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science for global insight

Bending the curve on terrestrial biodiversity loss: a multi-model assessment

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57 authors; 41 institutions

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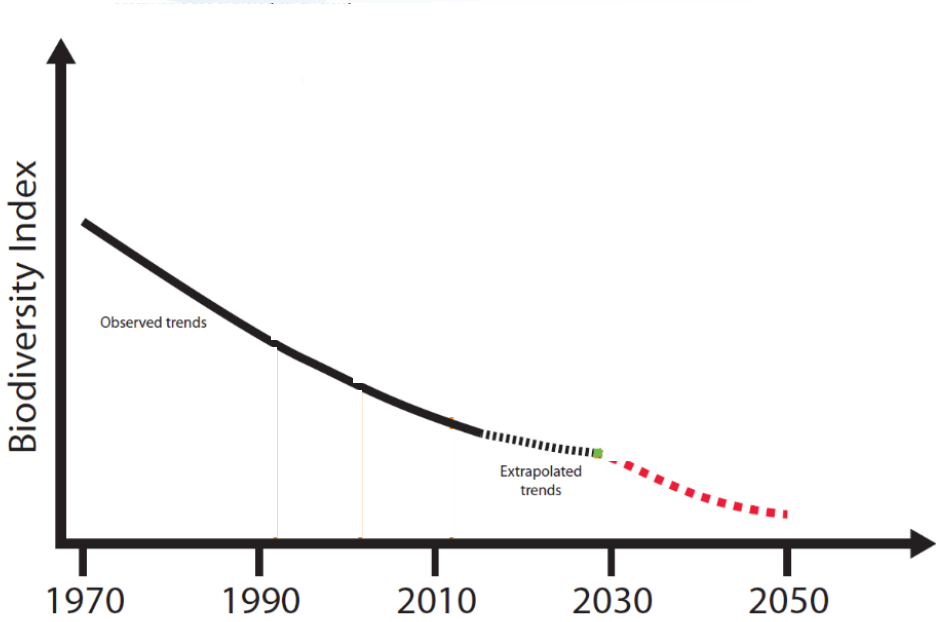
Declining biodiversity trends

"[…] **Rapid further losses are predicted under a business-as-usual land-use scenario** "

Newbold et al. (Nature, 2015)



Mace et al. (Nat. Sus., 2018)

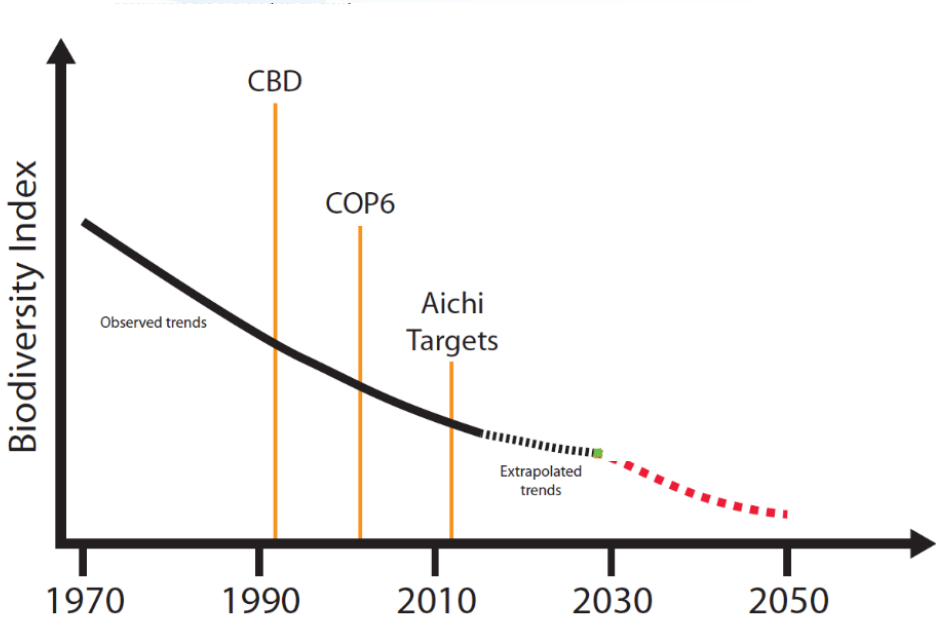
A need for ambitious actions

"[…] **Rapid further losses are predicted under a business-as-usual land-use scenario** "

Newbold et al. (Nature, 2015)

"[…] despite accelerating policy and management responses […] **efforts are unlikely to be reflected in improved trends** […] **by 2020**"

Tittensor et al. (Science, 2014)



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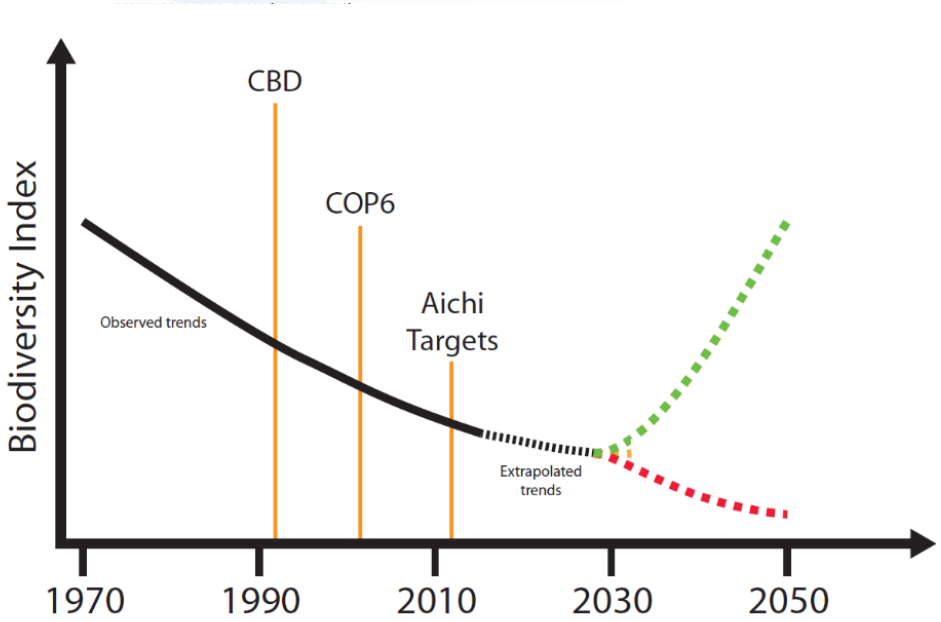
A need for ambitious actions



Mace et al. (Nat. Sus., 2018)

VS.

"Living in Harmony with Nature" where "**By 2050, biodiversity is valued, conserved, restored and wisely used** [...]"

CBD Vision (Strategic plan 2011-2020)

A need for ambitious actions

"[…] bend the curve of biodiversity loss"

Mace et al. (Nat. Sus., 2018)

"An international movement is calling for at least Half Earth to be allocated for conservation "

Venter & Watson (Nature, 2017)

A need for ambitious but well coordinated actions

[…] 3–29% of food calories from crops could be lost if half of Earth's terrestrial ecoregions were given back to nature.

Mehrabi et al. (2018)

SDGs for 2030

The bending the curve initiative

The bending the curve initiative

- combining current knowledge – i.e., existing data, models and scenarios – from the land-use & biodiversity modelling communities
- proof-of-concept analysis:
  - New global **scenarios** exploring the action space required to reverse the declining trends in biodiversity as affected by land use
  - Global **projections** of associated land-use change and biodiversity with multiple models and multiple measures of biodiversity
- Key questions:
  - Can we bend the curve of biodiversity loss from land use change without jeopardizing changes to progress on other SDGs?
  - If yes, what can we say about how to get there?

Scenarios exploring the space of actions

scenarios	Baseline assumptions	Additional efforts towards reversing trends in biodiversity					
	SSP2 (Middle of the Road)						
a) baseline scenario							
Baseline (BASE)	x	-	-	-	-	-	-

!! In this presentation, no climate change mitigation (RCPref)

Scenarios exploring the space of actions

scenarios	Baseline assumptions	Additional efforts towards reversing trends in biodiversity					
	SSP2 (Middle of the Road)	Yield increases	Trade increases	Reduced waste	Diet shifts	Expansion of PAs	Increased restoration
a) baseline scenario							
Baseline (BASE)	x	-	-	-	-	-	-
b) single bundble of action scenarios							
Supply-side efforts (SS)	x	x	x	-	-	-	-
Demand-side efforts (DS)	x	-	-	x	x	-	-
Increased conservation efforts (C)	x	-	-	-	-	x	x

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Increased conservation efforts (C)	x	-	-	-	-	x	x

~~SSP2~~ → SSP1

Scenarios exploring the space of actions

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Linear transition 2020-2050:

- from 0% to 50% substitution of BASE animal calories demand by vegetal calories (more ambitious than SSP1)
- from 0% to 50% reduction of BASE waste throughout the supply chain (~ SSP1)

Scenarios exploring the space of actions

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Increased conservation efforts (C)	x	-	-	-	-	x	x

More ambitious than any SSP:

- In 2020: from 15% to 40% of terrestrial area under PA (no biodiversity-decreasing land use change allowed)
- In 2020: tax/subsidy on biodiversity impact of land use change, starting with low tax value & increasing to 2100

Scenarios exploring the space of actions

scenarios	Baseline assumptions	Additional efforts towards reversing trends in biodiversity					
	SSP2 (Middle of the Road)	Yield increases	Trade increases	Reduced waste	Diet shifts	Expansion of PAs	Increased restoration
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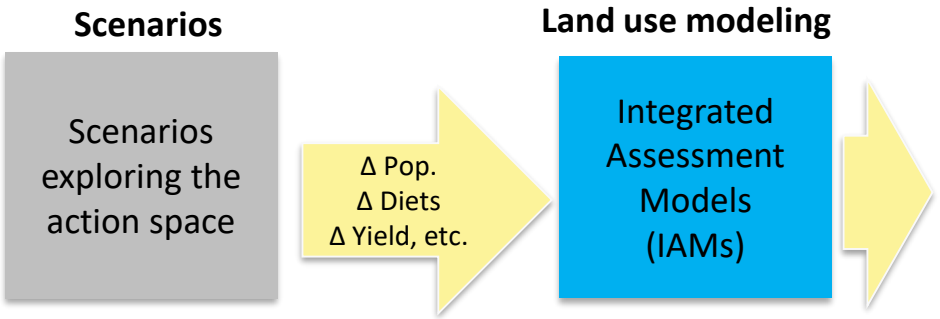
Baseline (BASE)	x	-	-	-	-	-	-
b) single bundble of action scenarios							
Supply-side efforts (SS)	x	x	x	-	-	-	-
Demand-side efforts (DS)	x	-	-	x	x	-	-
Increased conservation efforts (C)	x	-	-	-	-	x	x
c) combined action scenarios							
Inc. conservation & supply-side efforts (C+SS)	x	x	x	-	-	x	x
Inc. conservation & demand-side efforts (C+DS)	x	-	-	x	x	x	x
Integrated action portfolio (IAP)	x	x	x	x	x	x	x

Multi-model assessment



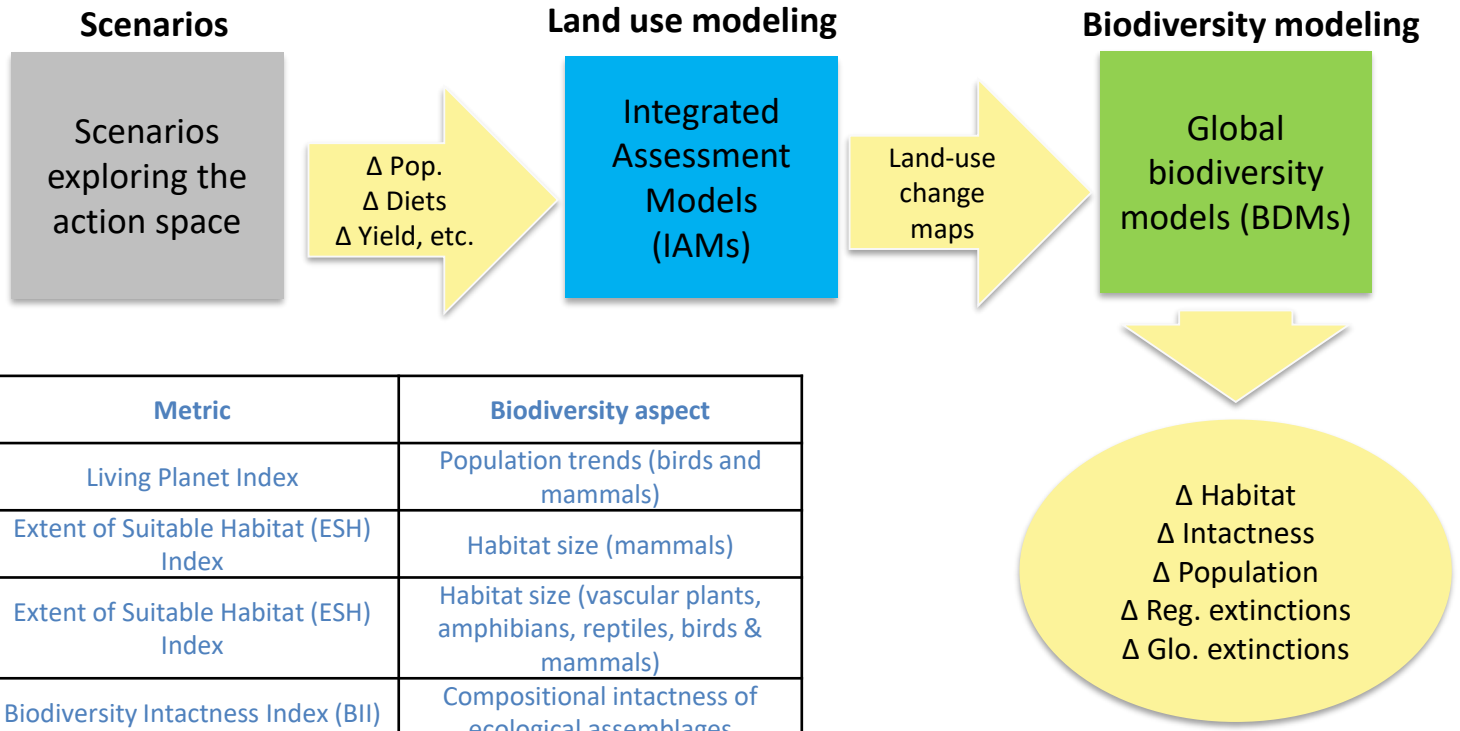
Spatially (30 arcmin, global) **& temporally explicit** (10 years, 2010-2100) **maps of land use change** (8 categories from urban to unmanaged forest)

4 different IAMs / scenario

Model name (Land use model/IAM)	Institution
Asia-Pacific Integrated Model (AIM/CGE)	National Institute For Environmental Studies (NIES, Japan)
Global Biosphere Management Model (GLOBIOM/MESSAGE)	International Institute Of Applied System Analysis (IIASA, Austria)
Integrated Model to Assess the Global Environment (IMAGE/MAGNET)	Netherlands Environmental Assessment Agency (PBL, Netherlands)
Model of Agricultural Production and its Impact on the Environment (MAgPIE/REMIND)	Potsdam Institute For Climate impact Research (PIK, Germany)

Multi-model assessment

Leclère et al. (IIASA, 2018)



Biodiversity model (BDM)	Metric	Biodiversity aspect
LPI model	Living Planet Index	Population trends (birds and mammals)
INSIGHTS model	Extent of Suitable Habitat (ESH) Index	Habitat size (mammals)
AIM-biodiversity	Extent of Suitable Habitat (ESH) Index	Habitat size (vascular plants, amphibians, reptiles, birds & mammals)
PREDICTS model	Biodiversity Intactness Index (BII)	Compositional intactness of ecological assemblages
GLOBIO model	Mean Species Abundance (MSA) Index	Compositional intactness of ecological assemblages
cSAR models (cSAR_US16 & cSAR_CB17)	Fraction of {globally/regionally} remaining species (F{R/G}RS) Index	Regional and global extinction species (vascular plants, amphibians, reptiles, birds & mammals)
BILBI model	Fraction of remaining species (FGRS)	Global extinction of vascular plants

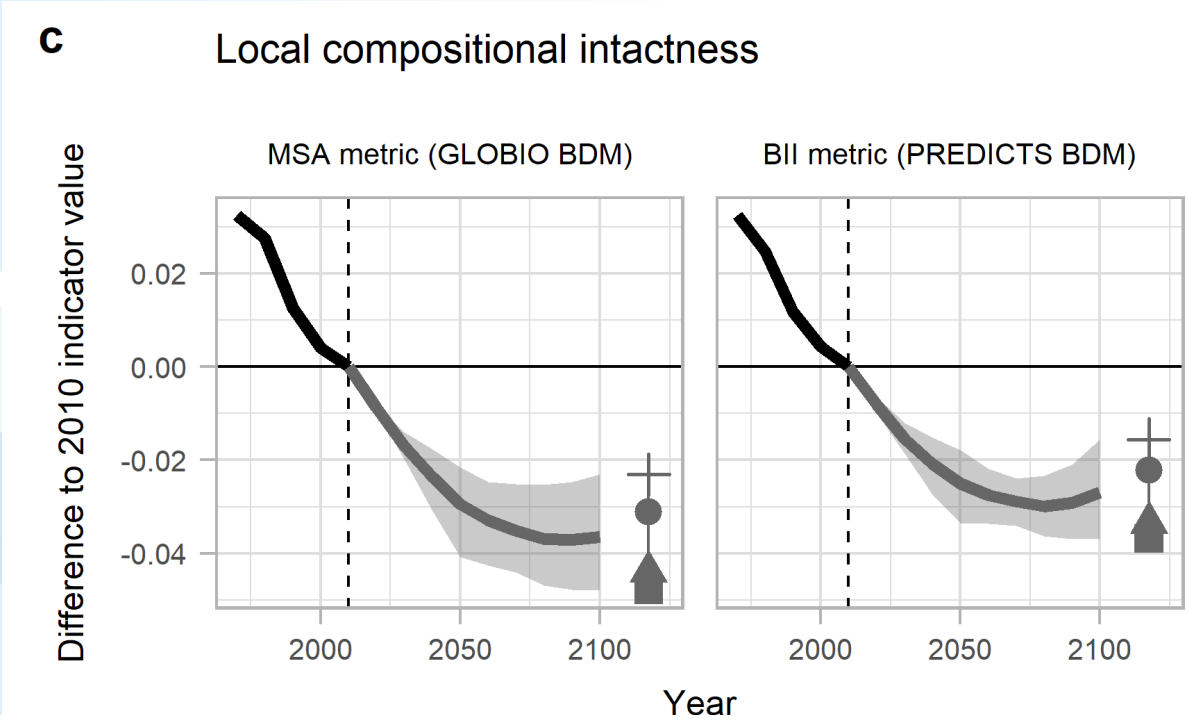
Spatially (17 IPBES subregions) **& temporally explicit** (10 years, 2010-2100) **maps of biodiversity indices** (10 indices over 6 metrics & 8 BDMs)

(10 indices x 4 IAM) per scenario

Results

What if we don’t raise ambition?

Continued global trends without ambitious action



- Robust decline
- Rates of decline ~ that of 1970-2010 until second half of 21st century

Projections (for scenarios: mean and range across IAMs)

Historical (IMAGE/HYDE3.1)

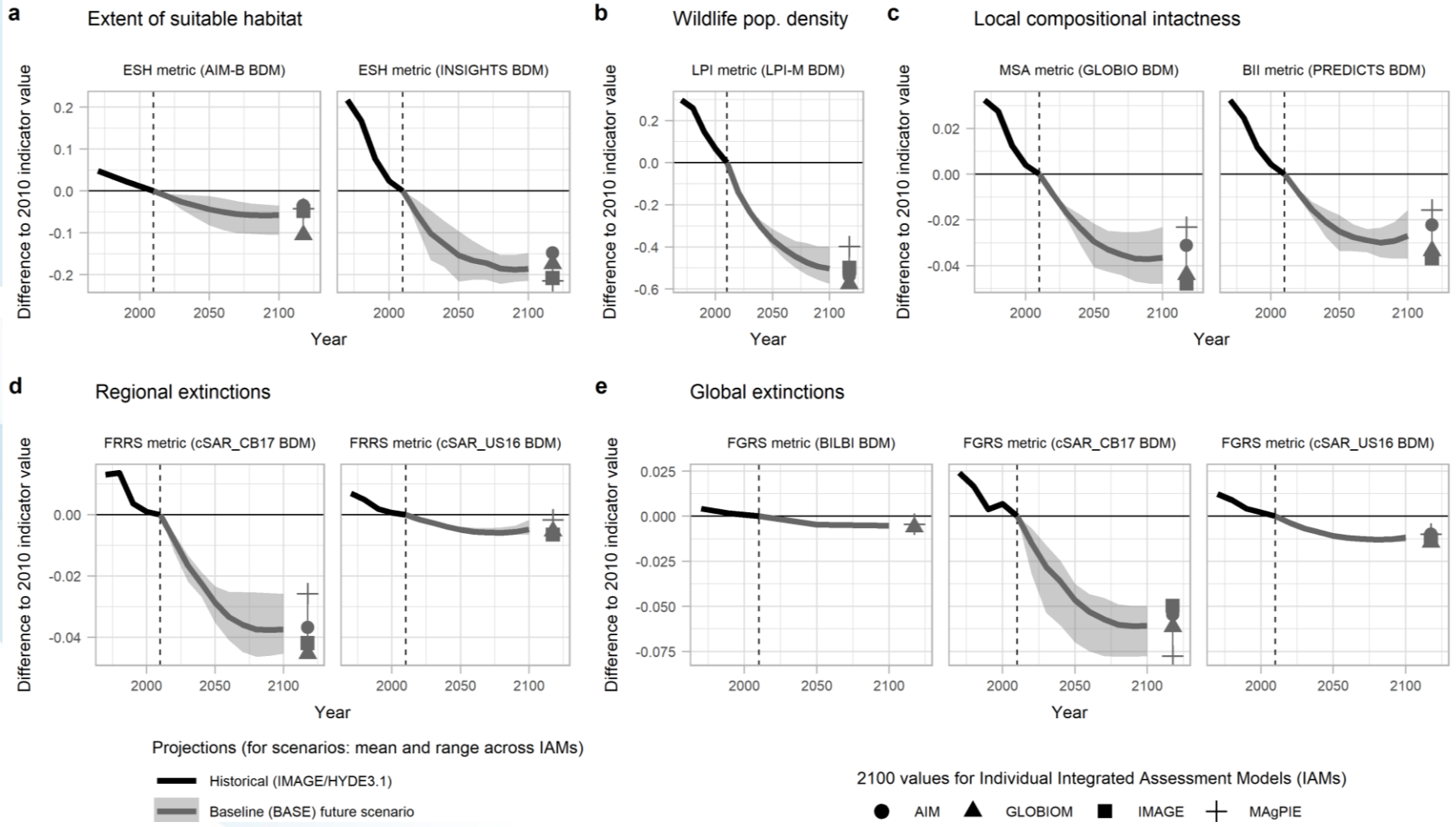
Baseline (BASE) future scenario

2100 values for Individual Integrated Assessment Models (IAMs)

AIM GLOBIOM IMAGE MAgPIE

Leclère et al. (sub.) – do not circulate, tweet or quote

Continued global trends without ambitious action



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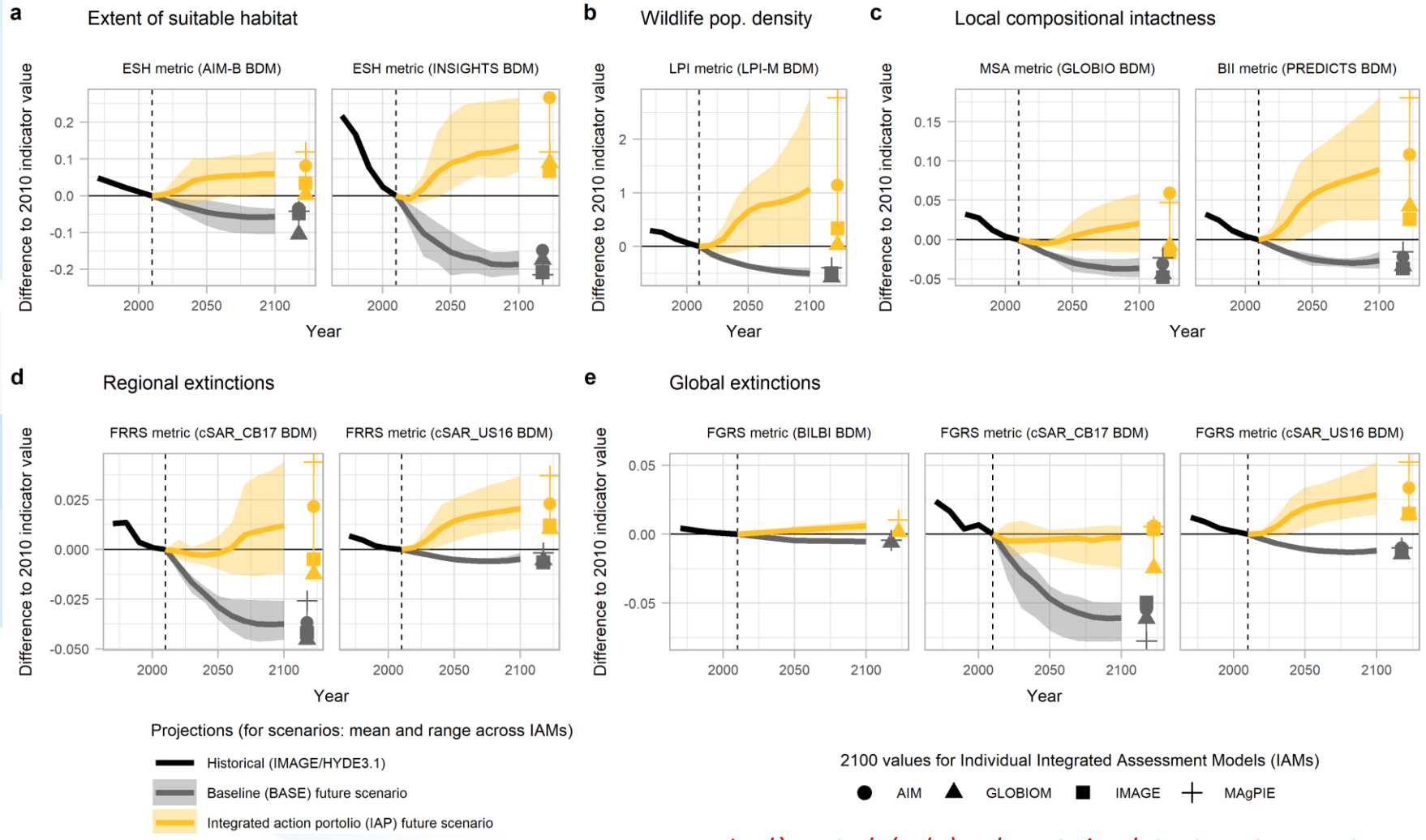
Can we bend the curve?

Combined actions could reverse global trends



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Combined actions could reverse global trends

If combining supply-side, demand-side and increased conservation efforts:

- Biodiversity trends reversed by 2050 for 34 out of 38 (IAM x BDI) combinations
- 60-95% of baseline losses avoided for 4 other cases
- 4 other cases correspond to the most conservative combination of model projections:

  e.g., (GLOBIOM or IMAGE) x (MSA indicator from GLOBIO model)

Lowest amount of managed grassland

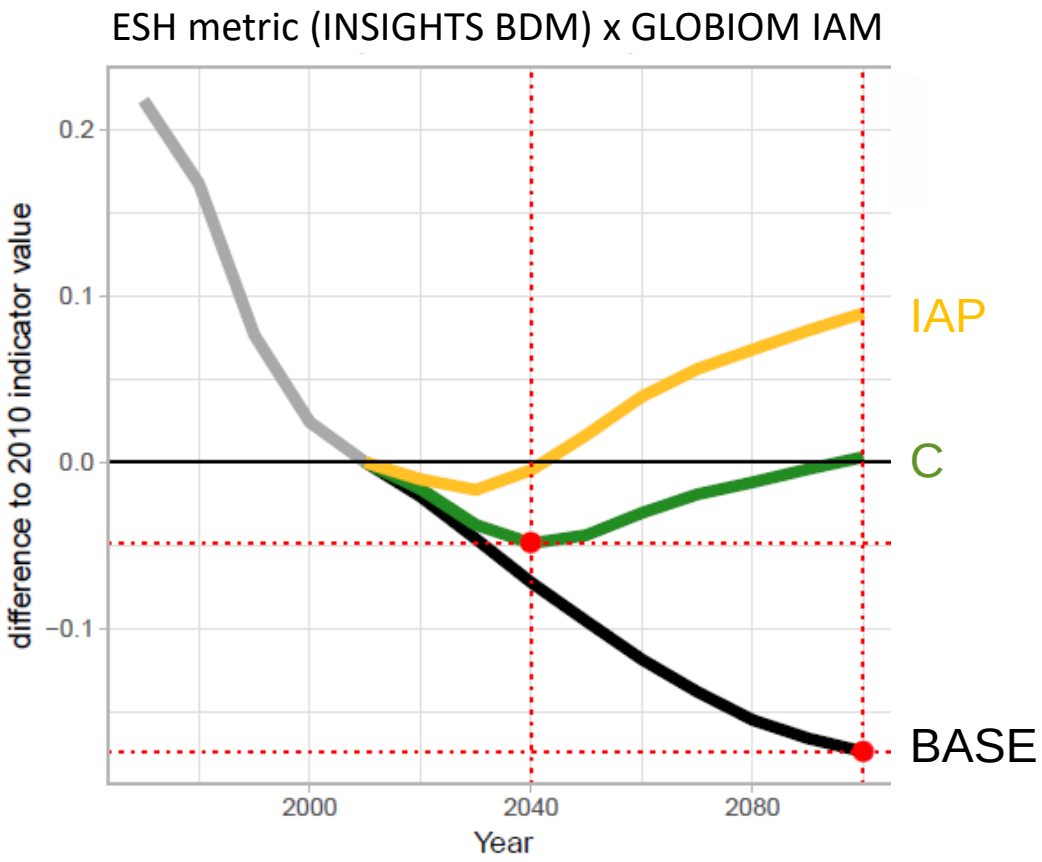
Lowest preference for restoration vs other land uses

Among highest assumptions about time for biodiversity recovery under restoration areas

Leclère et al. (sub.) – do not circulate, tweet or quote

How do we get there?

How do we get there?



For each scenario:

- When is the peak loss reached over the 21st century?
- What share of losses is avoided as compared to the reference scenario?
- How fast is the recovery after the peak loss has been reached?

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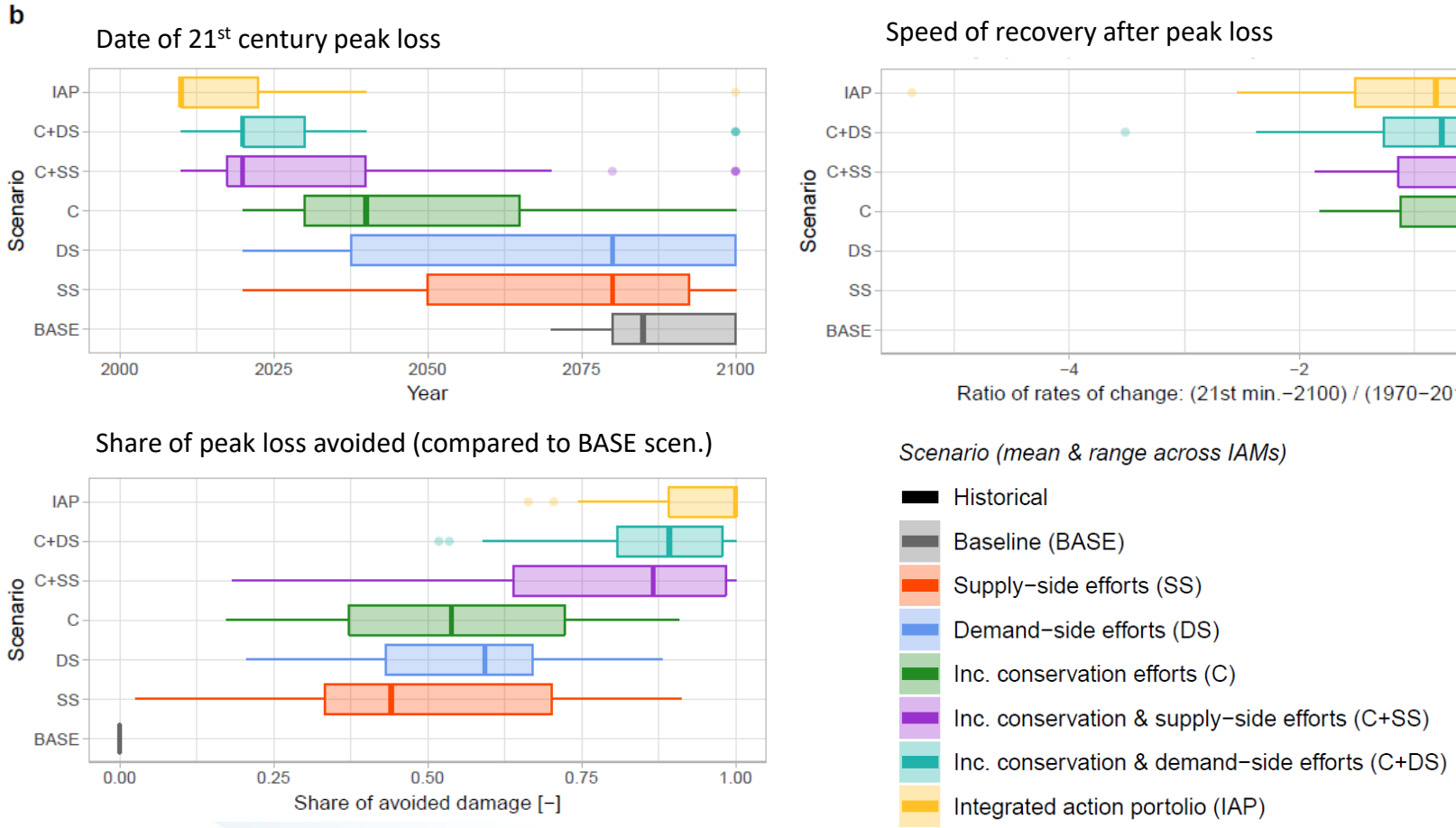
Increased conservation efforts are key …



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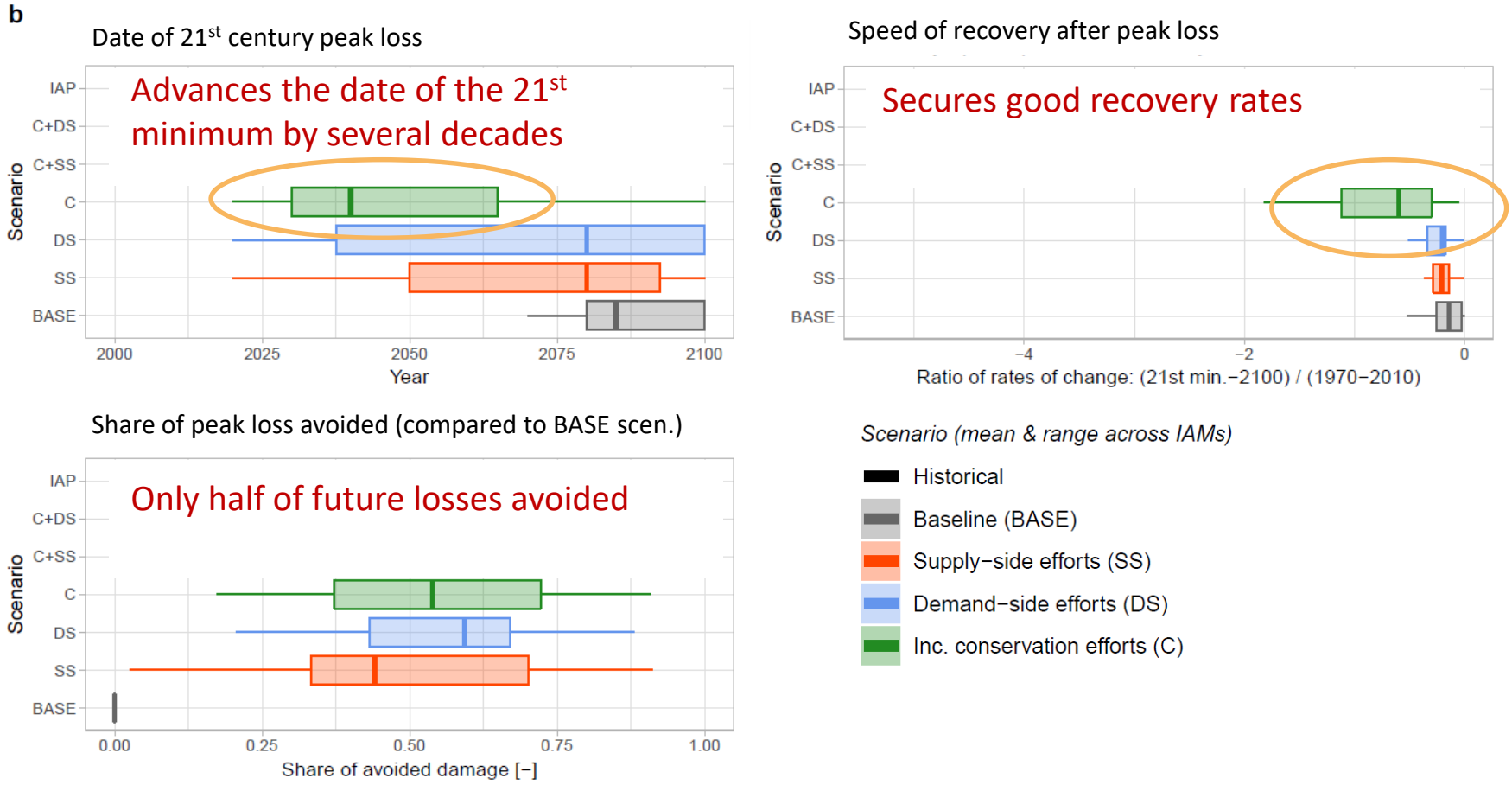

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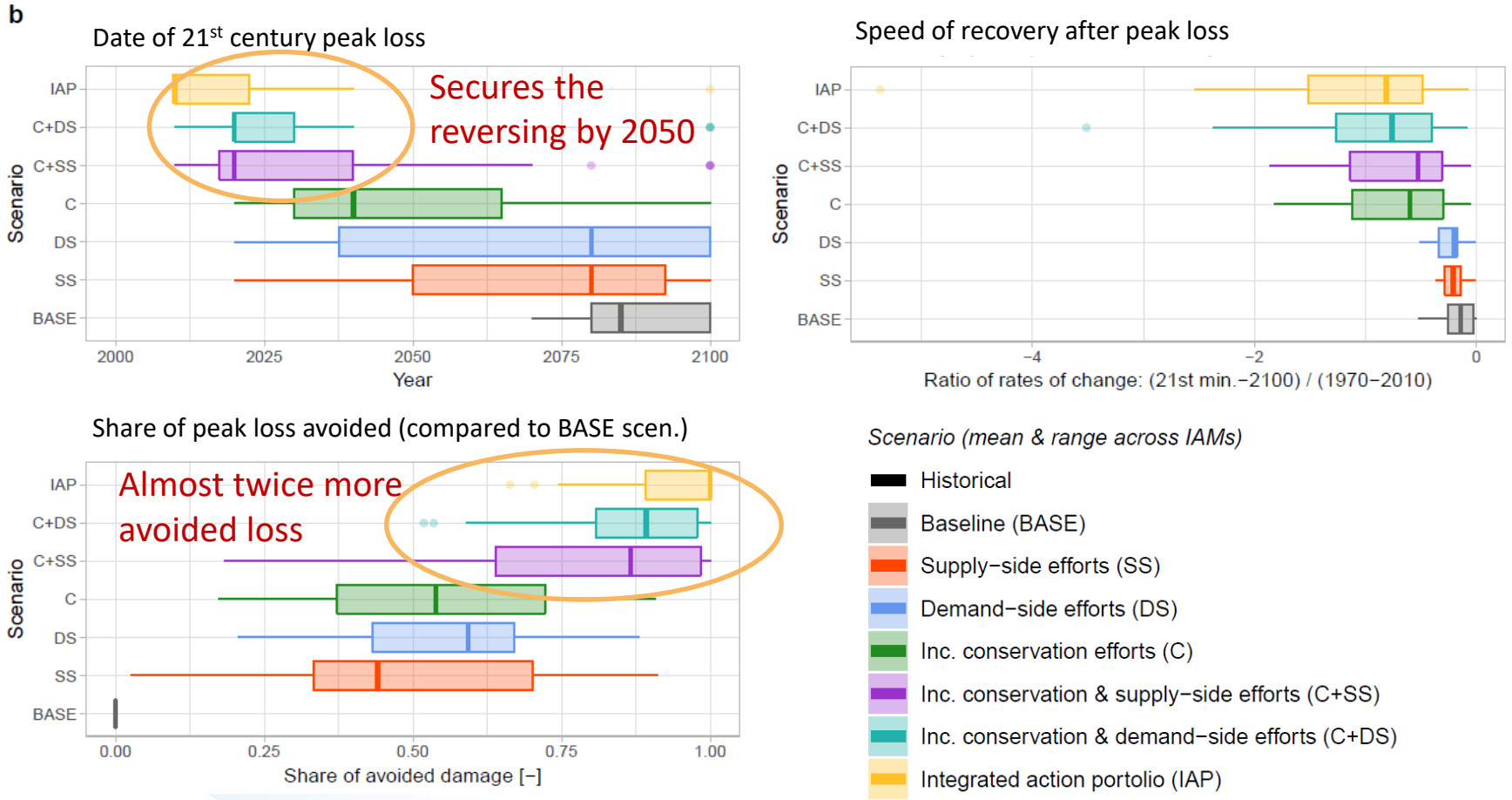
Increased conservation efforts are key …
… but additionally tackling the drivers as well



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Wait … what about impacts on food security etc.?

Trade-offs & synergies

- Conservation vs. affordable food trade-off: unfortunately, increased conservation effort also bend the curve of food price (to a moderate increase)

- Integrated strategies prevent the reversing of:
  - food price
  - environmental impacts of land use
    (water use, fertilizer application, GHG emissions)

Synergies with limiting future environmental impacts

ARTICLE

https://doi.org/10.1038/s41586-018-0594-0

Options for keeping the food system within environmental limits

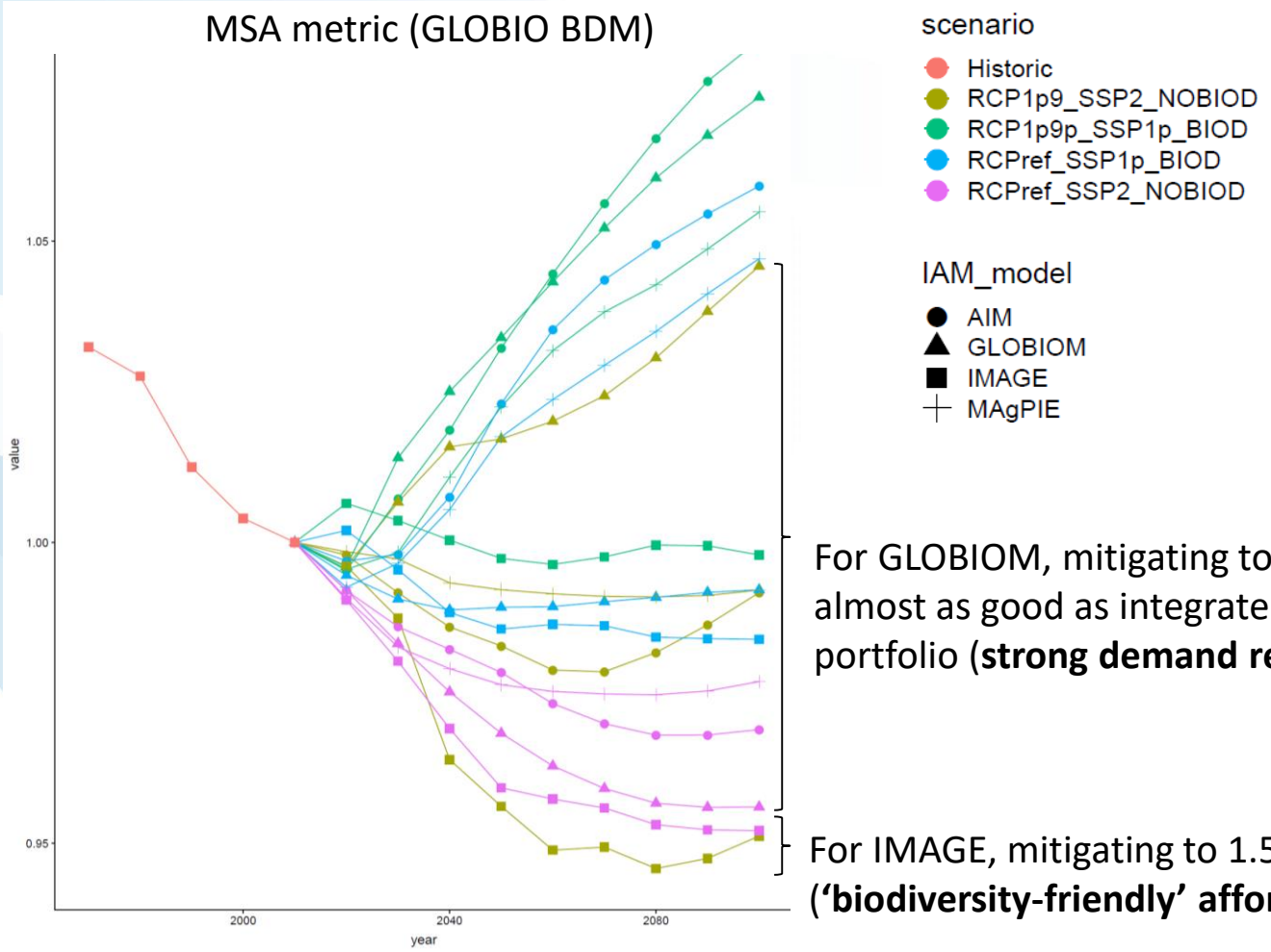
Marco Springmann[1,2*], Michael Clark[3], Daniel Mason-D'Croz[4,5], Keith Wiebe[4], Benjamin Leon Bodirsky[6], Luis Lassaletta[7], Wim de Vries[8], Sonja J. Vermeulen[9,10], Mario Herrero[5], Kimberly M. Carlson[11], Malin Jonell[12], Max Troell[12,13], Fabrice DeClerck[14,15], Line J. Gordon[12], Rami Zurayk[16], Peter Scarborough[2], Mike Rayner[2], Brent Loken[12,14], Jess Fanzo[17,18], H. Charles J. Godfray[1,19], David Tilman[20,21], Johan Rockström[6,12] & Walter Willett[22]

Concluding remarks

Conclusive remarks

- Reversing biodiversity trends without jeopardizing food security:
  - seems feasible by 2050
  - will however require an ambitious and integrated strategy
  - robust results from multiple models
- Suggests both ambitious conservation efforts and strategies to lessen drivers of land-use change should be part of a post-2020 strategy
- Some limits:
  - Biodiversity impact of future cropland intensification not well accounted for
  - Considers only biodiversity impact from land use change (ignores species invasion, hunting, climate change)

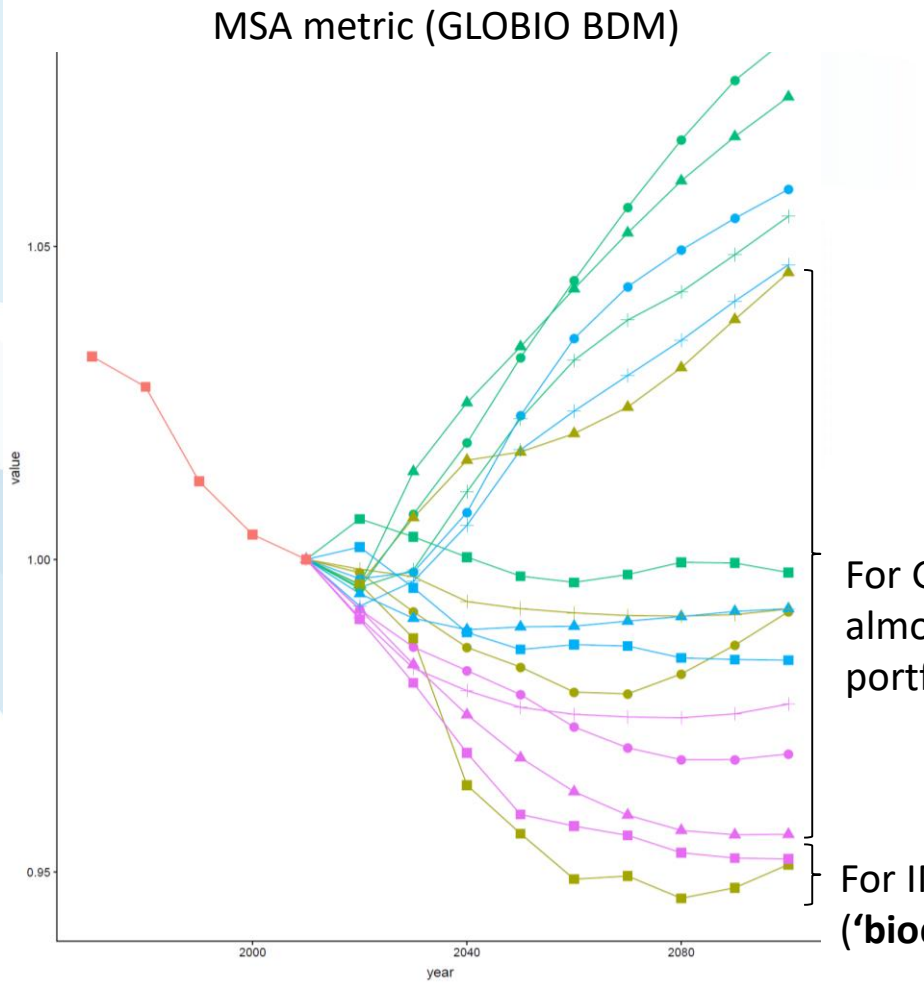
What if we add climate mitigation?

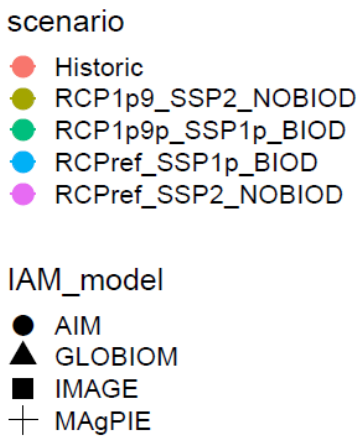


For GLOBIOM, mitigating to 1.5°C is almost as good as integrated action portfolio (**strong demand response**)

For IMAGE, mitigating to 1.5°C slightly harms (**'biodiversity-friendly' afforestation**)

What if we add climate mitigation?





Refinement needed:

- Harmonization of mitigation pathways across IAMs
- Finer representation of land uses at the interfaces between IAMs and BDMs

For GLOBIOM, mitigating to 1.5°C is almost as good as integrated action portfolio (**strong demand response**)

For IMAGE, mitigating to 1.5°C slightly harms (**'biodiversity-friendly' afforestation**)

Thank you! Questions?

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Partnership: