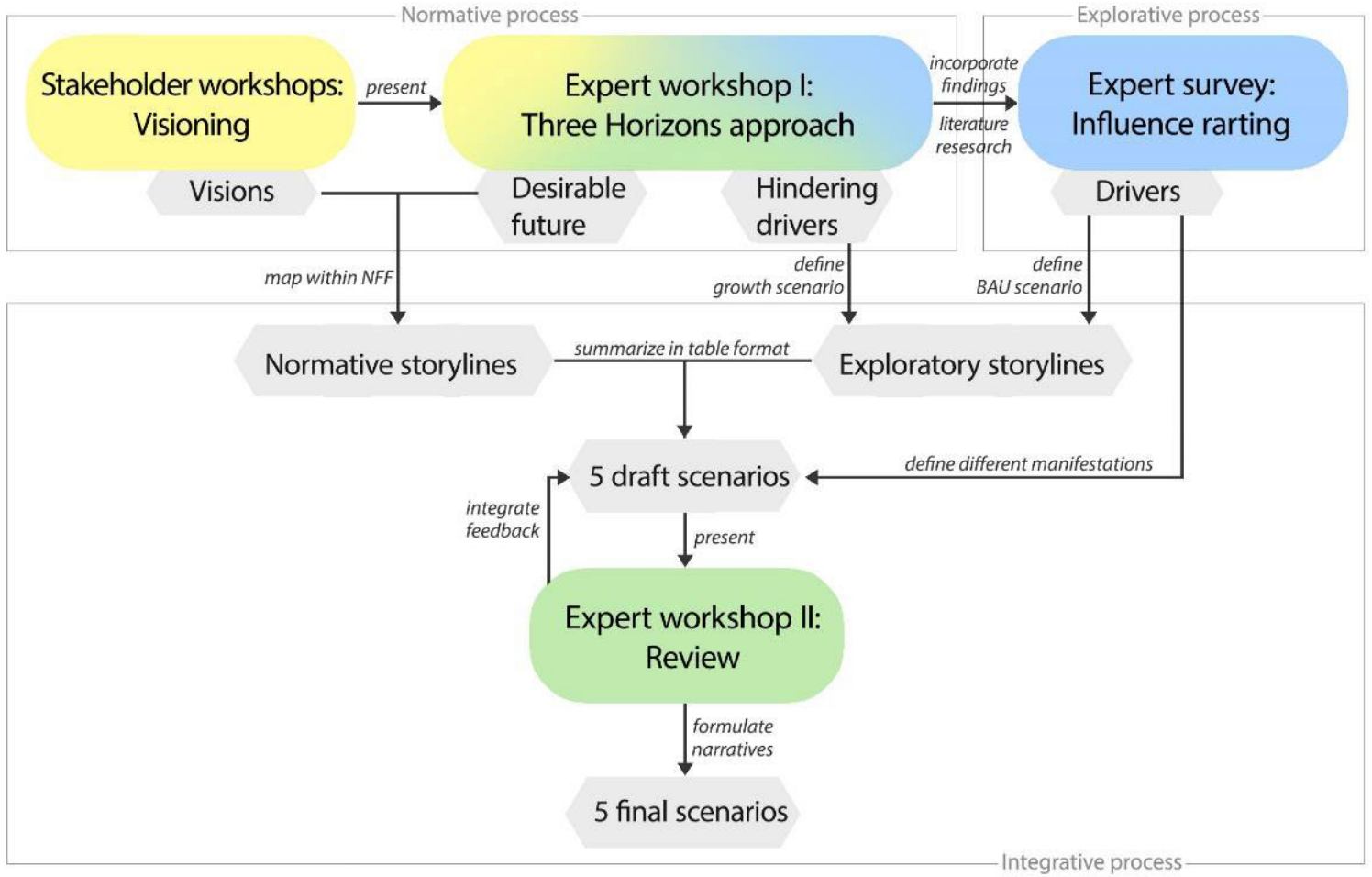
Interactive web platform → Expert feedback

- Narrative summaries
- Maps and visualizations
- Integrated questionnaire

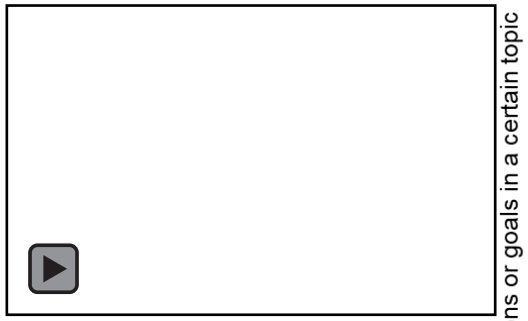
Black et al., Regional Environmental Change, 2024

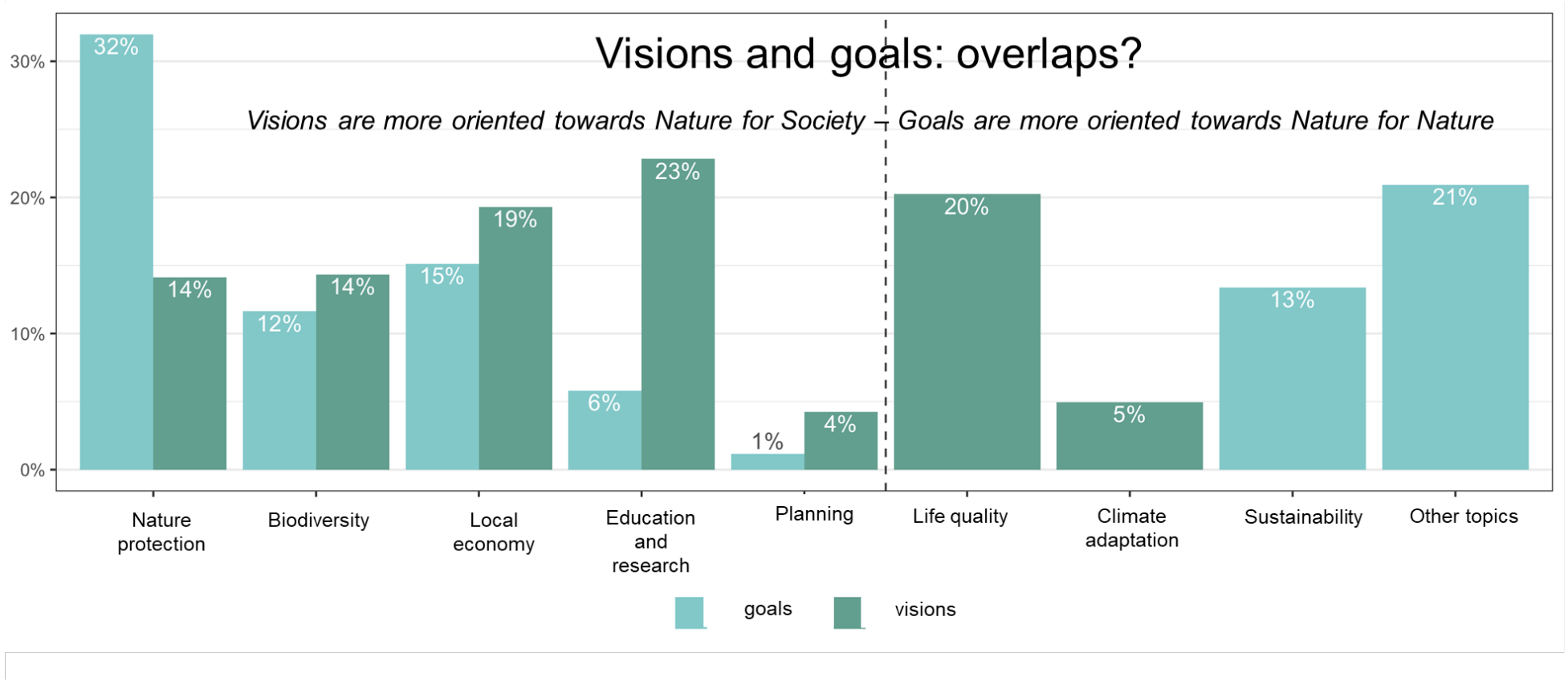
Participatory, normative scenarios





Participatory, normative scenarios





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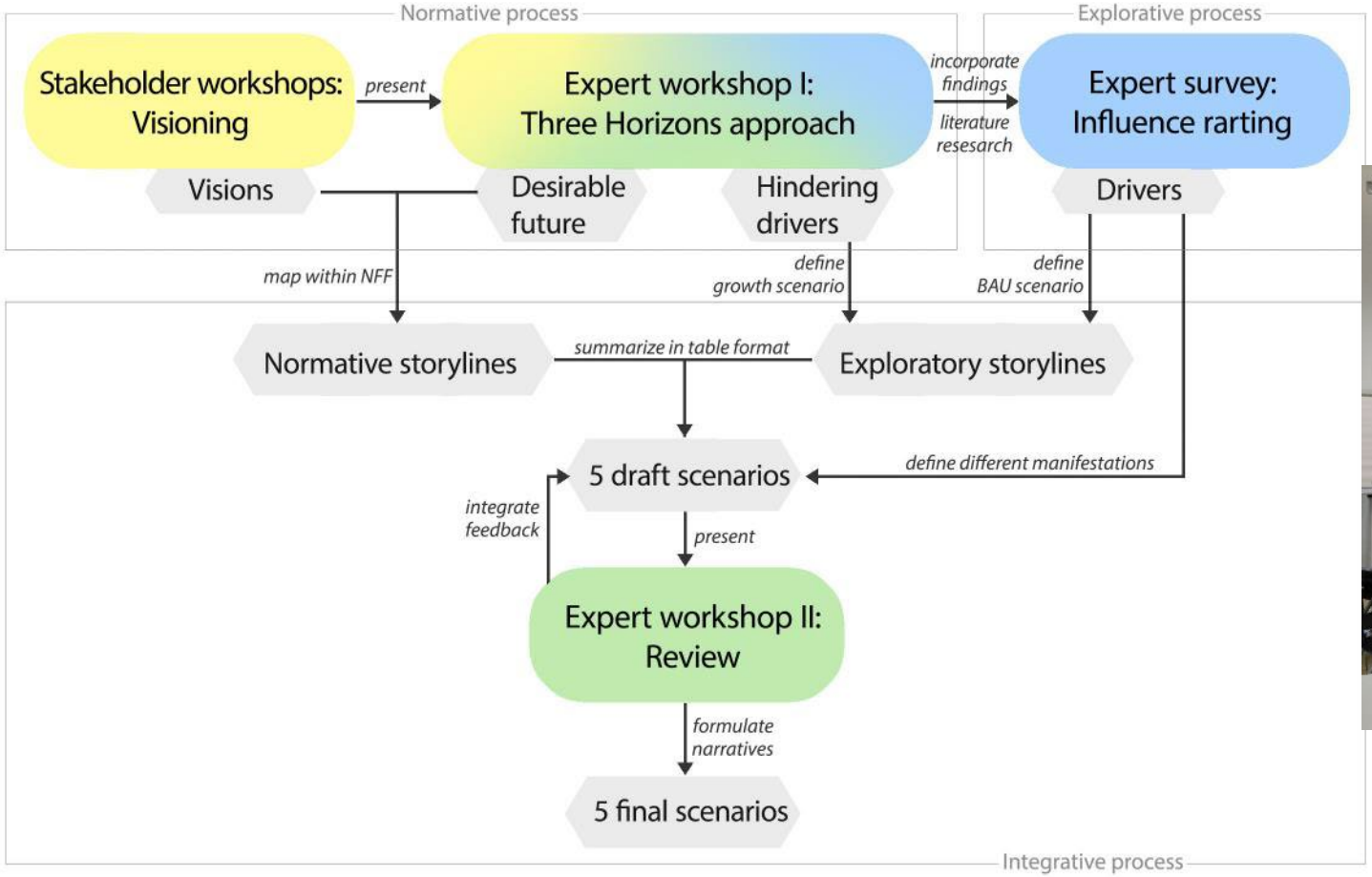
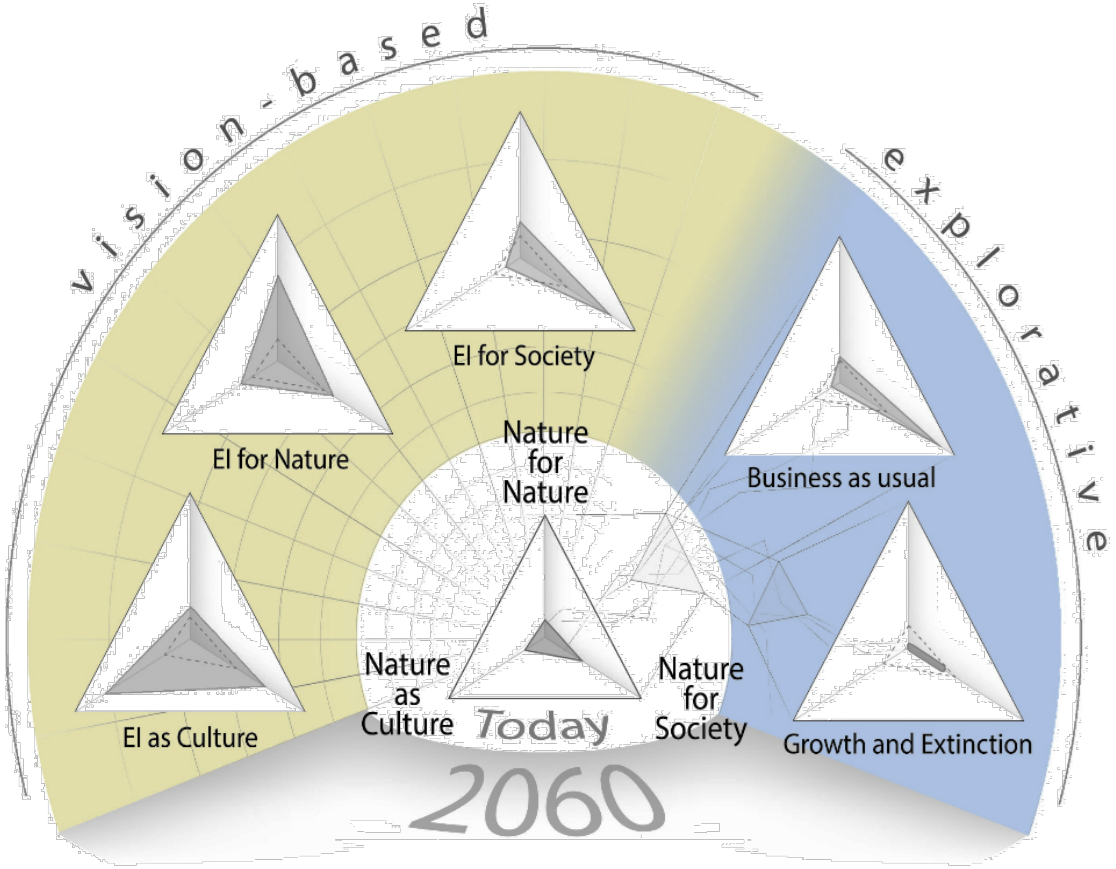
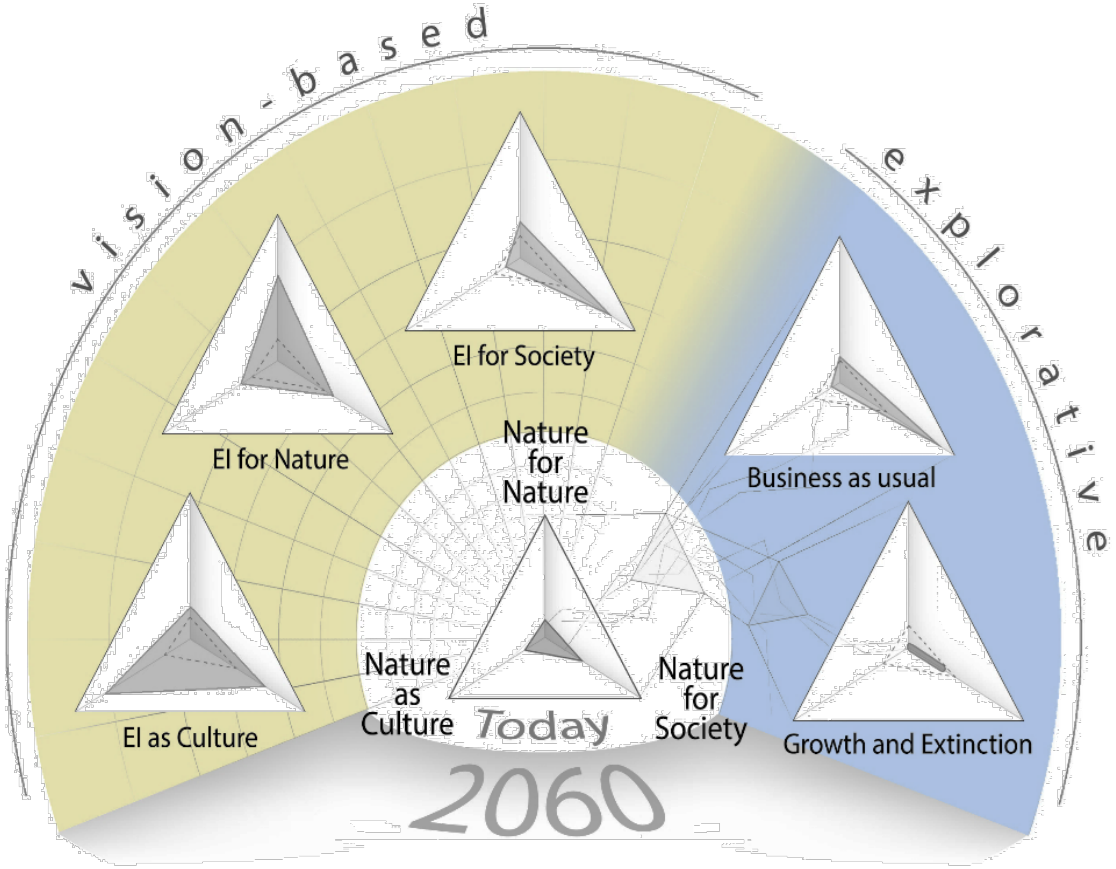


Participatory, normative scenarios



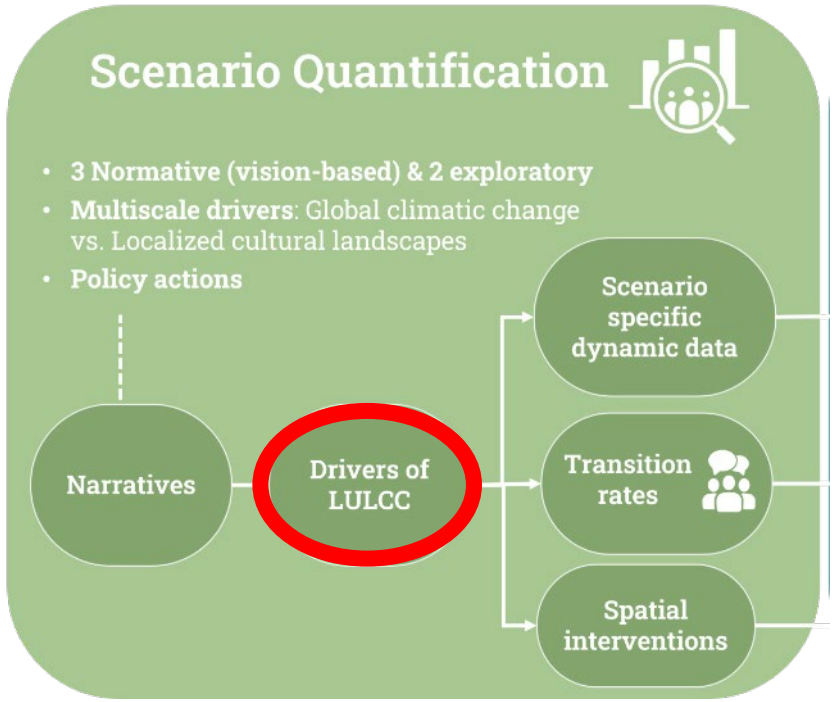
Nature for Nature emphasizes the **protection and promotion** of biodiversity. This scenario characterizes that in certain areas for biodiversity promotion, humans are denied access. There is a societal consensus that biodiversity needs its space to thrive, as **people value nature for its intrinsic values**. This scenario assumes that human society globally follows sustainable pathways (SSP1) and **climate action is effective** (**RCP2.1**). Switzerland aims for an economy beyond growth and expands **protected areas to 30%** of the Swiss land area until 2060.

Participatory, normative scenarios



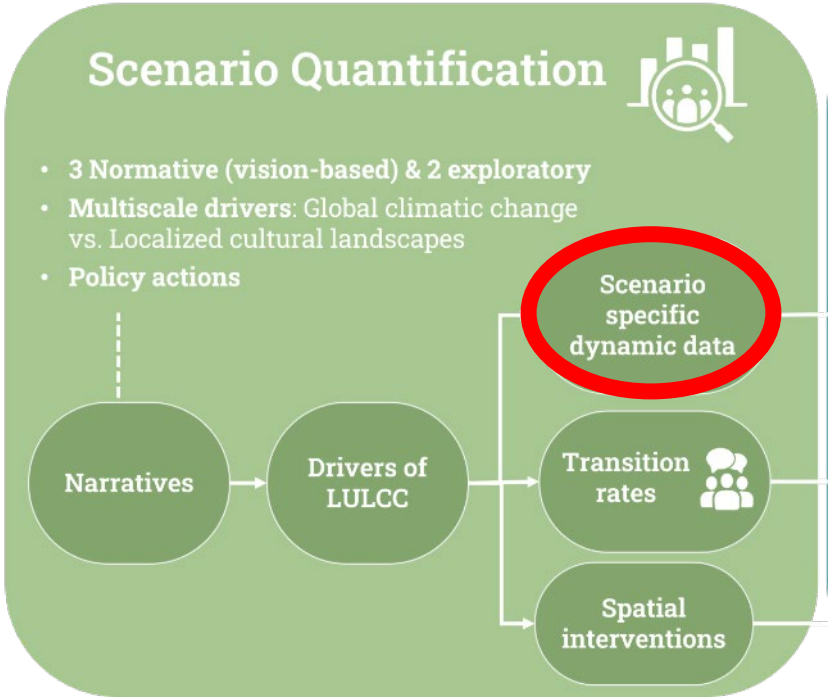
Nature for Society focuses on the **sustainable supply of NCPs** to the Swiss population. It assumes a strong division of the landscape: Housing, agricultural production, biodiversity protection, recreation, energy production are spatially separated. This has implications for the planning of rural and urban areas, with most people living in large, green cities. A global development of **RCP4.5** and SSP2 and a Swiss economy characterized **by green growth** form underlying assumptions of this scenario.

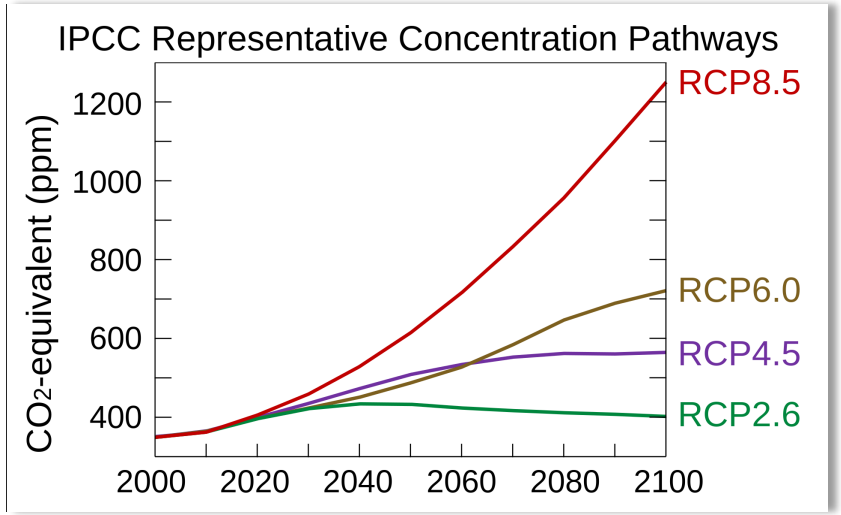
Participatory, normative scenarios

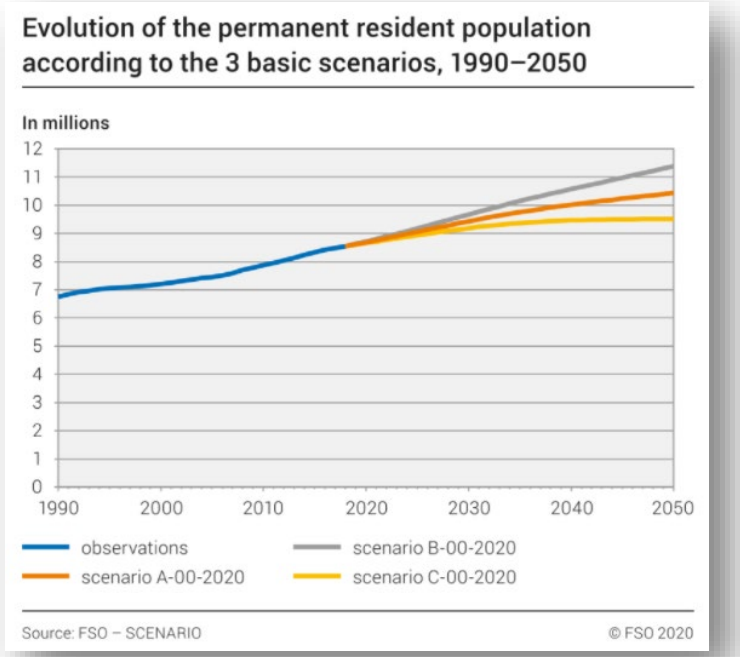


Driver	Nature for Nature	Nature for Society	Nature as Culture	Business as Usual	Growth and Extinction
	+1.4°C RCP 2.6	+2.3°C RCP 4.5	+1.4°C RCP 2.6	+2.3°C RCP 4.5	+3.1°C RCP 8.5
	Low 9.5M	Reference 10.5M	Reference 10.5M	Reference 10.5M	High 11.5M
	22% (2030) 30% (2060)	17% (2030) 22% (2060)	17% (2030) 25% (2060)	15% (2030) 20% (2060)	15% (2030) 0% (2060)
	SSP 1 Green Road	SSP 2 Middle of the road	SSP 1 Green Road	SSP 2 Middle of the road	SSP 3 Rocky Road

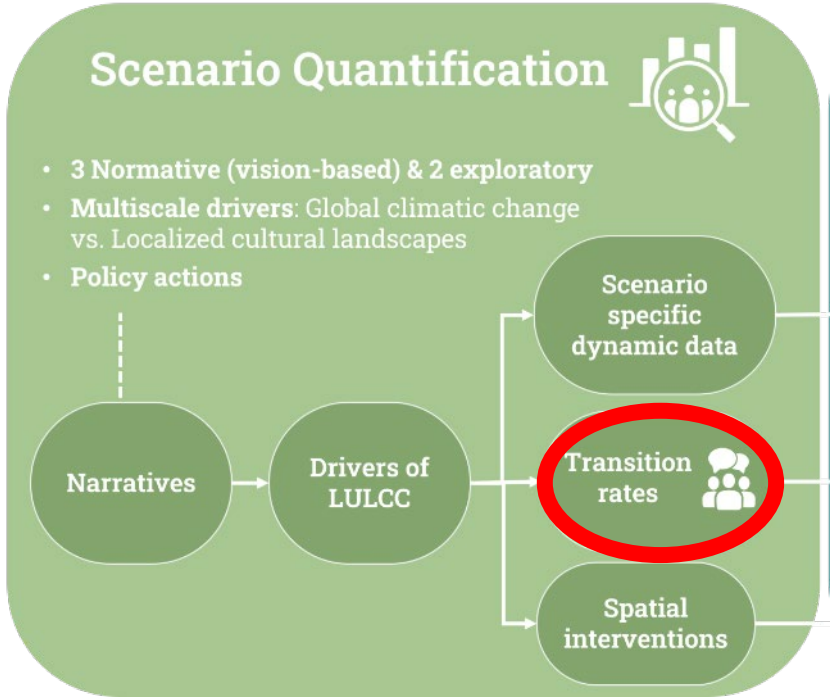
Participatory, normative scenarios







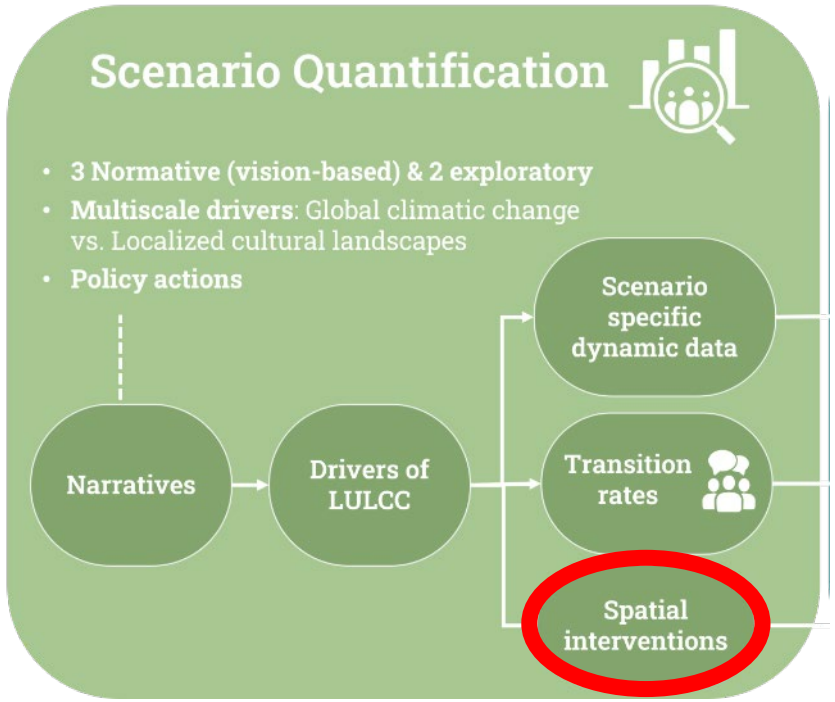
Participatory, normative scenarios



Driver	Sub-Driver	Urban Influence (++,+,0,-,--)
Spatial management of landscape	Multifunctional land management (biodiversity promotion integrated in agriculture). Moderate settlement growth	+
	Moderate growth of urban and peri-urban areas Rural exodus from mountain communes to cities Level of urban sprawl as today.	
	Soil-independent production only to a minor extent Intensive soil-dependent agriculture in rural areas Abandonment of poorly accessible marginal land	
	PAs are expanded and newly established (15% of Swiss land area protected by 2030, 17% by 2060) Site selection for new PAs prioritized on agriculturally unproductive land, or to protect habitats of endangered species; site-specific management under IUCN categories II or IV	

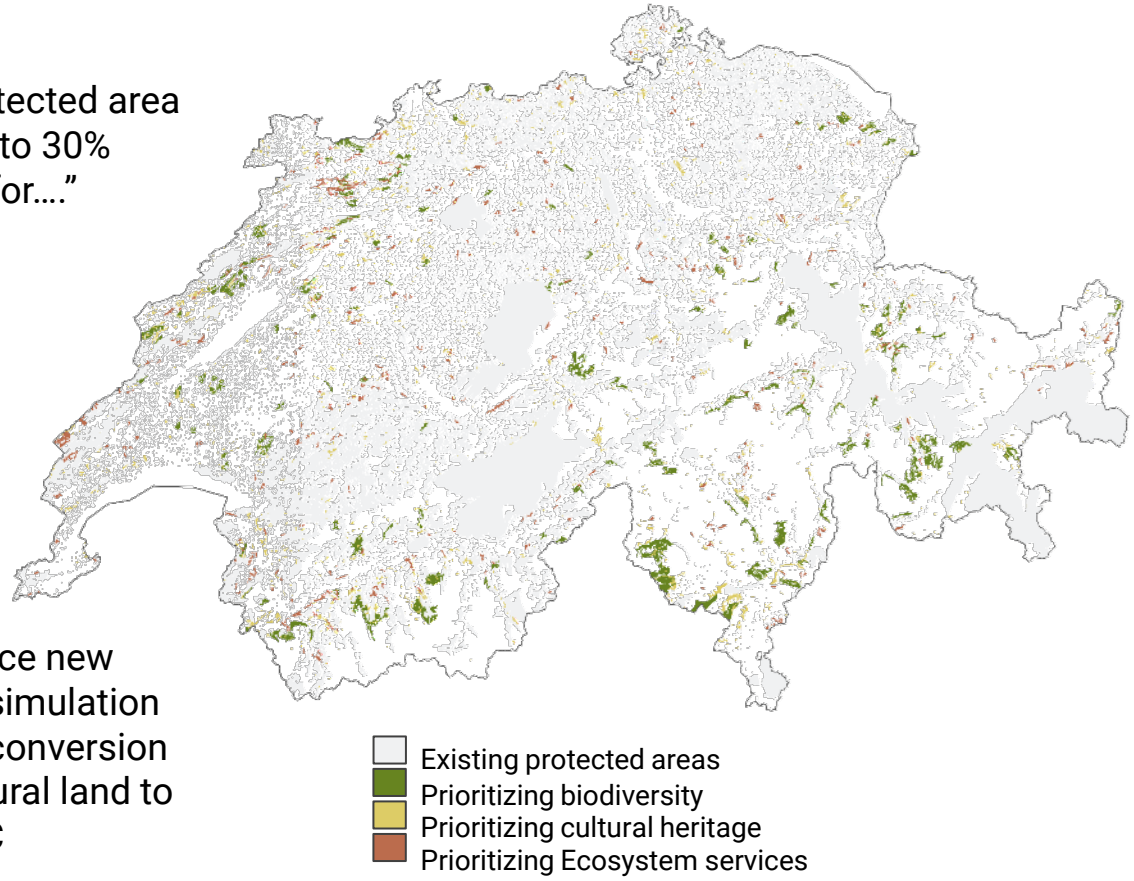
From \ To	Urban	Static	Open forest	Closed forest	Shrubland
Urban	99,34%	0,66%	0,00%	0,00%	0,00%
Static	0,00%	100,00%	0,00%	0,00%	0,00%
Open forest	0,00%	0,00%	0,00%	120,43%	0,00%
Closed forest	0,00%	0,00%	12,32%	87,68%	0,00%
Shrubland	0,00%	0,00%	21,54%	7,96%	66,35%

Participatory, normative scenarios

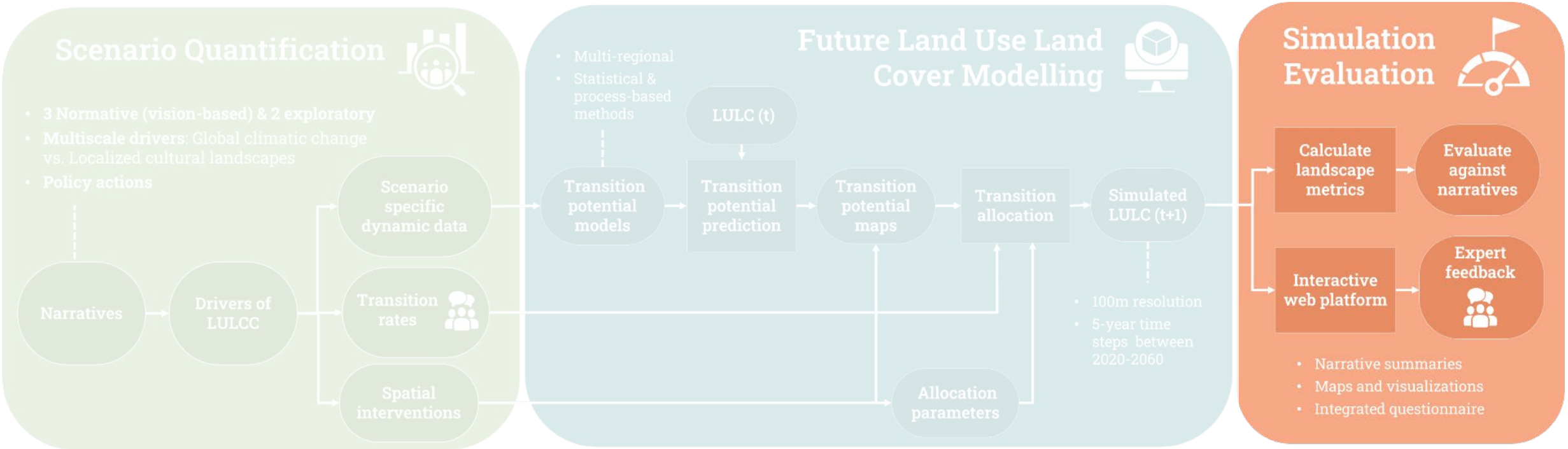


Scenario narrative: "Protected area coverage increased to 30% prioritizing areas for…."

Mechanism: Introduce new hypothetical PAs over simulation time steps, reduce the conversion of natural and semi-natural land to artificial LULC

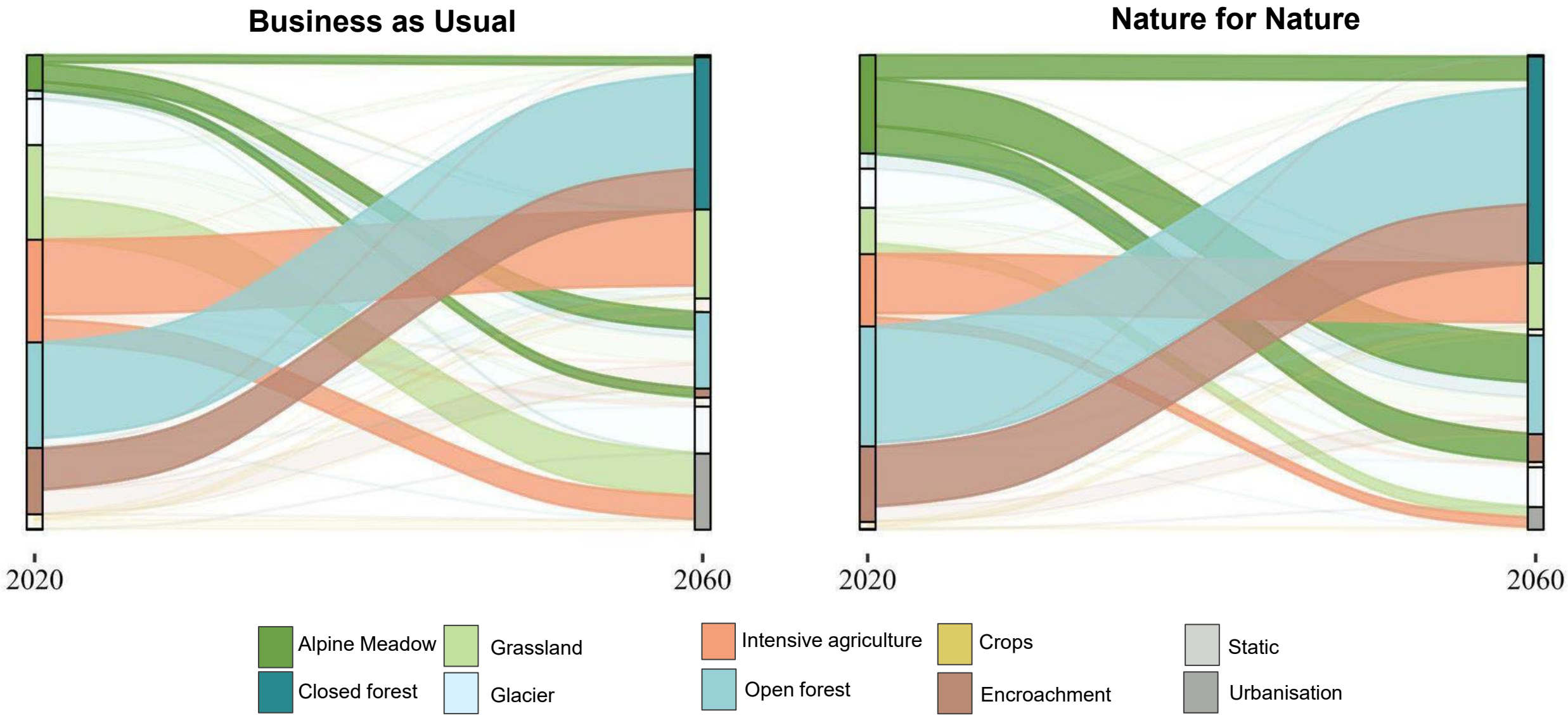


The destination: simulation outputs



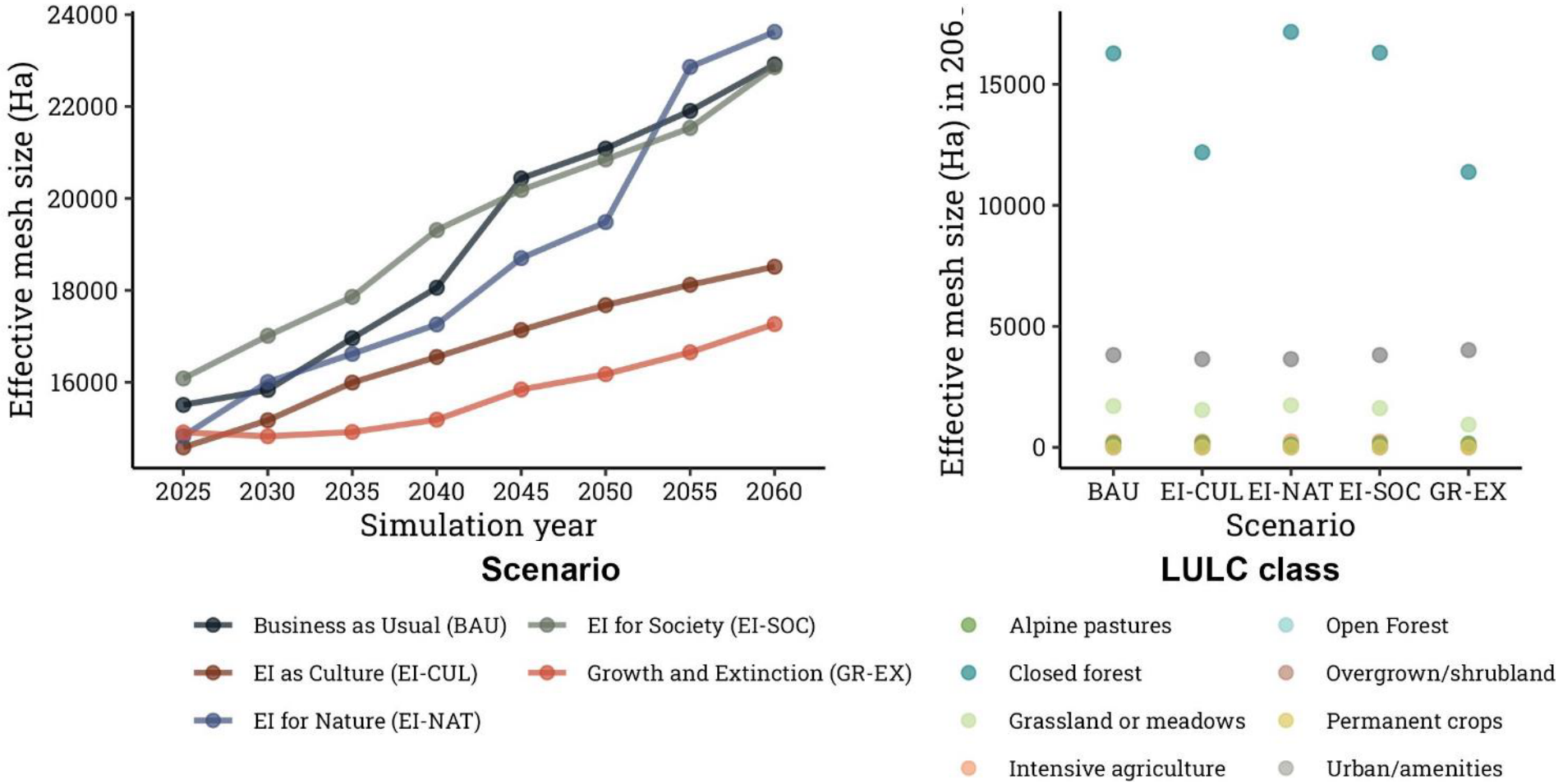
The destination: simulation outputs

Results


Business as Usual
Nature for Nature
2020
2060
2020
2060
Alpine Meadow
Grassland
Closed forest
Glacier
Intensive agriculture
Crops
Open forest
Encroachment
Static
Urbanisation

Results

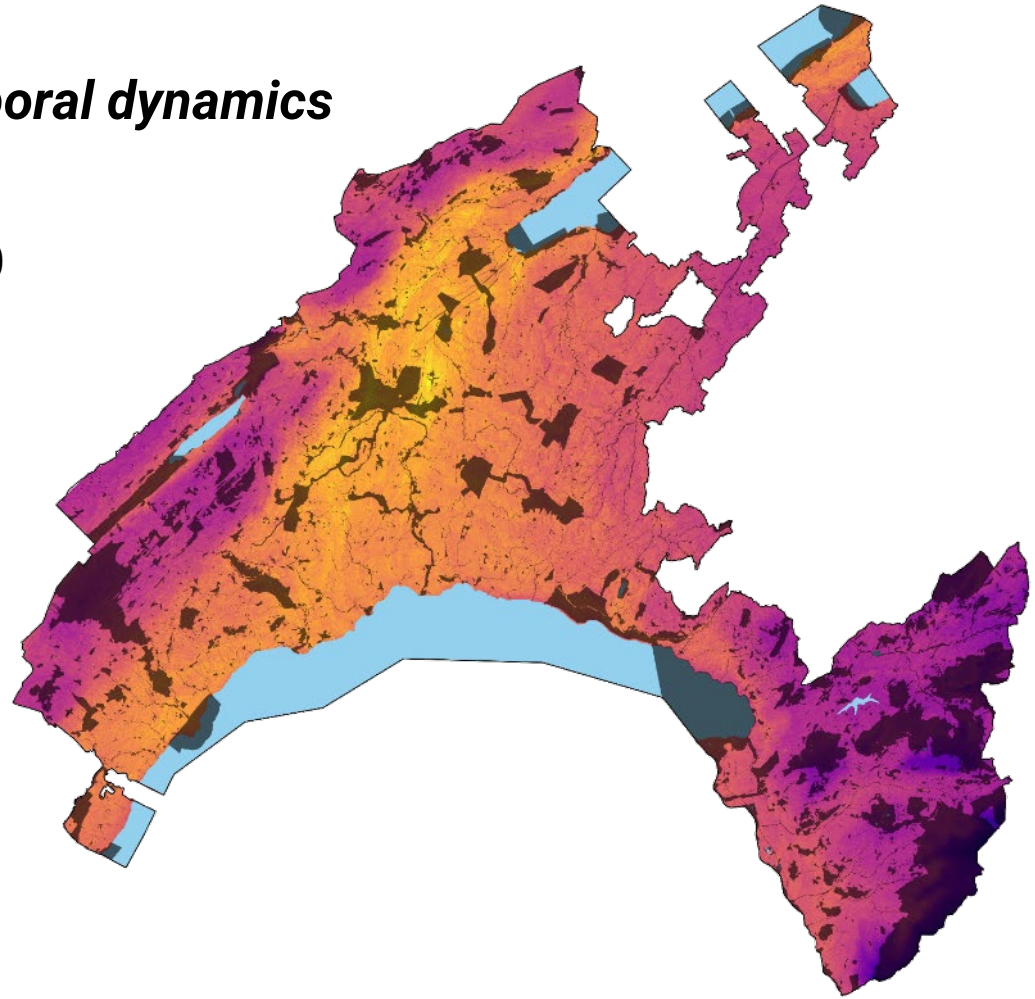
(1) Managing under normative goals



Results

(2) Considering temporal dynamics

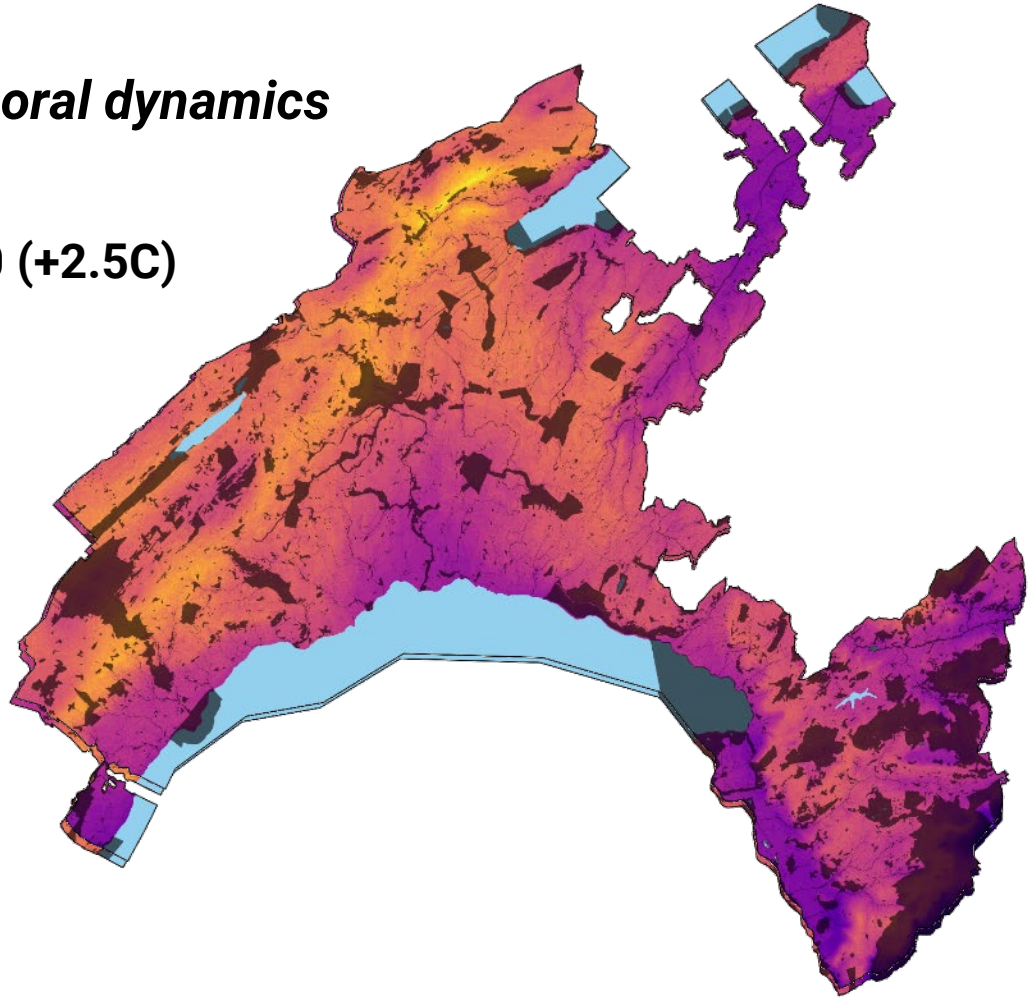
Habitat suitability 2020

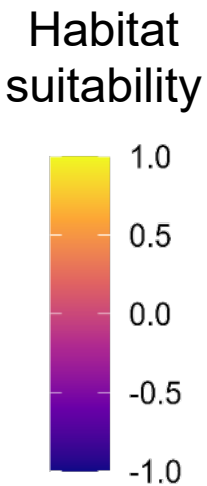


Results

(2) Considering temporal dynamics

Habitat suitability 2060 (+2.5C)

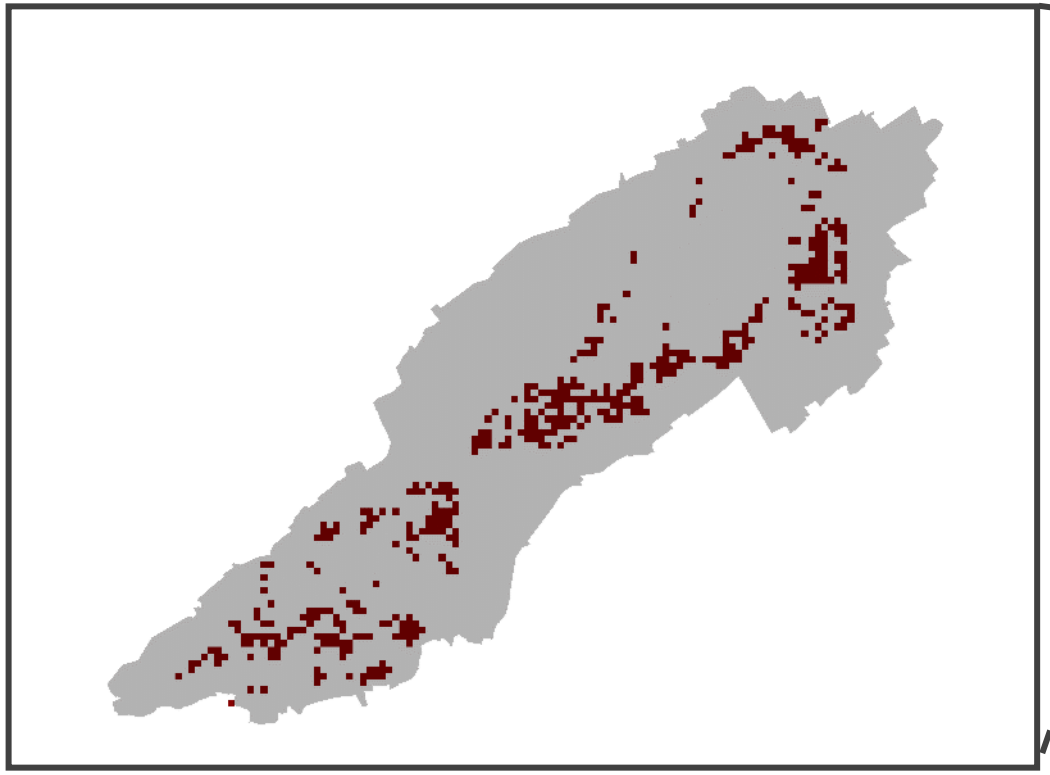




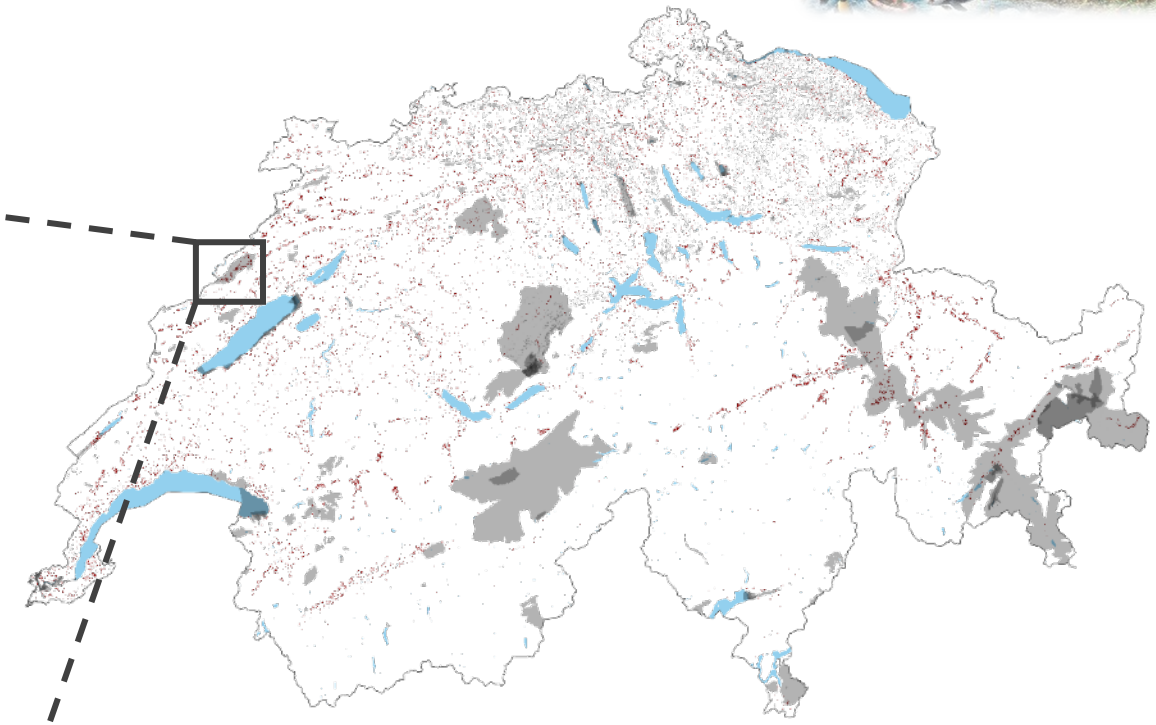
Results

(3) Considering NCPs in managing biodiversity

Business as Usual



UNESCO La Chaux-de-Fonds/Le Locle

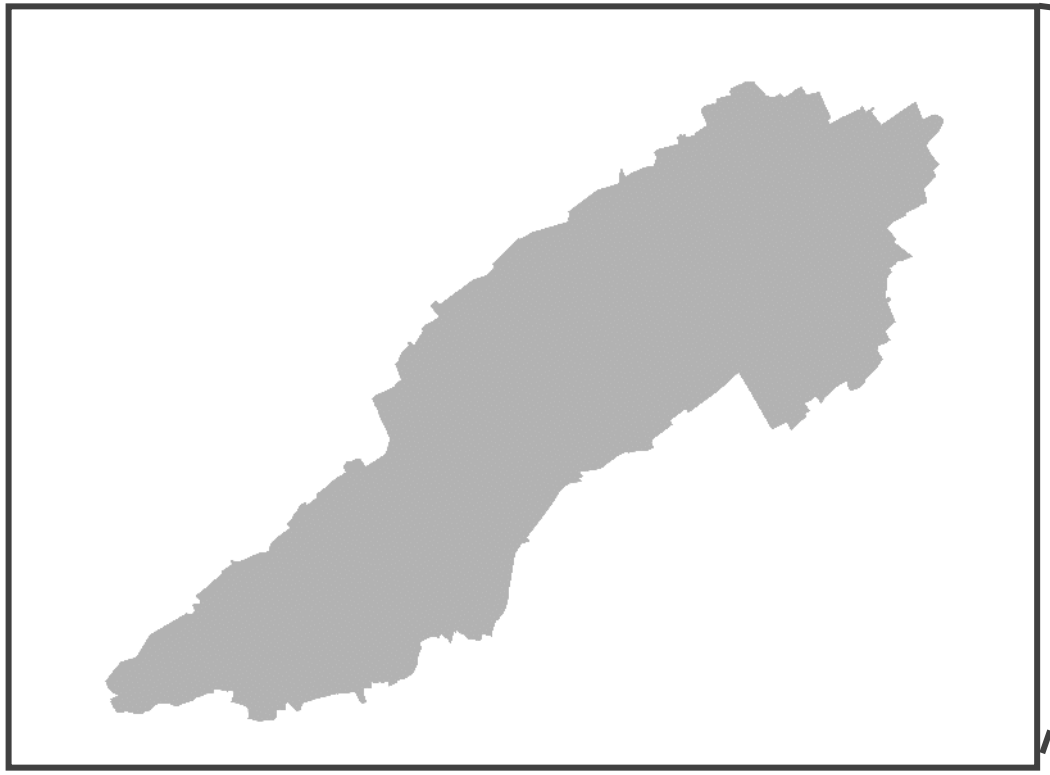


■ **Urbanisation in 2060**

Results

(3) Considering NCPs in managing biodiversity

Nature for Society



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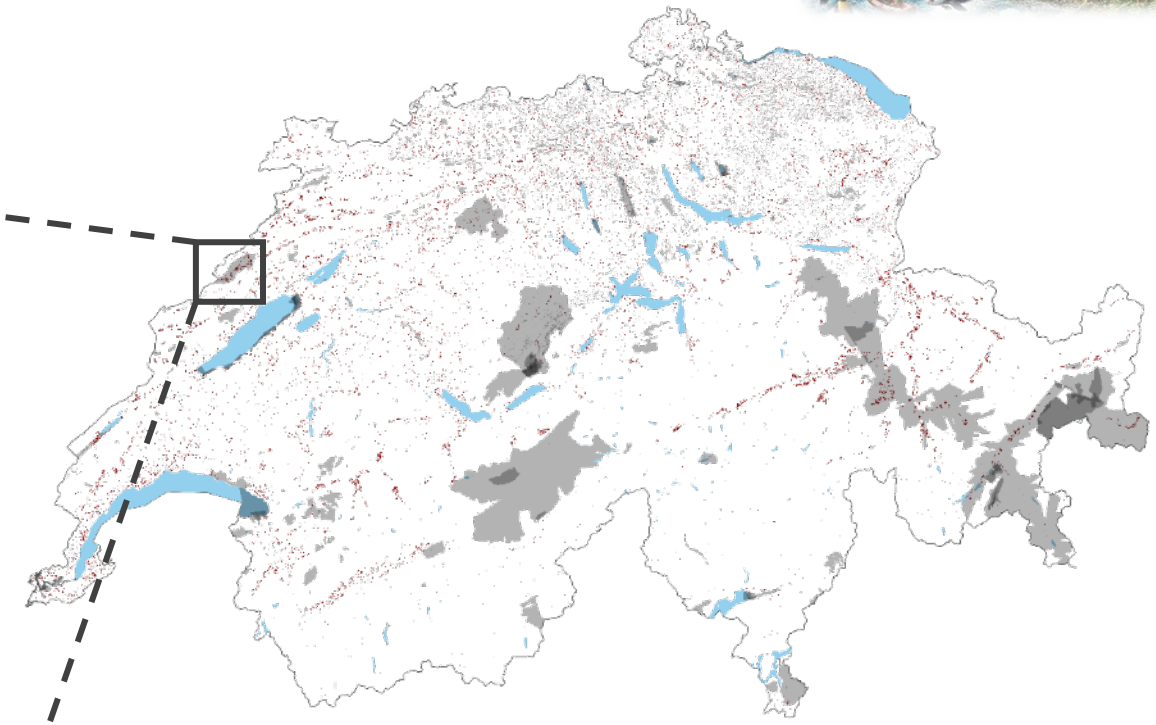

■ **Urbanisation in 2060**

Black et al, in prep.

Conclusions

Which areas shall we protect for biodiversity?

1) Consider temporal and spatial dynamics of biodiversity and NCPs

2) Define clear and negotiable goals

3) Communicate social value of biodiversity

Defining priority areas for biodiversity requires societal value negotiations.

Scenarios and simulations are useful ‘boundary objects’ in this process.

Build upon our work:

Publications:

- Scenarios: https://doi.org/10.1007/s11625-023-01380-7
- Quantification and modelling: **https://doi.org/10.1007/s10113-024-02261-0**

Land use land cover model code: https://github.com/blenback/LULCC-CH

Data: https://doi.org/10.5281/zenodo.8263509

Simulation results webpage: https://valpar.ch/land-use-change-scenarios/index-en.html