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Global biodiversity model for policy support

IBIF Webinar - welcome

Mark van Oorschot - PBL

Aafke Schipper - PBL and Radboud University

Marina Dumont - Pré Sustainability

Wijnand Broer - CREM/PBAF





IBIF Webinar agenda

The webinar will be recorded

Slides will be shared

- › Use of PBL data in a business context - Mark van Oorschot
- › GLOBIO and IBIF - Aafke Schipper
- › IBIF in the wider footprinting context - Marina Dumont
- › The pros and cons of biodiversity footprinting - Wijnand Broer
- › Q&A
- › Close



Target audience

- Business
 - Financial Institutions
 - Multi-national companies
- Consultancy
 - Tool developers
 - Data providers
- Academia
 - Methods
 - Indicators



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Global biodiversity model for policy support

IBIF Webinar: Use of PBL data

Mark van Oorschot - PBL

IBIF Webinar 25nov25



www.GLOBIO.info



Planbureau voor de Leefomgeving

PBL

Netherlands Environmental Assessment Agency

Independent government organization

Strategic policy analysis

Science-to-Policy bridge

Non-commercial

Open-Source Strategy

Quality control



Goals of the Convention on Biological Diversity (CBD)



Global biodiversity
assessment
(IPBES 2019)

To reverse biodiversity loss worldwide, action is needed at both consumption and production side of global supply-chains.



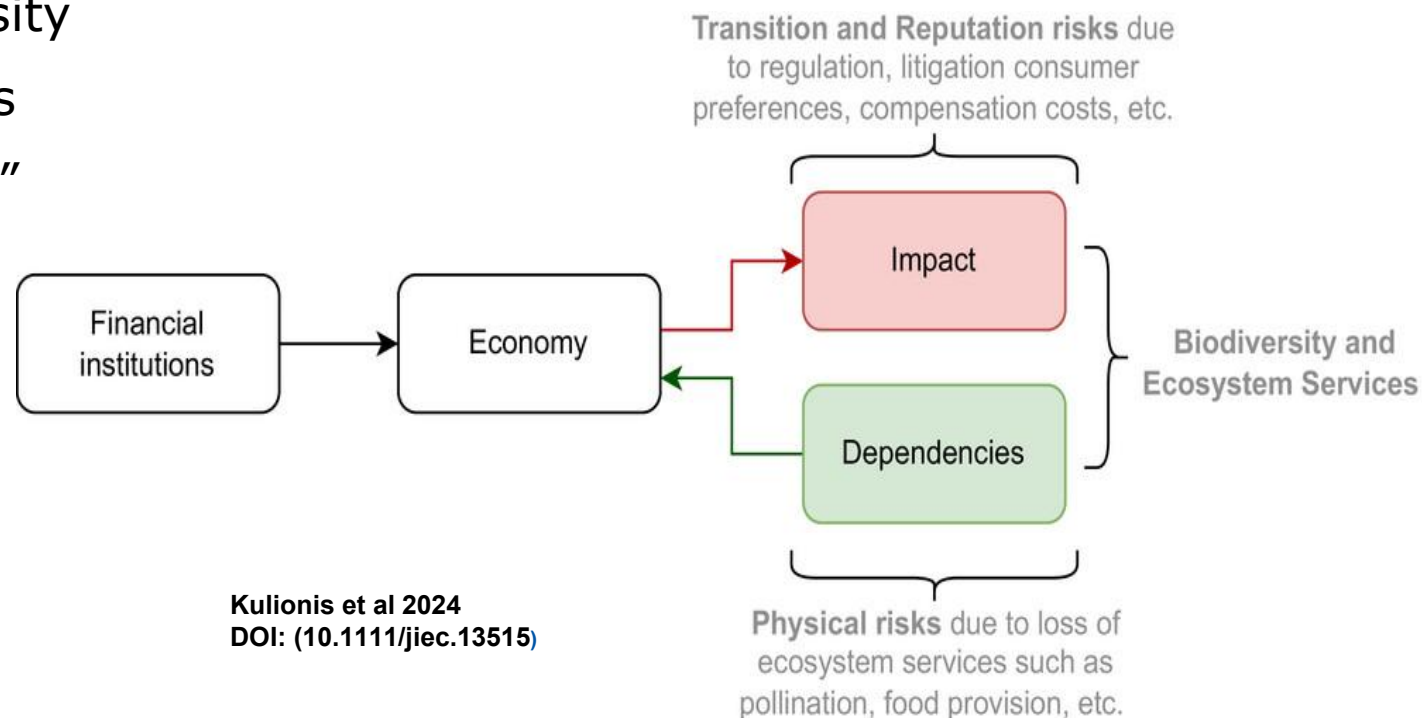
GBF Target 15:
Assess and disclose impacts
in supply chains

Ensure that large and transnational companies and financial institutions monitor and assess their **impacts and dependencies** on nature in their operations and supply chains, and transparently disclose and manage risks

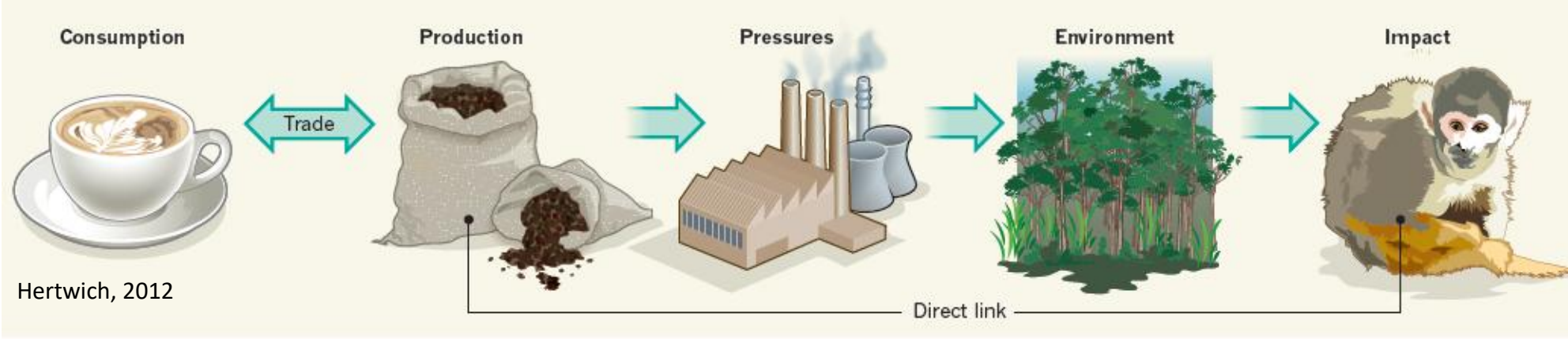
Relations of Business and Finance to Nature

> Assessing Impacts and Dependencies

- Ecosystems are degrading worldwide
- Companies exert pressure on biodiversity but also depend on ecosystem services
- Impacts and Dependencies “propagate” through global supply-chains
- Part of “Double materiality” loop



Link of GLOBIO model to footprint methods



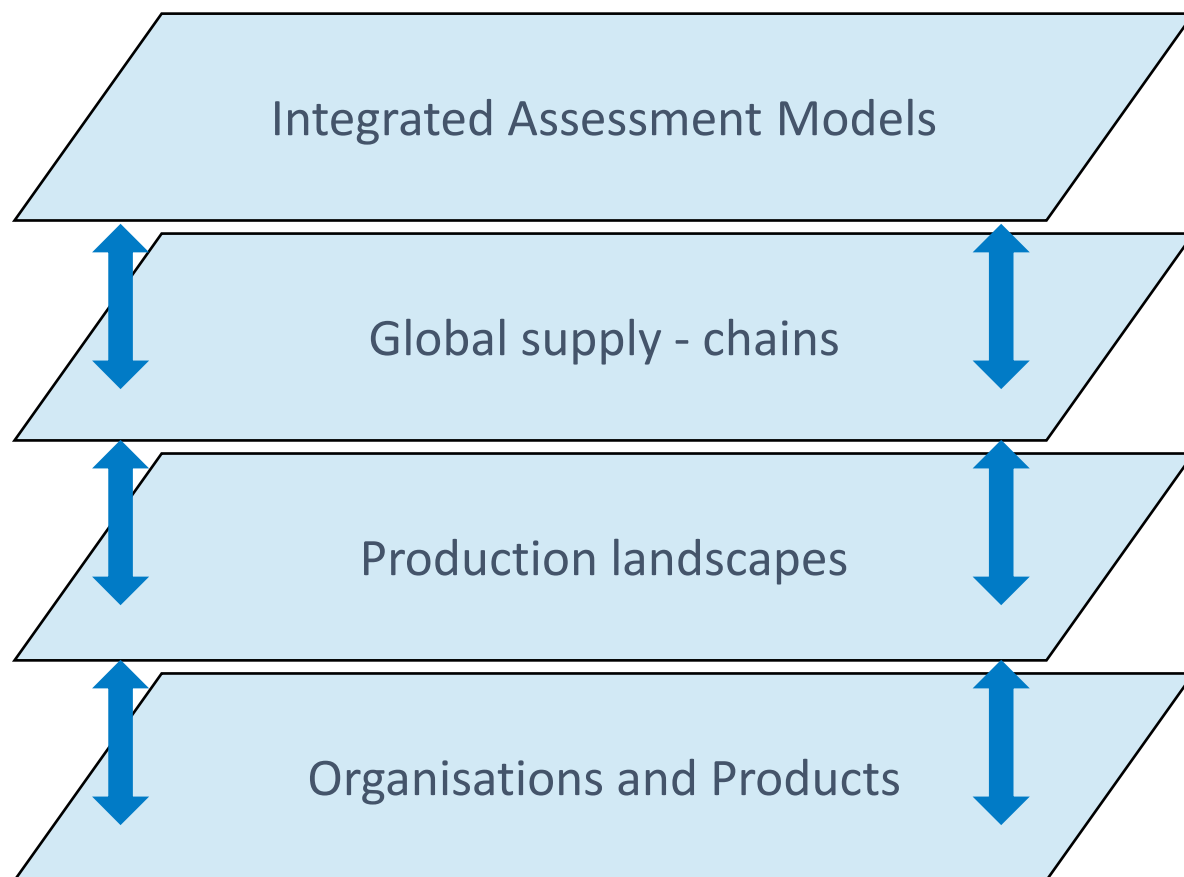
Life-cycle-analysis:
EEMRIO / LCA



GLOBIO v3 & v4

Biodiversity
characterization factors

GLOBIO and levels of data application



<= IMAGE/GLOBIO framework
scenarios CBD - CBD - FAO - UNCCD

<= EEMRIO models
Sector & Regional footprints

<= Spatial explicit models

<= LCIA (PEF & OEF)



PBL Open-Source Strategy

- › Quality control on models and data
 - Transparent about scientific foundation
 - Published in international peer reviewed journals
 - Information online
- › GLOBIO model available via www.GLOBIO.info
 - Full model version (Python)
 - Model data (gridded at 10 arc-seconds) for present and future years
 - MSA knowledge base and results
 - Land-use maps
 - Impact factors (IBIF)
 - Zenodo repository



IBIFs and CC BY (v 4.0)

- › CC - Creative Commons
- › “This license enables reusers to distribute, remix, adapt, and build upon the material in any medium or format, so long as attribution is given to the creator.”
- › “The license allows for commercial use.”
- › CC BY includes the following elements:
“credit must be given to the creator.”

Conditions for use

- CC-BY: Data can be used freely
 - Direct use of IBIF or GLOBIO data: correct reference
 - PBL does not endorse derived methods or commercial tools

- Claims
 - Derived information and methods:
 - Refer to used PBL knowledge base
 - Be transparent about derived data and methodology
 - Set up your own quality control and review process





Correct references – knowledge base

› GLOBIO Model V3/V4

- Alkemade et al. (2009) GLOBIO3: A Framework to Investigate Options for Reducing Global Terrestrial Biodiversity Loss. Ecosystems 12, 374–390.
<https://doi.org/10.1007/s10021-009-9229-5>
- Schipper et al. (2020) Projecting terrestrial biodiversity intactness with GLOBIO 4. Global Change Biology, 26, 760-771.
<https://doi.org/10.1111/gcb.14848>

› IBIF characterization factors

- Schipper et al. (2025) Impact factors for quantifying country-level terrestrial biodiversity intactness footprints (IBIF). Sci Data 12, 1660 (2025).
[10.1038/s41597-025-05946-1](https://doi.org/10.1038/s41597-025-05946-1)
- Data on Zenodo repository (version control)
<https://zenodo.org/records/16234138>
<https://doi.org/10.1038/s41597-025-05946-1>



Correct references - applications

› Model data / PBL Scenario studies

- M. Kok et al. (2018) Pathways for agriculture and forestry to contribute to terrestrial biodiversity conservation: A global scenario-study. *Biological Conservation*, 221, 137-150,
<https://doi.org/10.1016/j.biocon.2018.03.003>
- M. Kok, et al. (2023) Assessing ambitious nature conservation strategies in a below 2-degree and food-secure world, *Biological Conservation*, 284, 10068,
<https://doi.org/10.1016/j.biocon.2023.110068>

› Footprinting

- H. Wilting & M. van oorschot (2017) Quantifying biodiversity footprints of Dutch economic sectors: A global supply-chain analysis. *J of Cleaner Production*, 156, 194 – 202. <http://dx.doi.org/10.1016/j.jclepro.2017.04.066>
- C. Payro et al. (2024) Consumer resistance diminishes environmental gains of dietary change. *Environmental Research Letters*, 19, 054033 <https://doi.org/10.1088/1748-9326/ad3c57>
- L. de Weert et al. (2025) Linking a biodiversity abundance metric to life cycle assessment for quantifying the biodiversity footprint of Dutch diets. *Journal of Cleaner Production*, 520, 146081.
<https://doi.org/10.1016/j.jclepro.2025.146081>



Global biodiversity model for policy support

IBIF Webinar: GLOBIO model & IBIF

Aafke Schipper – PBL and Radboud University

What is GLOBIO?

- › A global biodiversity model for policy support
- › Example policy questions:
 - What are the most important direct drivers of biodiversity loss?
 - How may potential future environmental change affect biodiversity?
 - What are the implications of different policy choices for biodiversity?



essentially,
all models are wrong,
but some are useful

George E. P. Box

What is GLOBIO?

- > A global biodiversity model for policy support...
- > ... or rather a family of biodiversity models

GLOBIO

Impacts of human pressures on local **terrestrial** biodiversity intactness (MSA indicator)

GLOBIO - Aquatic

Impacts of human pressures on local **freshwater** biodiversity intactness (MSA indicator)

GLOBIO - Species

Impacts of human pressures on the **distribution** and **population size** of individual **vertebrate species**

GLOBIO - ES

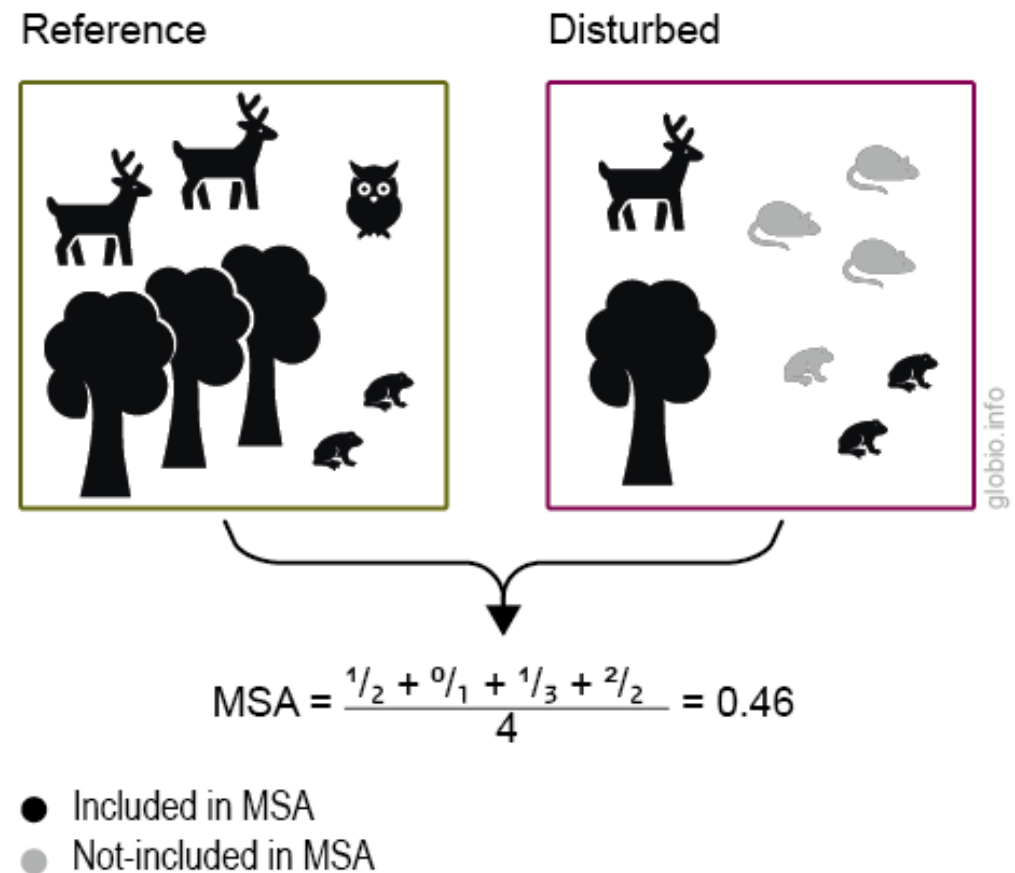
A selection of provisioning, regulating and cultural **ecosystem services**

Indicators

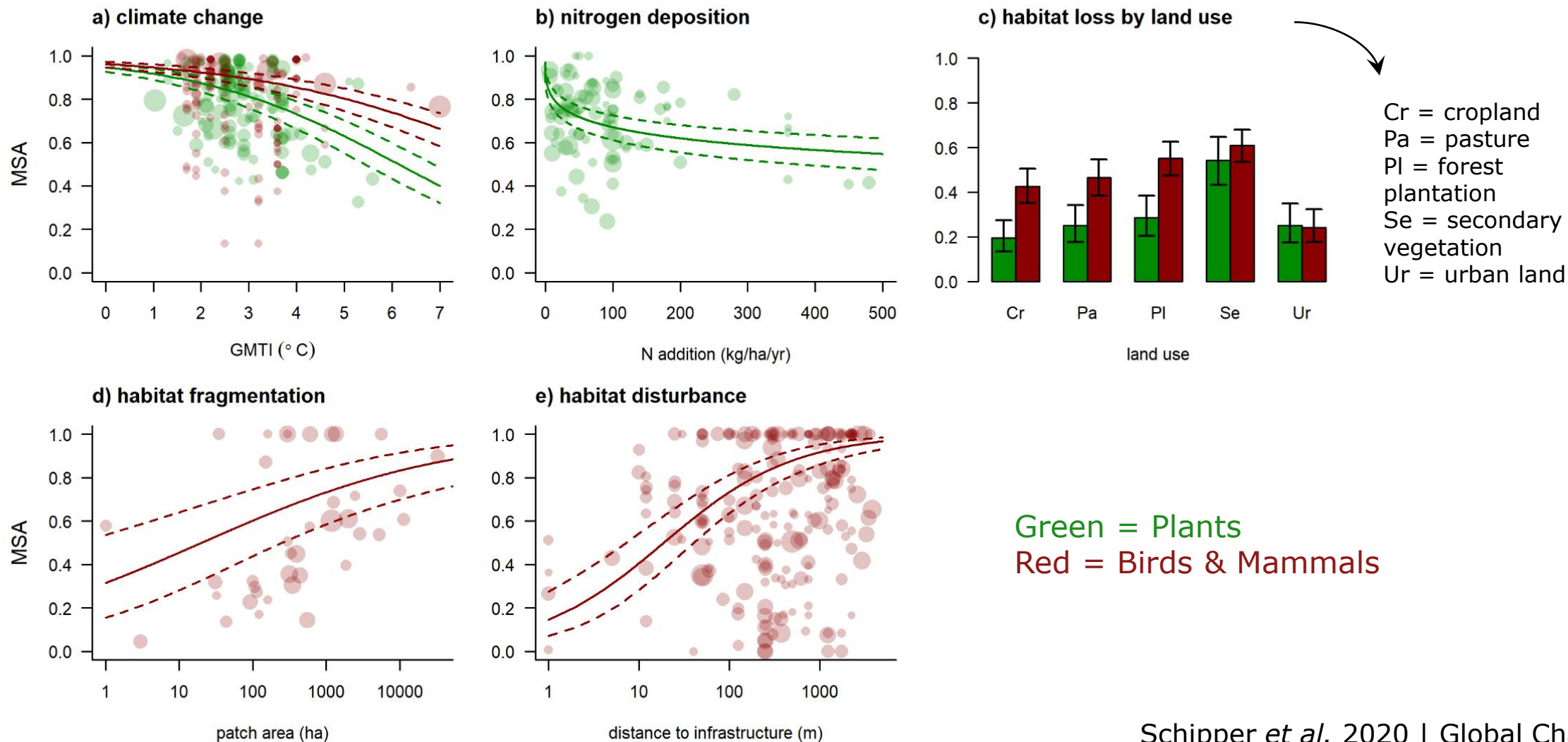
- Mean Species Abundance (MSA)
- Area of Habitat (AOH)
- Red List Index (RLI)
- Living Planet Index (LPI)
- ES supply and demand (a.o. pollination, soil retention, carbon regulation, natural pest control)

The GLOBIO model

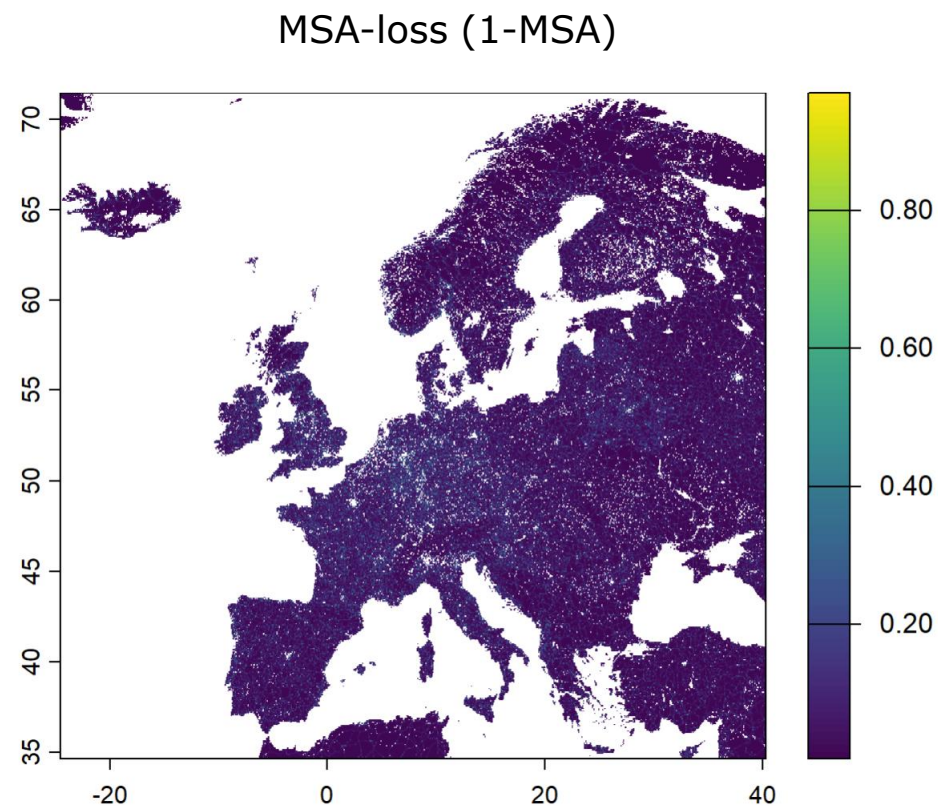
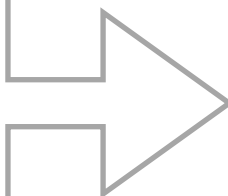
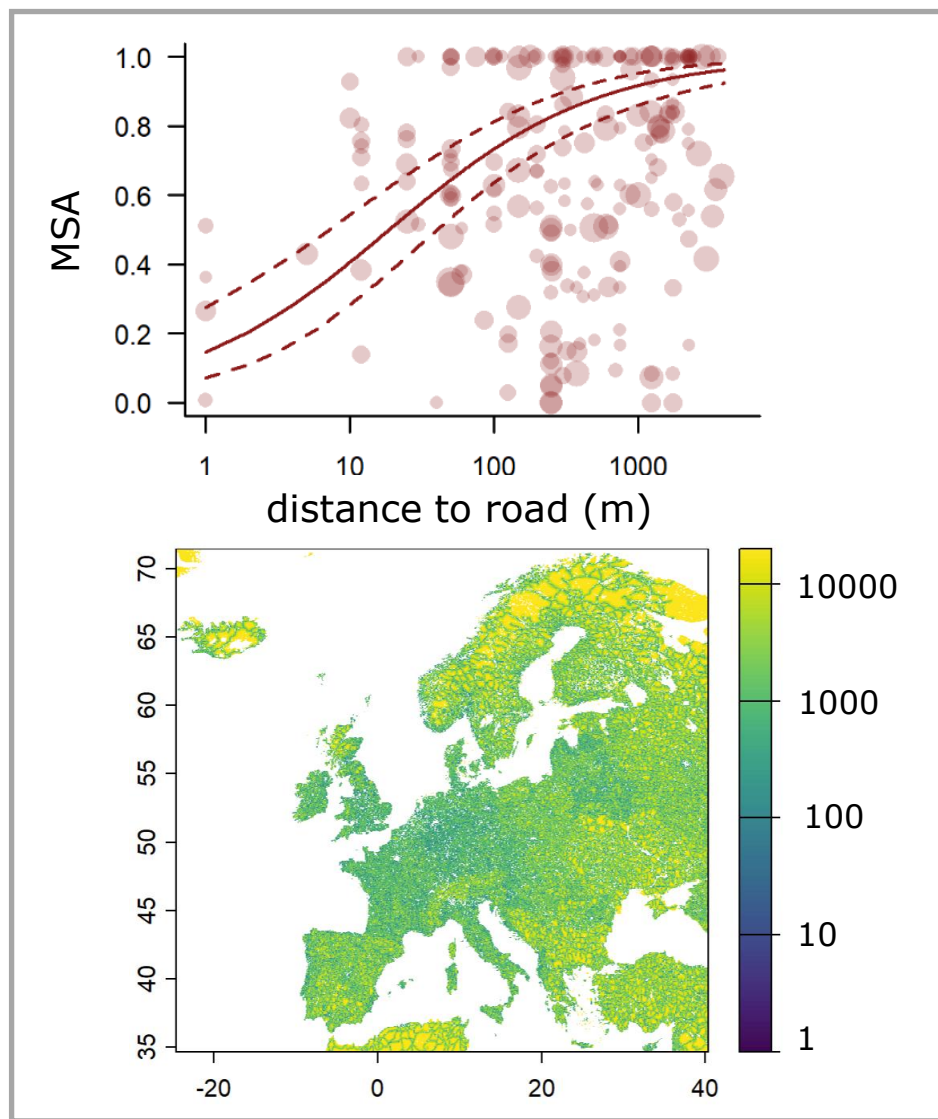
- *Global* model of *local* terrestrial biodiversity intactness
- Biodiversity metric: mean species abundance (MSA)
- Multiple pressures
- Empirical relationships pressure/state → impact



GLOBIO: MSA response relationships

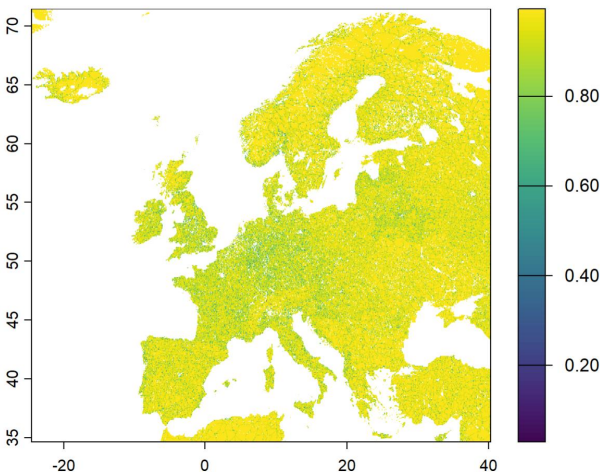


GLOBIO: MSA and MSA loss maps

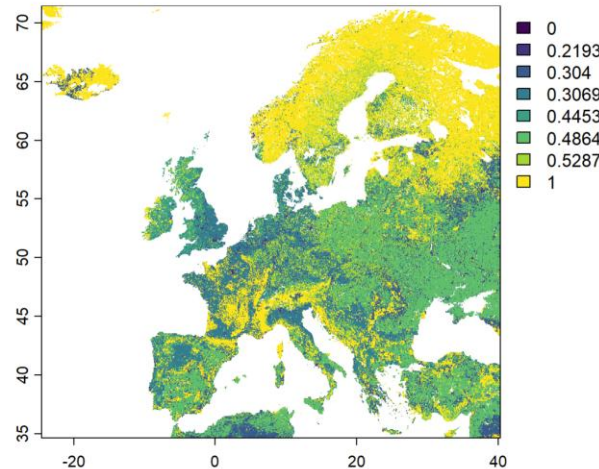


GLOBIO: MSA and MSA loss maps

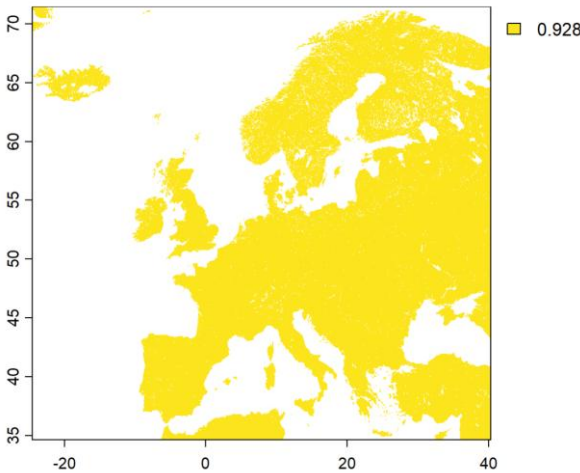
MSA for roads



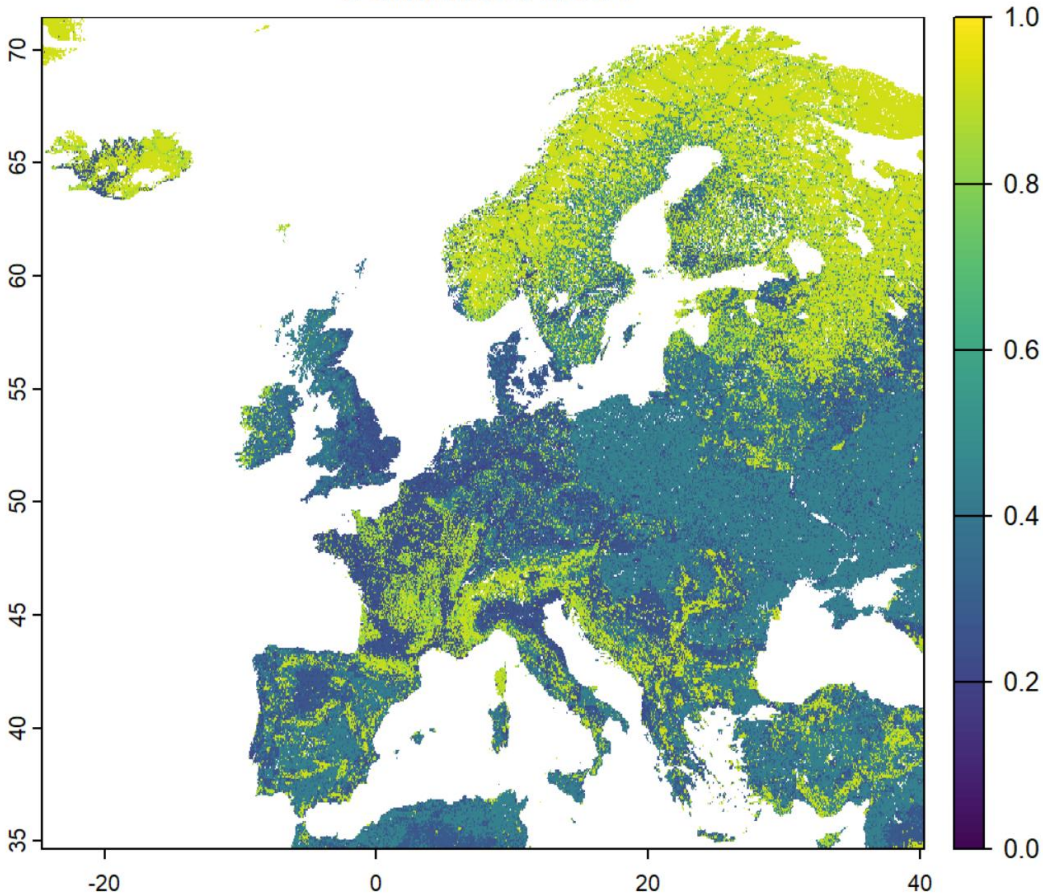
MSA for land use



MSA for climate change



Combined MSA





GLOBIO: pressure aggregation and attribution

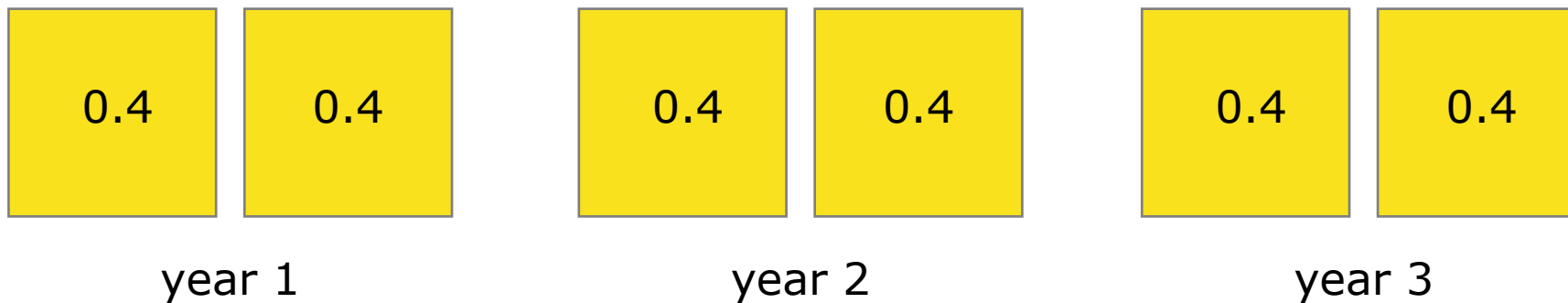
	Pressure 1	Pressure 2	Combined		Pressure 1	Pressure 2	Combined
MSA	0.6	0.2	0.2		0.6	0.2	0.12
MSA-loss	0.4	0.8	0.8		0.4	0.8	0.88
Pressure contribution to MSA-loss	0	0.8	0.8		0.29	0.59	0.88

IBIF

General principle

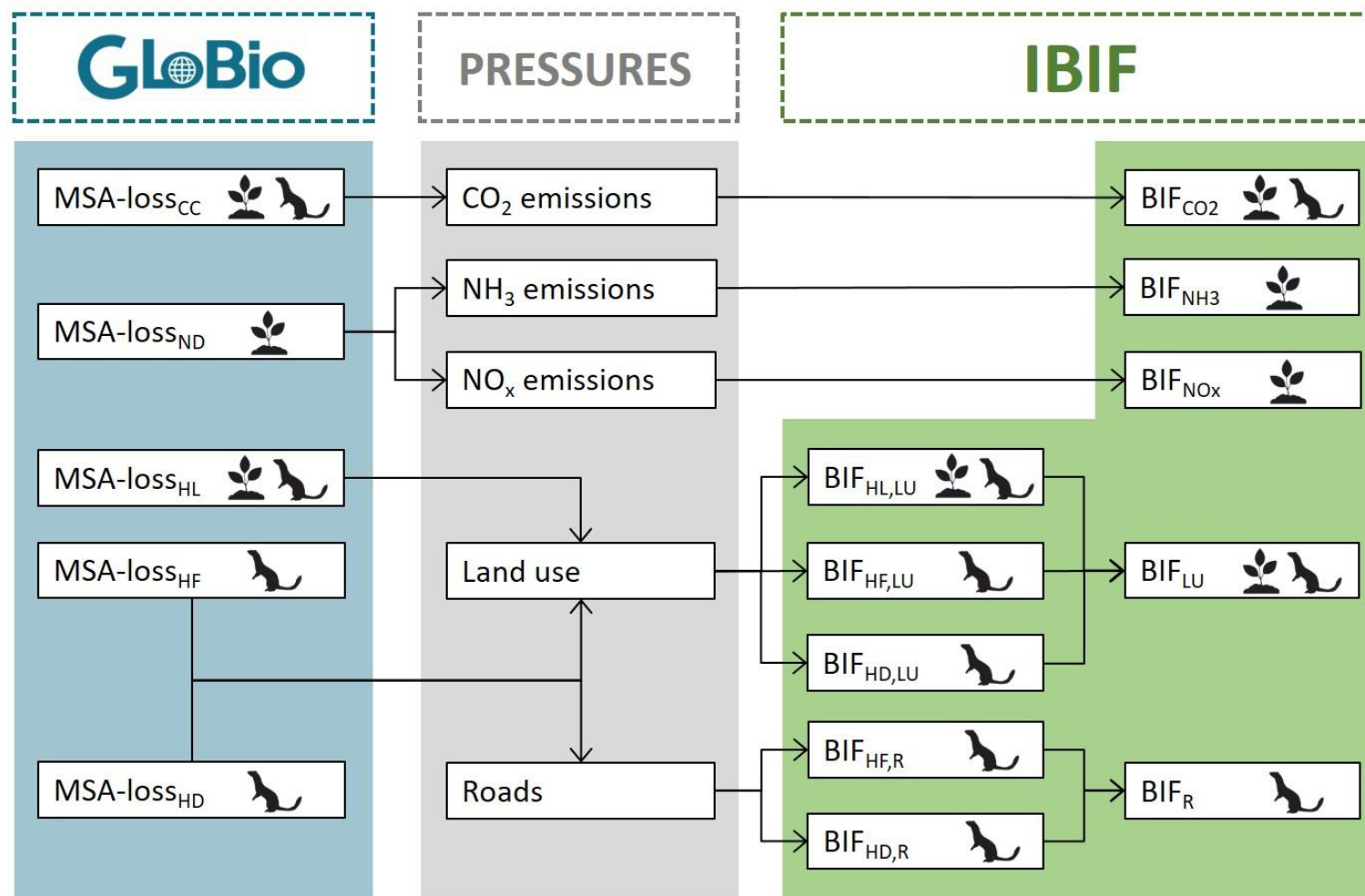
$$\text{IBIF}_{p,j} = \frac{\text{area-integrated loss in MSA due to pressure } p \text{ from country } j}{\text{change in state due to pressure } p \text{ from country } j} \cdot \text{duration of the change in state}$$

MSA-loss



IBIF

- 5 pressures
- 2 species groups
- Country-level impact factors





IBIF

Published July 21, 2025 | Version v2

Dataset

Open

336

VIEWS

106

DOWNLOADS

Show more details

IBIF: Intactness-based biodiversity impact factors

Marques, Alexandra (Producer)¹ ; van der Marel, Martijn (Producer)^{1, 2} ;

Schipper, Aafke M. (Producer)²

Show affiliations

The intactness-based biodiversity impact factors (IBIF) dataset contains a set of consistent country-level biodiversity impact factors (BIFs) that can be used to attribute losses in local terrestrial biodiversity intactness to emissions and extractions associated with production and consumption. The BIFs were obtained with the global biodiversity model GLOBIO, which quantifies local biodiversity intactness based on the mean species abundance (MSA) indicator. IBIF (v2) contains BIFs for five environmental pressures (CO₂ emissions, NH₃ emissions, NO_x emissions, land use (five categories) and roads) for 234 countries. For more information on how the factors were established, please see the accompanying journal article, available at:

<https://doi.org/10.1038/s41597-025-05946-1>

Versions

Version v2

Jul 21, 2025

10.5281/zenodo.16234138

Version v1

Nov 6, 2024

10.5281/zenodo.14043673

[View all 2 versions](#)

Cite all versions? You can cite all versions by using the DOI [10.5281/zenodo.14043672](https://doi.org/10.5281/zenodo.14043672). This DOI represents all versions, and will always resolve to the latest one. [Read more.](#)

External resources

Indexed in

Files

Files (75.0 kB)

Name

Size

Download all

IBIF_v2.xlsx

md5:ea470354b243138883adb68c725216e2

75.0 kB

Download



100%



IBIF – how to use the factors?

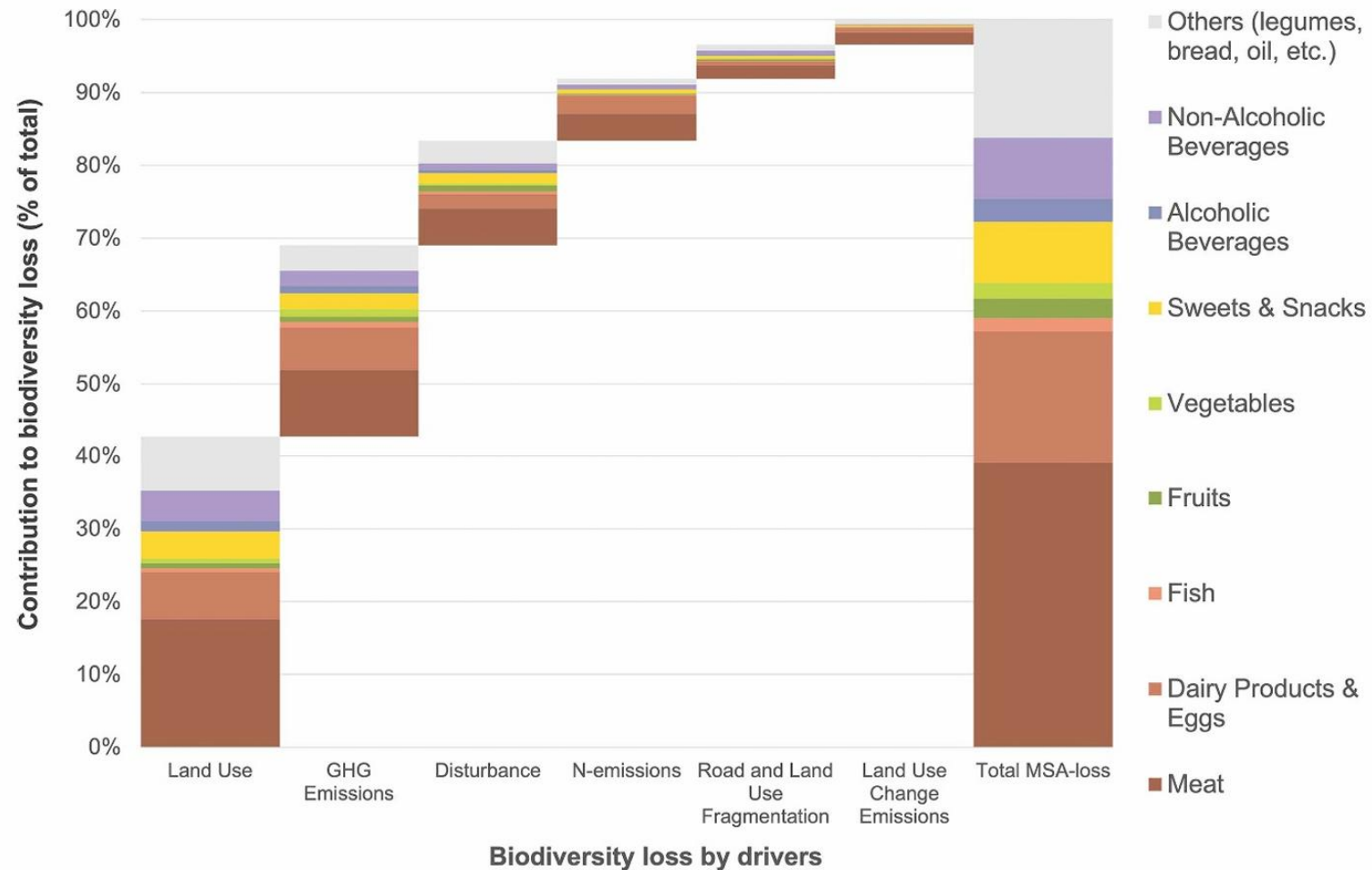
- › For product footprints: combine with life cycle inventory data
- › For consumer or sector footprints: combine with EE-MRIO data



IBIF – how to use the factors?

Inventory data		BIF		Footprint
Land occupation ($\text{km}^2 \cdot \text{yr}$)	✗	Land occupation ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{km}^{-2}$)	=	Land occupation ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr}$)
NH ₃ emission NO _x emission (kg)	✗	NH ₃ emission NO _x emission ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr} \cdot \text{kg}^{-1}$)	=	NH ₃ emission NO _x emission ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr}$)
GHG emission (kg CO ₂ -eq)	✗	CO ₂ emission ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr} \cdot \text{kg}^{-1} \text{CO}_2$)	=	GHG emission ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr}$)
GHG emission (kg)				
		Roads ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{km}^{-1}$)		
Road use (ton · km) (person · km)	✗	Roads ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr} \cdot \text{ton}^{-1} \cdot \text{km}^{-1}$) ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr} \cdot \text{person}^{-1} \cdot \text{km}^{-1}$)	=	Road use ($\text{MSA-loss} \cdot \text{km}^2 \cdot \text{yr}$)

IBIF – how to use the factors?





IBIF – future updates

Planned refinements of GLOBIO

- › More refined land use categories (including management)
- › Updated response relationship for disturbance due to mines
- › Spatially differentiated MSA responses (if relevant and supported)
- › Time-dependent recovery upon pressure release

Other dimensions of biodiversity



Thanks!

- › Alexandra Marques (PBL)
- › Martijn van der Marel (PBL)
- › Michel Bakkenes (PBL)
- › Paul Giesen (PBL)
- › Harry Wilting (PBL)
- › Mark Huijbregts (Radboud University)
- › Mark van Oorschot (PBL)



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Global biodiversity model for policy support

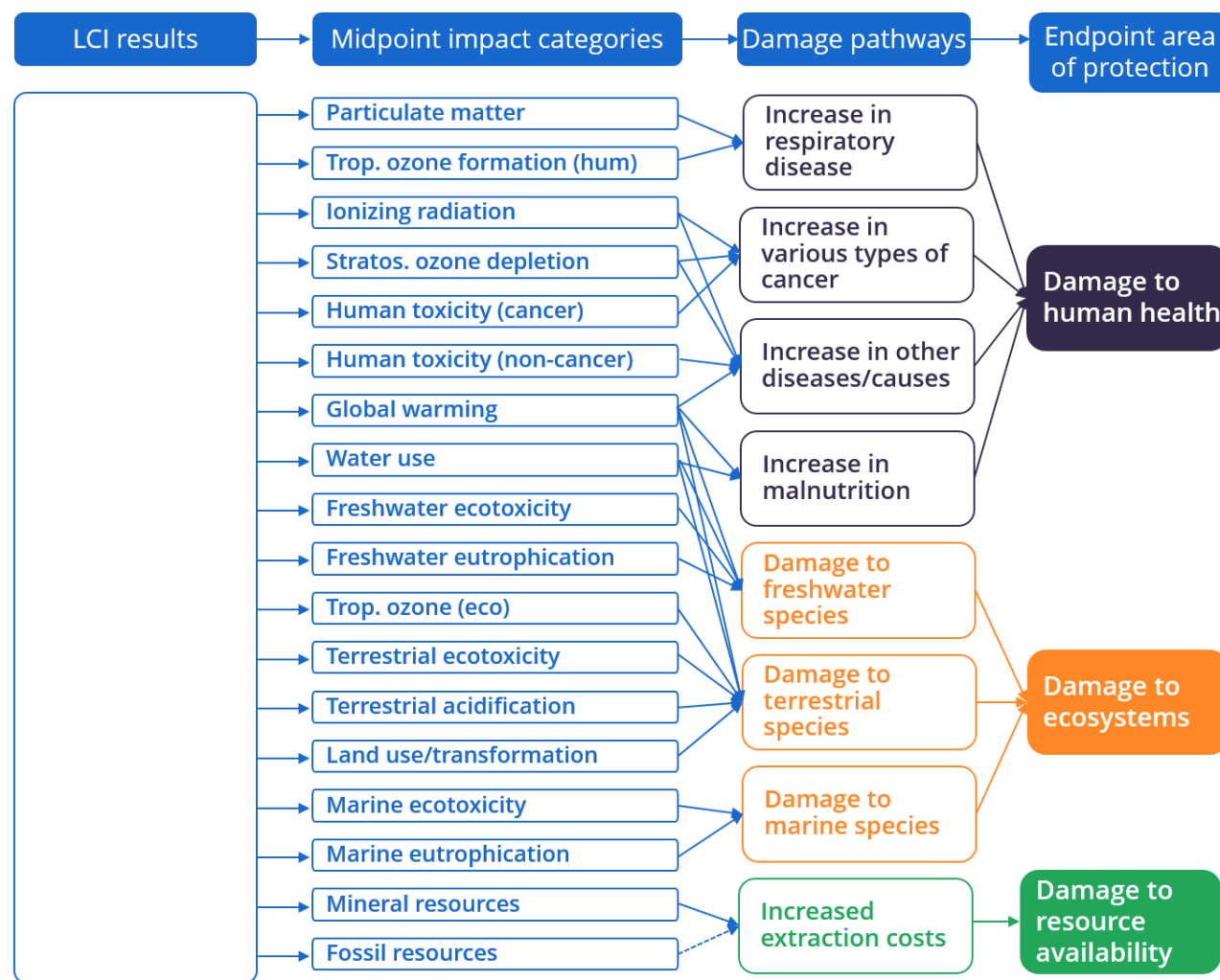
IBIF Webinar: Position of IBIF in the wider footprinting context

Marina Dumont – PRé Sustainability

IBIF Webinar 25nov25



From midpoint to endpoint in ReCiPe 2016



What does IBIF measure (and what not)?

Pressure	Driver	Country-specific impact factor
CO ₂ emissions	Climate Change	No
NH ₃ emissions	Nitrogen Deposition	Yes
NO _x emissions		Yes
Land use	Habitat loss	CL*; PA*; PLA – Yes URB; MIN – No *for plants not, for mammals yes =total yes.
	Habitat fragmentation	Yes (mines)
	Habitat disturbance	Yes
Roads	Habitat fragmentation	Yes
	Habitat disturbance	Yes

Novel impact drivers

CL = cropland
PA = pasture
Pla = plantation forest
Urb = urban land
Min = Mines

Country-specific factor, but not region/biome-specific impact: e.g., 1 kg Nitrogen has the same impact in all biomes, but the magnitude of impact depends on the country-specific context

What is not (yet) assessed?

Terrestrial drivers NOT included:

- Ecotoxicity*
- Ozone formation*
- Water*
- Plastic pollution*
- Invasive species*

NO aquatic biodiversity loss and drivers

* Common in other LCA methods
(e.g., ReCiPe 2016, ImpactWorld+, GLAM, etc.)

* Novel in e.g., GLAM

* Not yet common in other LCA methods

From GLOBIO4 not included:

- Direct exploitation
(Hunting)

How can it be used by practitioners?

- › When used in combination LCA:
with LCI databases & EEIO-models

- › 1. Characterization needed
 - Characterizing LCI toward the
midpoint impact category
(method/ factor implementation)



e.g., global warming:
characterizing other
GHGs beyond carbon

- › 2. Conversion needed
 - Ensuring the inventory data from the
dataset fits the unit of the factors
(database alignment)



e.g., attributing the
impacts of roads on
habitat fragmentation
towards the subject of
assessment

How can it be used by practitioners?

Pressure	Driver	Inventory data needed	Characterization needed	Conversion of inventory data needed
CO₂ emissions	Climate Change	Emissions of CO ₂ or CO ₂ equivalents (kg)	Yes: if more GHG emissions beyond Carbon dioxide are to be included (e.g., based on latest IPCC model)	No
NH₃ emissions	Nitrogen Deposition	Emissions of NH ₃ (kg)	Yes: stoichiometric conversion to kg N	No
NO_x emissions		Emissions of NO _x (kg)		No
Land use	Habitat loss	Duration of use of cropland, pasture, plantation forest, urban land and mines (km ² · yr)	Yes: mapping of land use types of IBIF to available flows in databases/ software required: often, a 1:1 can be found, but in case of gaps mapping required	No
	Habitat fragmentation	Duration of use of cropland, pasture and urban land (km ² · yr)		
	Habitat disturbance	Duration of use of mines (km ² · yr)		
Roads	Habitat fragmentation	Fuel use per ton-km of freight transport (MJ · ton ⁻¹ · km ⁻¹) or per person-km of people transport (MJ · person ⁻¹ · km ⁻¹); annual fuel use per industrial sector or by households (final demand) (MJ · yr ⁻¹)	No	Yes: conversion from BIF per km road to BIF per ton.km/ person.km or per sector/consumer. total fuel use in region and total road length required: convert the impact to direct fuel use per person-km or ton-km or fuel use of sectors / consumers needed of impacts per km road.
	Habitat disturbance			

How can it be interpreted by practitioners?

Advantages for practitioners

- Can shed light on relevant country-level drivers of terrestrial biodiversity loss
- Provides *consistent* analysis, from the state of biodiversity linking it to lower levels
- Avoids double-counting (unlike other LCA methods)

Limitations for practitioners

- Limited impact categories for a complete biodiversity footprint
- Limited land-use types (mining added), not suited to distinguish between alternative land use forms for example (e.g., agroforestry, other farming, intensive, extensive, etc.)
- Less suited for tracking worsening or improvements of practices over time, incl. potential recovery /restoration

Complementary use with other methods

LCA-based methods like ReCiPe 2016, ImpactWorld+ etc.:

ReCiPe 2016 Potentially Disappeared Fraction of species:

- less sensitive;
- pot. double counting;
- more drivers included (incl. aquatic);
- cause-effect chain from an activity without considering the overall state

Globio, IBIF, etc.:

Mean Species Abundance (as in IBIF Now):

- more sensitive to biodiversity loss;
- less drivers, but also some novel drivers such as mining and habitat fragmentation of roads;
- from a policy level, useful for consistent systemic analysis

Complementary use with other methods

1. **Integrated use** (e.g., midpoint characterization)
2. **Complementary use** to extend subjects of analysis, drivers towards biodiversity loss, and understand ranges of results
3. **Extend with other type than LCA analysis for additional complementary** : E.g., ecosystem dependencies, WWF Risk filer, or proximity analyses to biodiversity hotspots to extend the analysis .

Keep in mind for interpretation

Different methods can give different results, even with same impact categories:

- due to varying characterized flows, factors, or due to varying underlying models
- even possible with the same metrics

Each method is purpose and context-specific
That context should be considered **when interpreting results.**

Partnership for Biodiversity Accounting Financials (PBAF)

Pros and cons of biodiversity footprinting

PBL Launch IBIF
25 Nov 2025



PBAF



The **Partnership for Biodiversity Accounting Financials** (PBAF) is a global partnership of financial institutions (>75 FIs from 20 countries)

Practical guidance on Measuring Impact & Dependencies & PBAF Standard

Safeguarding Quality of tools & data + Harmonization & Mainstreaming

→ tools & data providers provide data which is science based, robust, consistent and fit for purpose

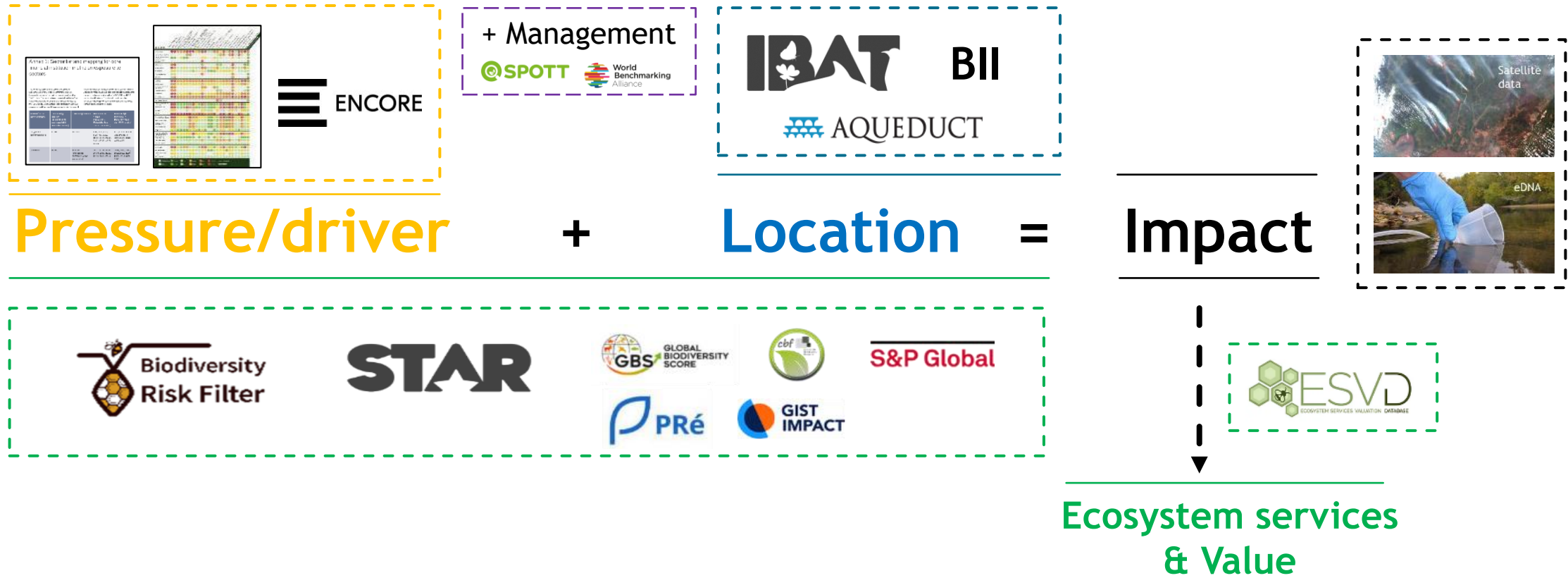
Used to

- Inform biodiversity strategy & targets
- Inform engagement
- Disclose according to TNFD/CSRD/SFDR/GRI
- Align finance with nature







Fit for purpose?

1. **Screening *potential* impact** - What is the expected impact of a company/project?
2. **Measuring *actual* impact** - What is the real impact of a company/project?



Fit for purpose? ALIGN project

Figure E2. Good and best practice measurement criteria for site and supply chains

SITE & PROJECT LEVEL		GOOD PRACTICE	BEST PRACTICE
WHAT TO MEASURE	CHARACTERISTICS OF MEASUREMENT APPROACH	MOST APPLICABLE METHODS	
SCREEN  <ul style="list-style-type: none"> Potential presence & proximity to material species & ecosystems Potential impacts based on sector-average impact drivers 	<ul style="list-style-type: none"> Feasibility (screening) - High (able to apply screening at multiple sites) Spatial precision - Medium Accuracy - Medium (measures reflect potential presence & impacts on species & ecosystems, but are not ground-truthed) 	<ul style="list-style-type: none"> ✓ Spatial overlays with static biodiversity data layers (ecosystem extent / condition) ✓ Species threat & range layers ✓ Screening using modelled state based on pressures 	
MEASURE  <ul style="list-style-type: none"> Ecosystem extent & condition indicators; or Measurement of material impact drivers (at least land use change) Periodic measurements that start from a baseline, & measurements that reflect changes in state resulting from company-specific impact drivers 	<ul style="list-style-type: none"> Responsiveness - Medium (able to reflect how changes in pressures affects biodiversity state) Spatial precision - Medium Accuracy - Medium (measures reflect potential presence & impacts on species & ecosystems, but are not ground-truthed) 	<ul style="list-style-type: none"> ✓ Primary data based on surveys ✓ Measuring using responsive biodiversity data layers ✓ Measuring using modelled state based on pressures 	
SCREEN  <ul style="list-style-type: none"> Potential presence & condition of material species & ecosystems, results ground-truthed Species extinction risk indicators Potential impacts based on company specific impact drivers 	<ul style="list-style-type: none"> Feasibility (screening) - High (for screening, able to apply for screening at multiple sites) Spatial precision - High (captures species & ecosystems at site level) Accuracy - High (measures reflect actual, ground-truthed presence of/impacts on species & ecosystems) 	<ul style="list-style-type: none"> ✓ Modelled state based on pressures (using company specific impact driver data) for screening only ✓ Species threat & range layers 	
MEASURE  <ul style="list-style-type: none"> Ecosystem extent & condition for individual ecosystem assets Species extinction risk indicators Periodic measurements that start from a baseline, & measurements that reflect changes in state resulting from site-level mitigation measures <p>Based on primary data on material impact drivers</p>	<ul style="list-style-type: none"> Responsiveness (measuring impacts) - High - reflects effects of site-level mitigation measures Spatial precision - High (captures species & ecosystems at site level) Accuracy - High (measures reflect actual, ground-truthed presence of/impacts on species & ecosystems) 	<ul style="list-style-type: none"> ✓ Primary data based on surveys 	



There is no one tool fits all!

Fit for purpose?

Solutions available
in different steps of
the loan and
investment process

Asset Manager

Commercial Bank

Impact Investor

Introduction

Methodology

How to use the Toolbox

Into the Toolbox

PPT DD AC AO E R

Contents

Financial Institutions

Screening & Materiality

What is our exposure to (sub)sectors which have a relatively high potential impact risk looking at the drivers of biodiversity loss?

What is our exposure to (sub)sectors which have a high or very high material dependency on one or more ecosystem services?

What is our exposure to sensitive locations?

Based on the economic activities of a (sub)sector, (sub)sectors can be characterised as having a relatively high potential impact (initial screening). Exposure to these sectors may lead to transition risks, like new legislation in the locations where the impact takes place and loss of reputation.

Solution	Type	Expertise level	Costs	Location data	TNFD link
ENCORE					
SBTN Materiality Screening tool					
Model-based footprinting tools					
NEC					
SBTN High Impact Commodity List					
TNFD Annex 1					
Nature Target Setting Framework FFB					
Biodiversity Measurement approaches, FFB					



[Link](#)

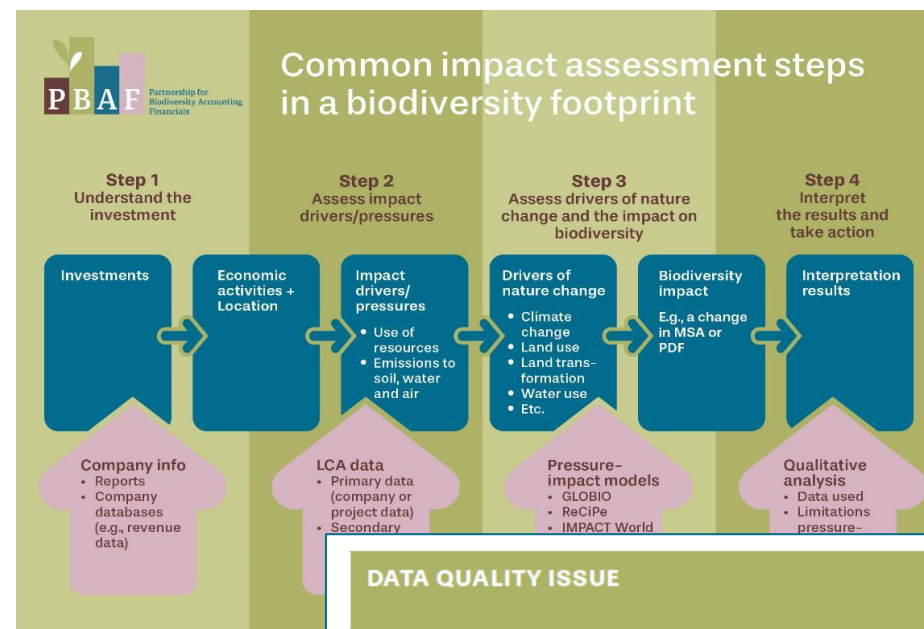
+ Understand the limitations

Each step in a biodiversity footprint adds a layer of uncertainty

Understand the value and limitations to interpret and use correctly



[Link](#)



DATA QUALITY ISSUE

Responsiveness to company action and the use of investment criteria

The use of sector averages affects the responsiveness of a footprint. Best in class companies from a biodiversity point of view will score the same as underperforming companies in the same sector. It also means that investment criteria addressing drivers of biodiversity loss or gain, filtering out worst in class performers in sectors or only including best in class performers, are not reflected in the footprint calculation.

HOW CAN THIS AFFECT A FOOTPRINT RESULT?

The use of sector averages may lead to a footprint which is too high or too low, when the company invested in actually performs better or worse than the sector average.

In the case of financial institutions that have strict biodiversity related investment criteria, the footprint result may be more negative than the actual impact. This means that such investment criteria are not rewarded via the footprint.



Partnership for
Biodiversity Accounting
Financials

Financial Institutions are welcome to become a PBAF Partner or Supporter!

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Global biodiversity model for policy support

IBIF Webinar: Q and A