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A joint organization of UNEP & SETAC

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UNEP-SETAC Life Cycle Initiative on the assessment of biodiversity impacts of land use in LCA

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61st LCA Discussion Forum

HOW TO ASSESS IMPACTS OF LAND USE ON BIODIVERSITY AND SOIL QUALITY IN LCA?

March 15, 2016, ETH Zürich, Alumni Pavilion

Quantis
Sustainability counts

Forschungsinstitut für biologischen Landbau
Institut de recherche de l'agriculture biologique
Research Institute of Organic Agriculture
Istituto di ricerche dell'agricoltura biologica
Instituto de investigaciones para la agricultura orgánica
FiBL

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LCIA Global Consensus Project: Biodiversity Land Use taskforce

GOAL

To provide **global guidance and consensus building** regarding indicators and methods for the assessment of **biodiversity impacts from Land Use** in LCA

Specific Tasks

❖ **Critical review of the existing framework for LU impact assessment**

❖ **Expert workshops**

❖ **Review and evaluation of existing indicators**

❖ **Guidance on guidance on which models or indicators hold promise and future improvements in the modelling framework**

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Impact Pathway
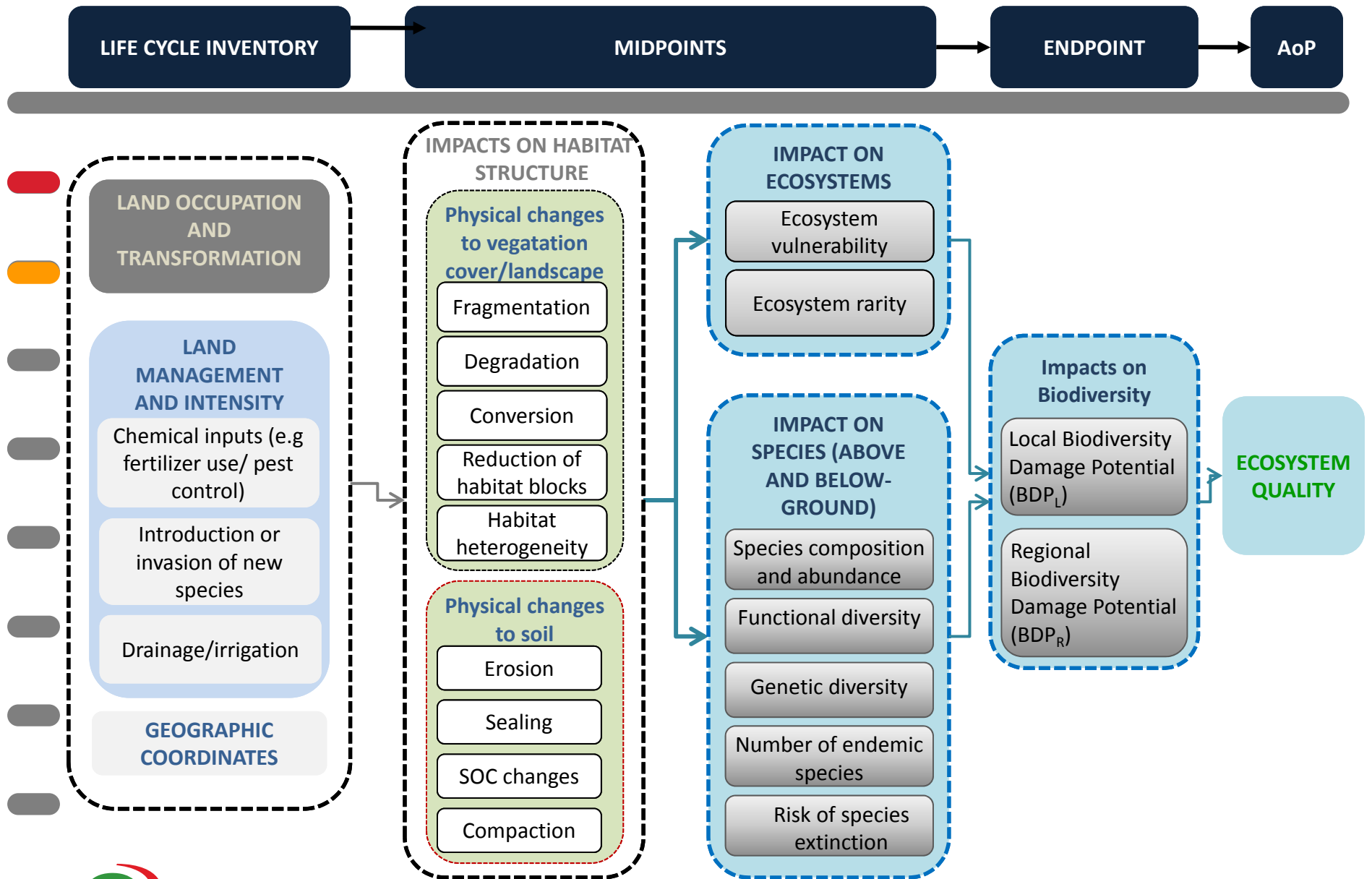
Expert workshops

San Francisco on October 7th, 2014 (hosted by the US EPA)

14 participants

Brussels on November 18 - 19, 2014 (hosted by the Alliance for Beverage Cartons and the Environment, ACE)

24 participants

Valencia on January 25 - 29, 2016: Pellston workshop (consensus finding) on model endorsement

7 participants

Participants were invited experts in LCA, conservation and ecology (academia and NGOs), as well as institutional and business partners. **Topics** discussed were:

(a) Concept of biodiversity and modelling strategies,

(b) Data availability and feasibility,

(c) Desired characteristics of indicators, usability and consensus

(d) Concerns and limitations about using biodiversity indicators in LCA.

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Expert workshops: conclusions

❖ Using **species richness** seems the best option to start

❖ Inclusion of **habitat configuration** (fragmentation and vulnerability), as well as intensity-base indicators (**NPP/HANPP)**

❖ The **regional state** and **pressure component** may consist of a composite index

❖ Model must include at minimum aspects of **irreplaceability and vulnerability** at the relevant scale of analysis

❖ The interpretation of LCA results should be **clear about the scope** of the models used and, depending on the intended uses, **point to deeper assessment tools that can assess local specificities**.

Teixeira, R.; Souza, D.; Curran, M.P.; Antón, A.; Michelsen, O.; Milà i Canals, Ll. 2015 Towards consensus on land use impacts on biodiversity in LCA: UNEP/SETAC Life Cycle Initiative preliminary recommendations based on expert contributions. Journal of Cleaner Production (doi:10.1016/j.jclepro.2015.07.118)
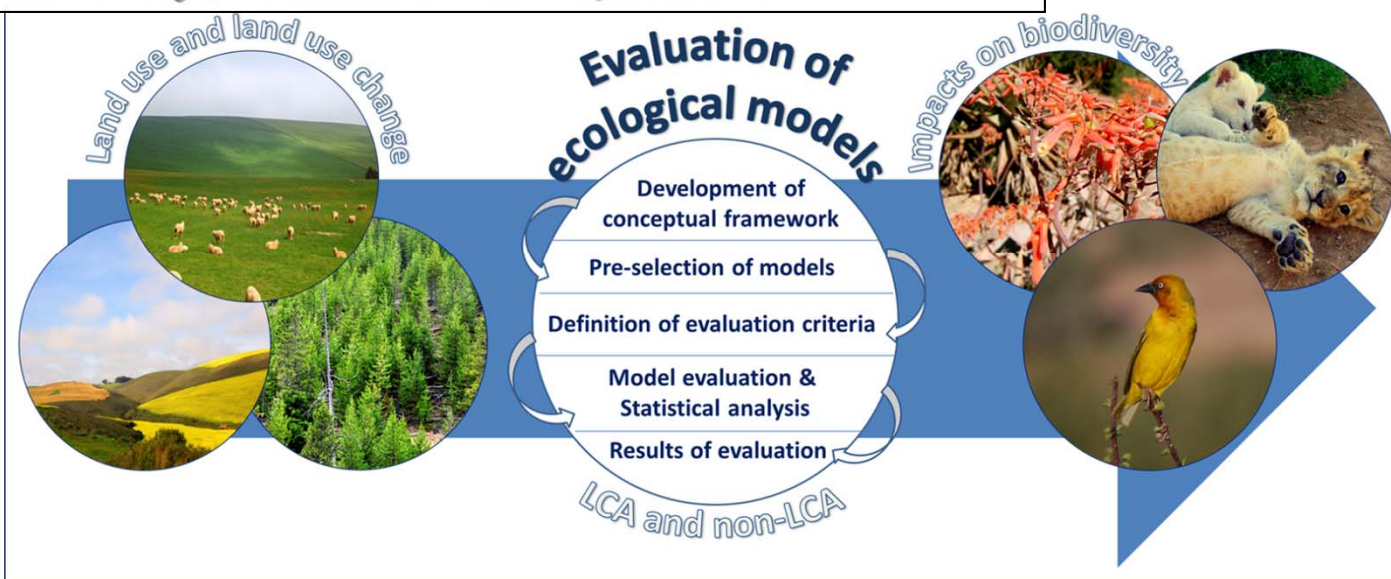
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Review and evaluation

Environmental Science & Technology

Critical Review

pubs.acs.org/est

How Well Does LCA Model Land Use Impacts on Biodiversity?—A Comparison with Approaches from Ecology and Conservation

Michael Curran,[*,†] Danielle Maia de Souza,[‡,§,ll] Assumpció Antón,[£] Ricardo F.M. Teixeira,[⊥,#] Ottar Michelsen,[∇] Beatriz Vidal-Legaz,[○] Serenella Sala,[○] and Llorenç Milà i Canals[◆]

Land use and land use change

Evaluation of ecological models

Impacts on biodiversity

Development of conceptual framework

Pre-selection of models

Definition of evaluation criteria

Model evaluation & Statistical analysis

Results of evaluation

LCA and non-LCA

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Review and evaluation: models

	Non-LCA
1	Alkemade et al. (2009, 2013)
2	Gardi et al. (2013)
3	Gibson et al. (2011)
4	Haberl et al. (2004, 2005)
5	Leh et al. (2013), Tallis et al. (2011)*
6	Lenzen et al. (2009, 2013)
7	Lenzen et al. (2012)
8	Louette et al. (2010), Delbaere et al. (2009), Overmars et al. (2014)
9	Nelson et al. (2009)*
10	Newbold et al. (2014)
11	Scholes and Biggs (2005)

	LCA
1	Brentrup et al. (2002)
2	Burke et al. (2008), Kyläkorpi et al. (2005)
3	Chaudhary et al. (2015)
4	Coelho and Michelsen (2014)
5	de Baan et al. (2013a)
6	de Baan et al. (2013b)
7	de Baan et al. (2015)
8	de Schryver et al. (2010), Goedkoop et al. (2009)
9	Elshout et al. (2014)
10	Geyer et al. (2010a, 2010b)
11	Jeanneret et al. (2014, 2006)
12	Schmidt (2008), Koellner (2000)
13	Koellner and Scholz (2007, 2008)
14	Lindeijer (2000)
15	Matsuda et al. (2003), Li et al. (2008)
16	Michelsen (2008)
17	Mueller et al. (2014)
18	Souza et al. (2013)
19	Urban et al. (2012)
20	Vogtlaender et al. (2004)

- 73 papers reviewed
- 31 methods selected and evaluated
- Critical Review paper published in ES&T (In Press)

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Review and evaluation: criteria

COMPLETENESS OF SCOPE (scored)

- Land use classes considered (number and intensity)
- Spatial, temporal, ecological characterization (e.g. geographic scope, resolution, taxa)

BIODIVERSITY REPRESENTATION (scored)

- Hierarchical levels of organization (genes -> ecosystems)
- Biological attributes (i.e. function, structure, composition)
- Extinction risk (e.g. IUCN cats, rarity, vulnerability)

IMPACT PATHWAY COVERAGE (scored)

- Ecosystem fragmentation and loss
- Local habitat modification

SCIENTIFIC QUALITY (described)

- Scientific robustness
- Uncertainty representation
- Documentation and transparency

STAKEHOLDERS ACCEPTANCE (described)
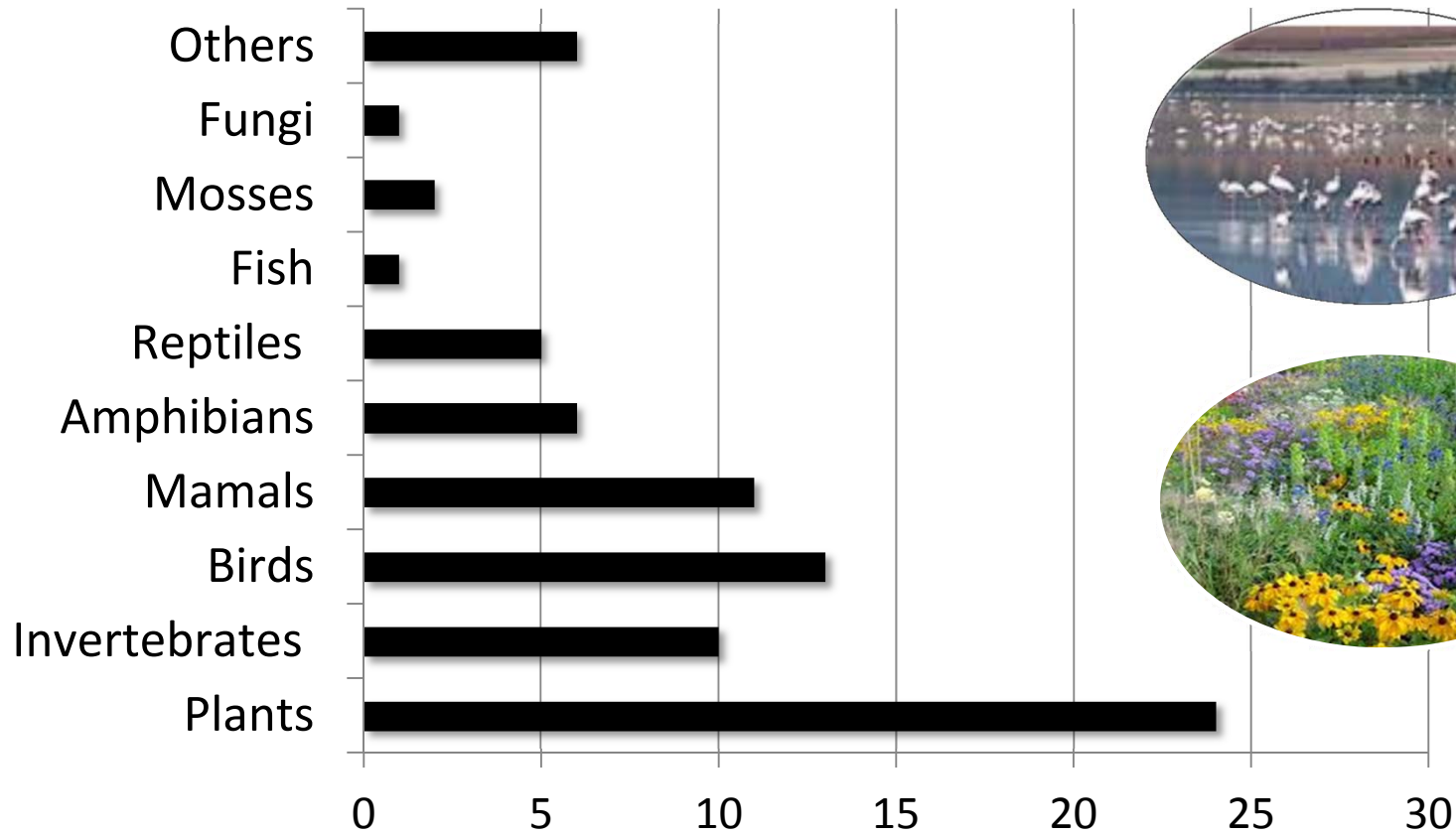
- Applicabilty
- Understandability
- Endorsement

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Review and evaluation: results

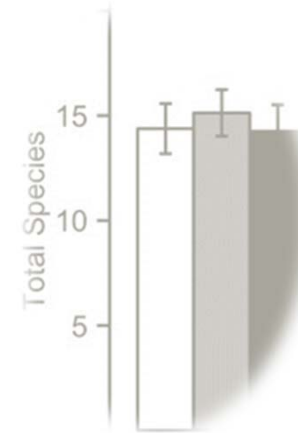**Completeness of scope: spatial scale and realm coverage**
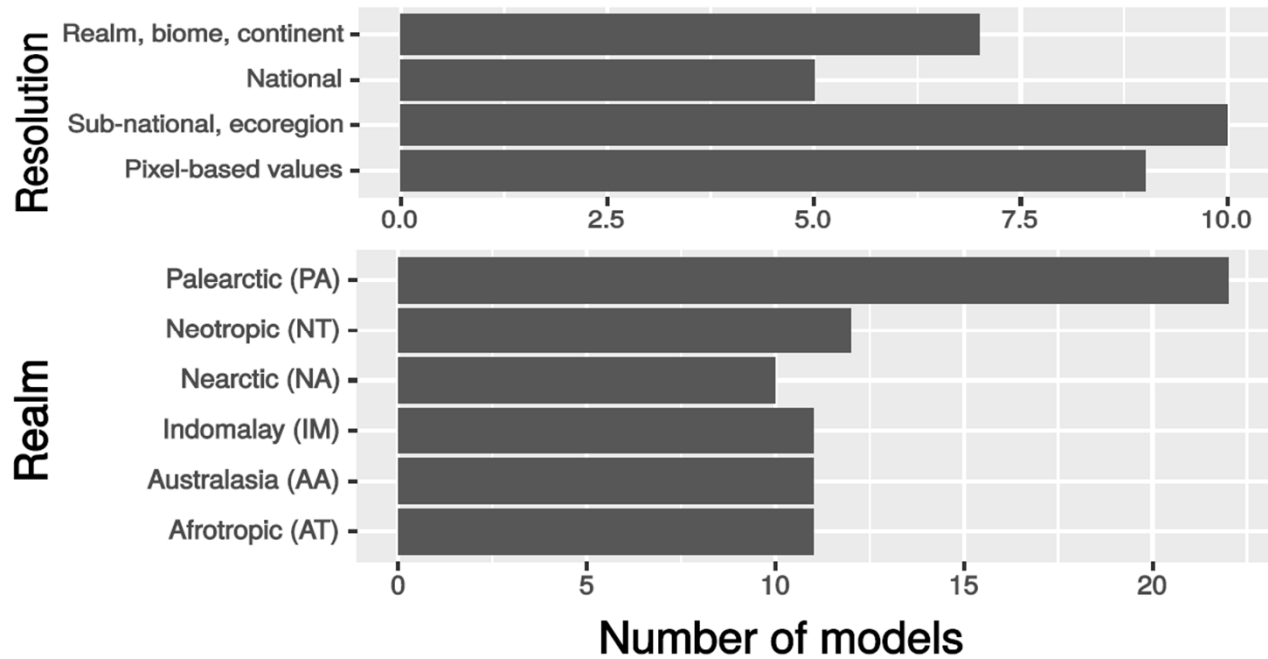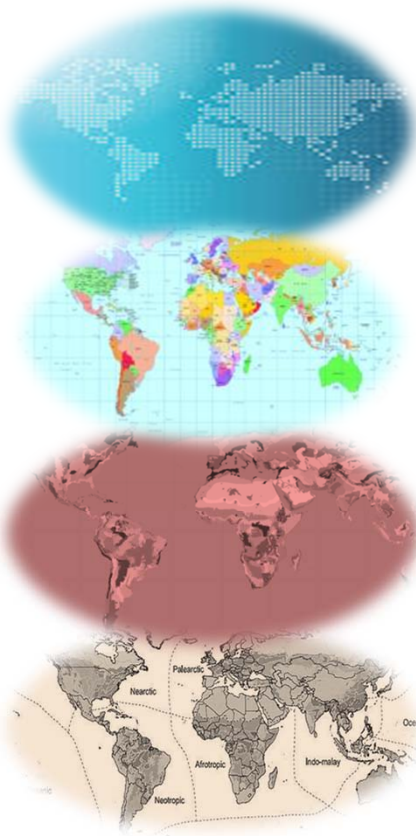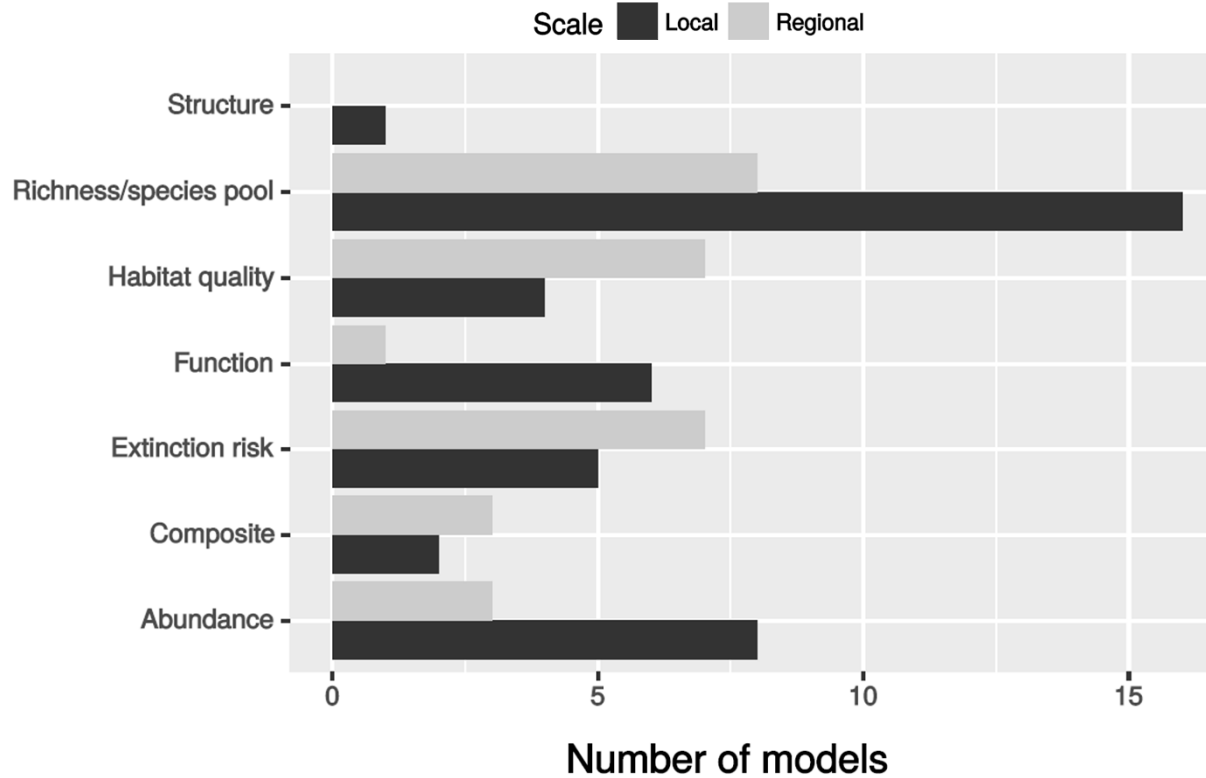
Review and evaluation: results

Completeness of scope : taxa covered

Review and evaluation: results
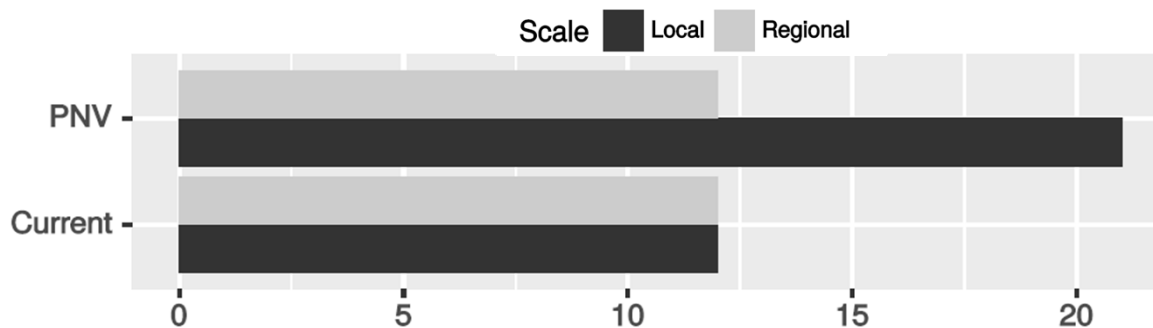
**Biodiversity representation: indicator class**

Review and evaluation: results

Biodiversity representation: Reference state

- Reference state dependent on scale:
    - "Local benchmark" (land cover comparisions)
    - "Regional baseline" (regional weights, scenarios)
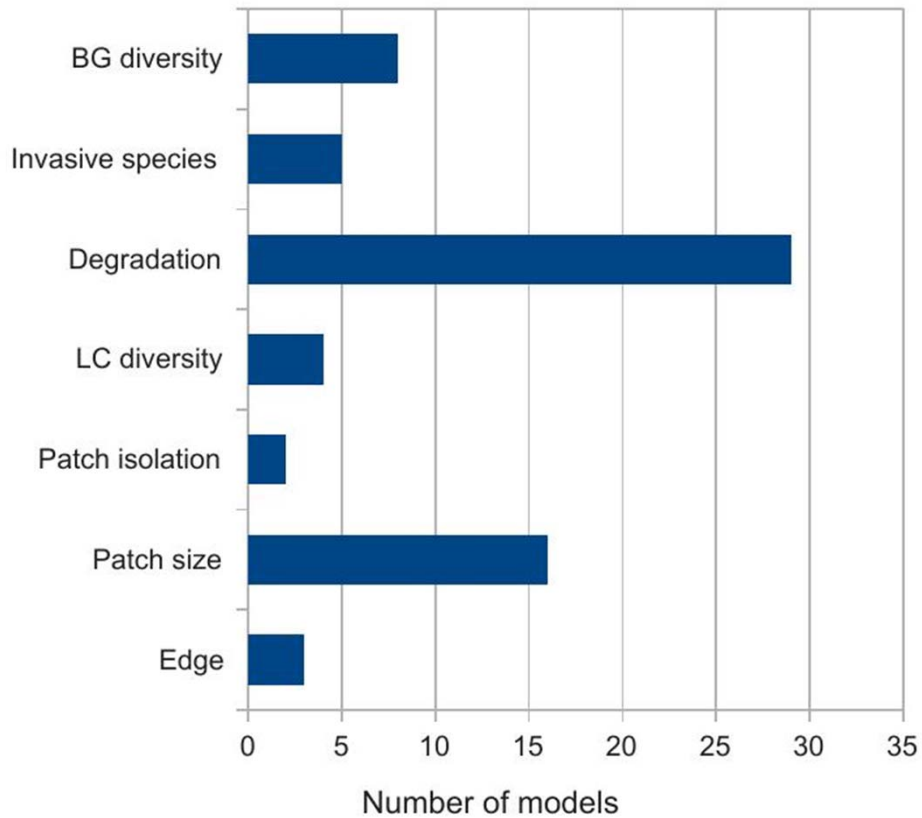

- Potential Natural Vegetation (PNV) concept debated
- Appropriate definition: "*Hypothetical biotic potential*" (Loidi et al. 2010)
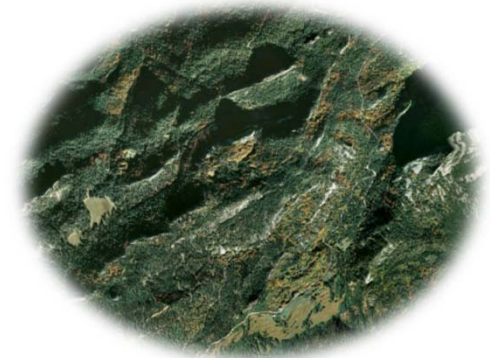
Review and evaluation: results

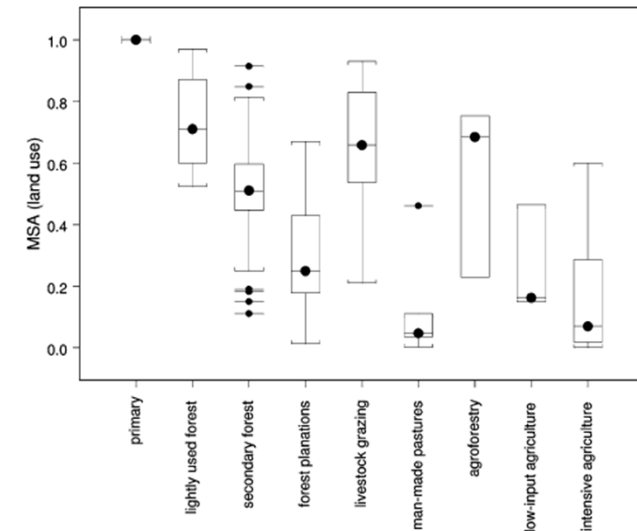**Impact pathway coverage**

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Review and evaluation: results

Scientific quality

- Models well documented
- Uncertainty partially considered (e.g. M-C, sensitivity analysis)

Stakeholders acceptance

- Most ecology models compatible with but not implemented in LCA

Curran, M., Souza, D.M. de, Antón, A., Teixeira, R.F.M., Michelsen, O., Vidal-Legaz, B. Sala, S., Milà i Canals, Ll. How well does LCA model land use impacts on biodiversity?—A comparison with approaches from ecology and conservation. Environmental Science and Technology (submitted)

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Review and evaluation: results

LCA model performance (ordinal scoring)

Category geometric mean

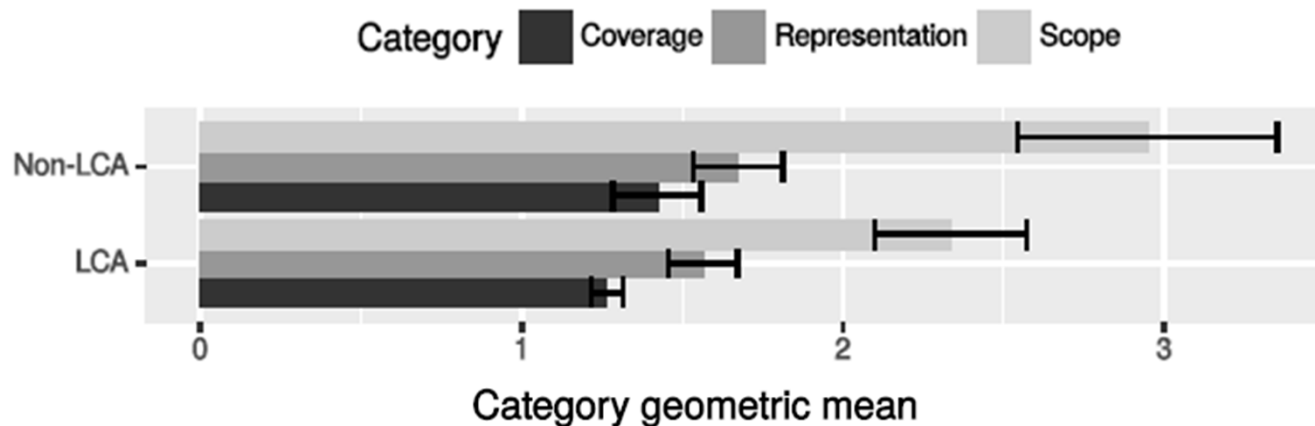- Non-significant difference in model scores, but room for improvement in LCA (lower average scores)

Curran, M., Souza, D.M. de, Antón, A., Teixeira, R.F.M., Michelsen, O., Vidal-Legaz, B. Sala, S., Milà i Canals, Ll. How well does LCA model land use impacts on biodiversity?—A comparison with approaches from ecology and conservation. Environmental Science and Technology (In Press)

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Review and evaluation: conclusions

1. Take a **multidimensional approach** in indicator development
2. Develop and document both **local and regional model components** (BDP_L and BDP_R)
3. Reflect **intrinsic value and vulnerability** of biodiversity in the regional component
4. Differentiate basic **extensive/intensive land management** practices
5. Assess and report **model and indicator uncertainty**
6. Interpret the **PNV reference** at local and regional scales as "*hypothetical biotic potential*"
7. Experiment with **alternative reference states** (local and regional)

Outlook

Empirical comparison, common case studies

Consensus model, existing data

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Pellston workshop: consensus

- **Provisionally recommend** global CFs based on:
  - **Chaudhary et al. (2015)**: Country-side SAR model with vulnerability/rarity weighing at ecoregion level
- **"Hotspot analysis"** in LCA only
- **Ecoregional CFs** rather than country averages
- CFs **not** be used for comparative assertions and product labelling
- **Indicator name** explicitly states what is measured:
  - *Suggestion*: Potential Species Loss from Land Use (Regional and Global - PSL_R and PSL_G)

| Land use classes	Scale	Taxonomic coverage
6 land use types: intensive forestry, extensive forestry, annual crops, permanent crops, pasture and urban	Ecoregion and country level assessment (804 ecoregions and 245 countries)	4 groups: mammals, birds, reptiles, amphibians

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Pellston workshop: consensus

- ***Partial* recommendation justification:**
  - Global coverage, six LU types
  - Based on richness of 4 taxa + vulnerability (IUCN threat) and irreplaceability (rarity) weight
  - SAR approach: regional impacts
  - Empirically based (meta-analysis)
  - Understandable
  - Robust uncertainty analysis
  - Improves upon de Baan et al. (2013)
- ***Full* recommendation requirements:**
  - Inclusion of plants
  - Better intensity differentiation
  - Demonstraion to various case studies (crops, grazing, plantation, infrastructure) in various regions/biomes
  - Validation with extinction data
  - Sensitivity test of some assumptions (e.g. vulnerability/rarity weights, reference)
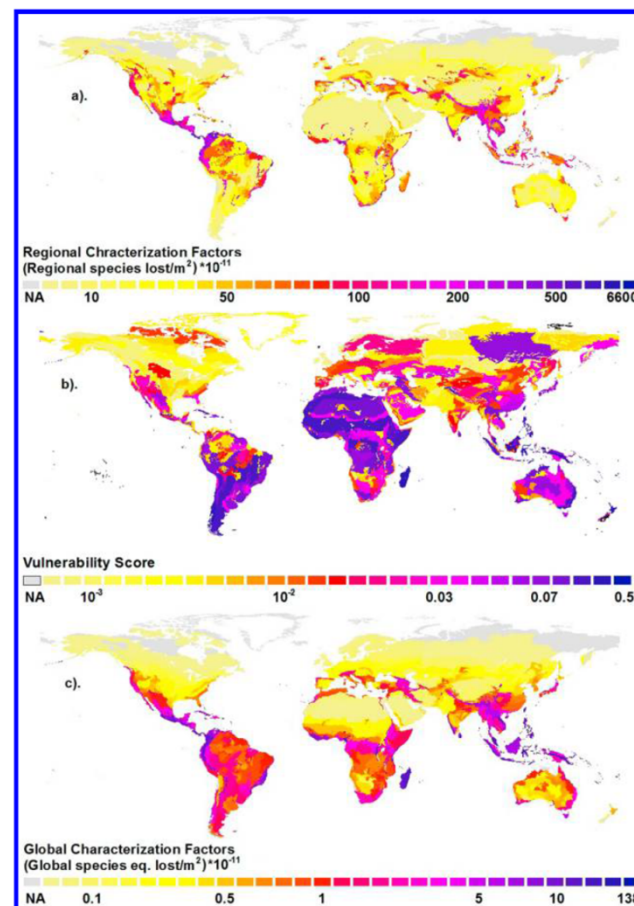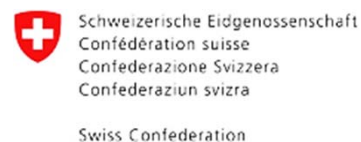

Chaudhary, A., Verones, F., de Baan, L. & Hellweg, S. (2015) Quantifying Land Use Impacts on Biodiversity: Combining Species–Area Models and Vulnerability Indicators. Environmental Science & Technology, 49, 9987–9995.

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Aknowledgements

Thanks for your attention

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