



The climatization of biodiversity in green finance: the case of biodiversity footprinting

Klaudia Prodani

PhD candidate, University of Twente: Politics of Environmental Knowledge

Visiting Scholar, PBL Netherlands Environmental Assessment Agency

Research Fellow, IPBES Business and Biodiversity Assessment

k.prodani@utwente.nl

Overview

- Regulatory context behind the drive to measure biodiversity impacts and the flourishing third-party “nature data” provider scene
- Focus on biodiversity footprinting
 - Mean Species Abundance and the underlying GLOBIO model
- Uses of biodiversity footprinting
 - Proxy for “nature-related transition risks”
- Alternative

Regulatory context

GOAL D

Adequate means of implementation, including financial resources, capacity-building, technical and scientific cooperation, and access to and transfer of technology to fully implement the Kunming-Montreal Global Biodiversity Framework are secured and equitably accessible to all Parties, especially developing country Parties, in particular the least developed countries and small island developing States, as well as countries with economies in transition, progressively closing the biodiversity finance gap of \$700 billion per year, and aligning financial flows with the Kunming-Montreal Global Biodiversity Framework and the 2050 Vision for biodiversity.

TARGET 15

Take legal, administrative or policy measures to encourage and enable business, and in particular to ensure that large and transnational companies and financial institutions:

(a) Regularly monitor, assess, and transparently disclose their risks, dependencies and impacts on biodiversity, including with requirements for all large as well as transnational companies and financial institutions along their operations, supply and value chains, and portfolios;

(b) Provide information needed to consumers to promote sustainable consumption patterns;

(c) Report on compliance with access and benefit-sharing regulations and measures, as applicable;

in order to progressively reduce negative impacts on biodiversity, increase positive impacts, reduce biodiversity-related risks to business and financial institutions, and promote actions to ensure sustainable patterns of production.

Regulatory context

- 2021, France: Article 29 of the French law on Energy and Climate. The implementing decree explicitly mentions the option to disclose a “biodiversity footprint indicator”
- (2021) 2023, European Union: SFDR – Principal Adverse Impacts (PAIs), notably on investments in biodiversity-sensitive areas 2023
- 2023, European Union: CSRD – impacts on “ecosystem condition” and “ecosystem extent”



PCAF
Partnership for
Carbon Accounting
Financials



GREENHOUSE
GAS PROTOCOL



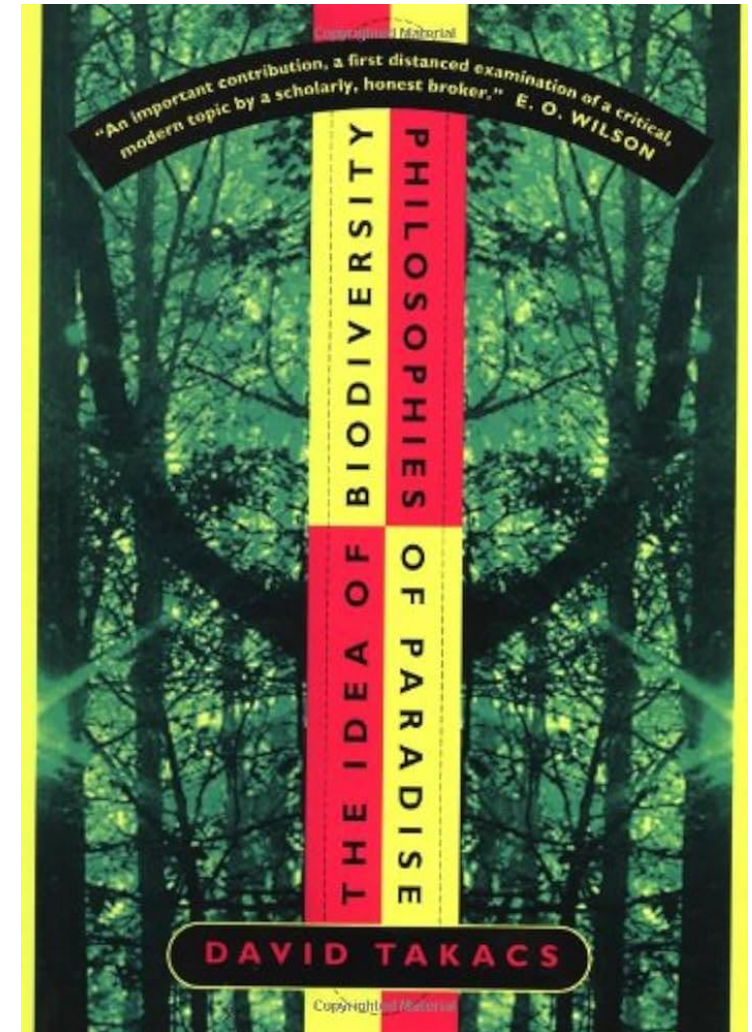
Ecosystem
Condition
Protocol

What is biodiversity?

“the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” (UN, 1992)

Purposefully elusive and all-encompassing

- “[it] is shorthand for all the richness of life” (Noss)
- “the history of life in all its forms over the entire time it’s existed on our planet” (Ray)
- “Maintenance of biological diversity can be thought of as another way to say ‘maintenance of everything’” (Takacs 1996, 75)
- “when we attempt to save endangered species on a case-by-case basis, we avoid looking at, and trying to avert, the more global determinants of species loss. ...biodiversity is a macroterm to focus attention on a macroproblem” (Takacs 1996, 95)
- “Biodiversity is a revolutionary term: its makers and promoters aim to foment radical changes on several fronts” (Takacs 1996, 309)



Third-party “nature data provider” scene

Announcements —

Share in  

The Natural History Museum and Bloomberg Team Up to Make the Museum’s Biodiversity Intactness Index Available to Financial Markets for the First Time

November 29, 2023



MSCI Biodiversity Footprint Metrics: Mean Species Abundance (MSA)

The MSA is an indicator for measuring local biodiversity intactness developed by the PBL Netherlands Environmental Assessment Agency. It measures the abundance of species relative to their abundance in 19 an undisturbed ecosystem



Company assets

CDC BIODIVERSITÉ



S&P Global Sustainable1 Launches New Nature & Biodiversity Risk Dataset

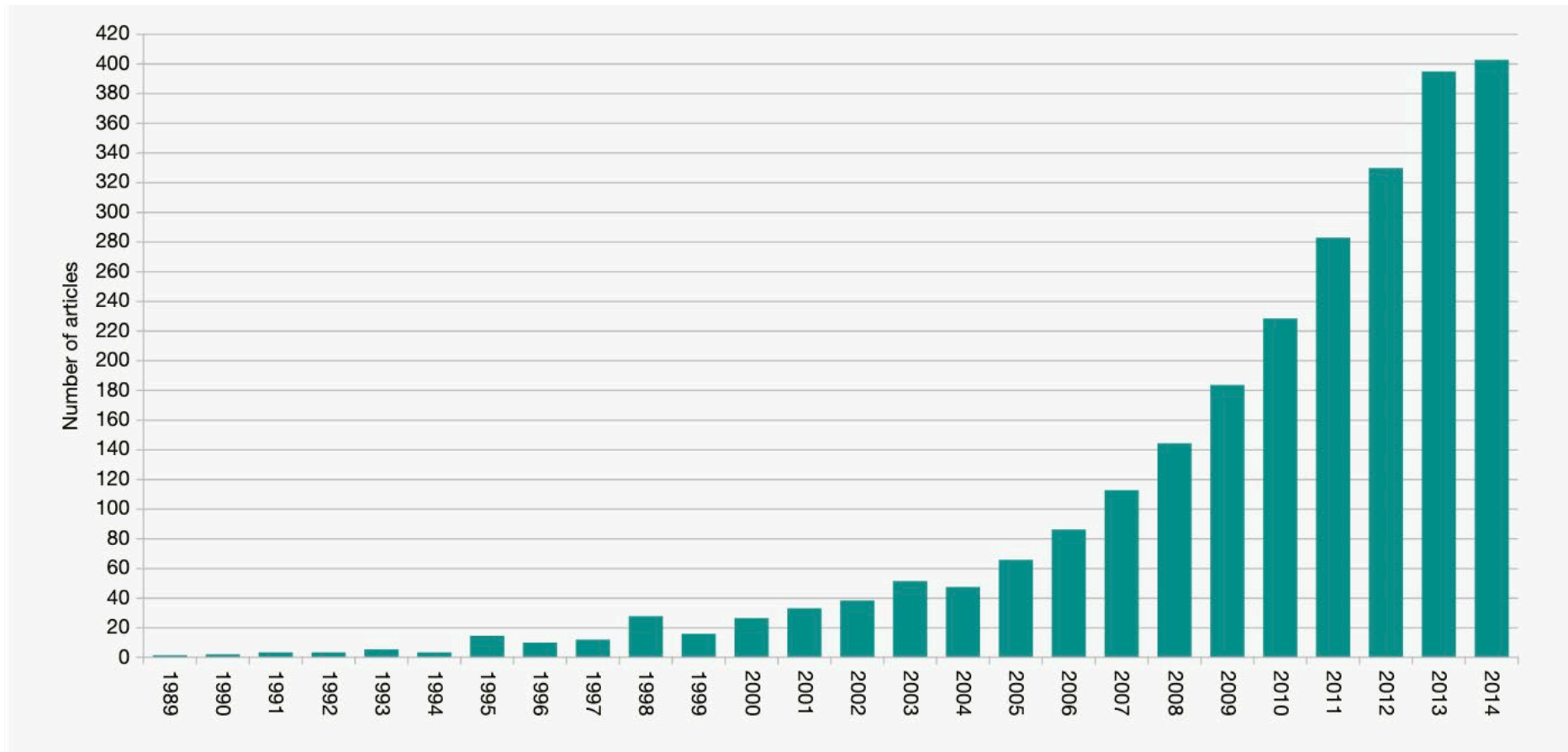
Focus: Mean Species Abundance (MSA) and GLOBIO

Methods

- 3 years of “fieldwork” among biodiversity scientists at the Netherlands Environmental Assessment Agency (PBL), which hosts GLOBIO and MSA
- ca. 40 semi-structured interviews along the “nature data value chain”
- Event ethnography at leading “nature intelligence” industry gatherings

Recency of model use in biodiversity assessments

Figure 1. Number of articles related to future projections of biodiversity and ecosystem services based on scenarios and models

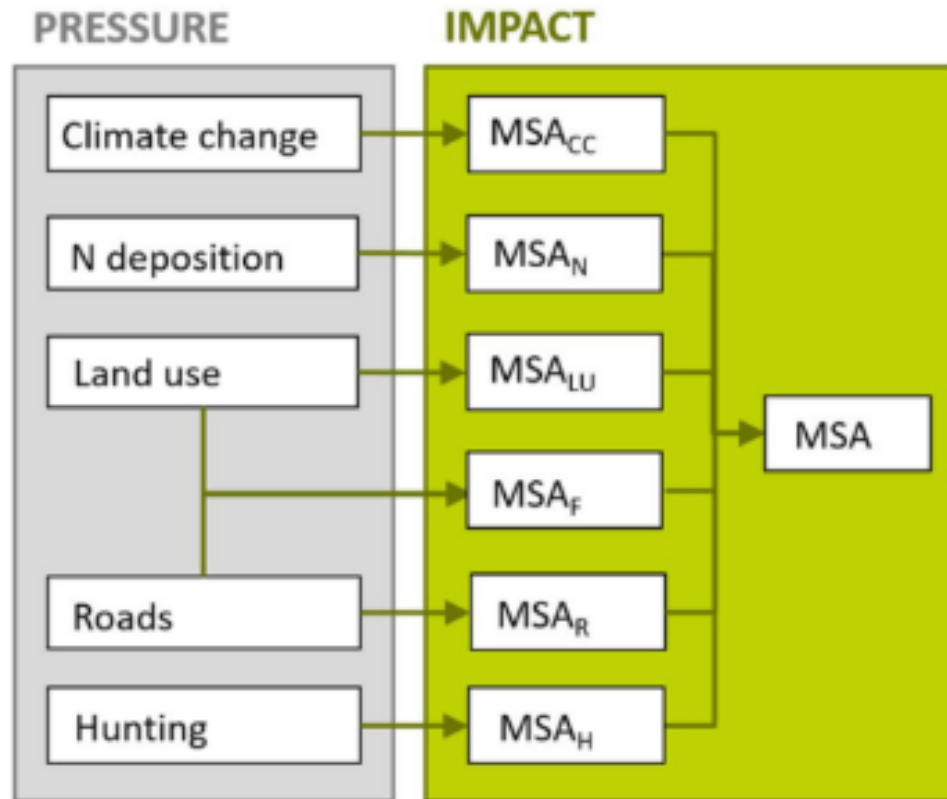


Source: IPBES 2016

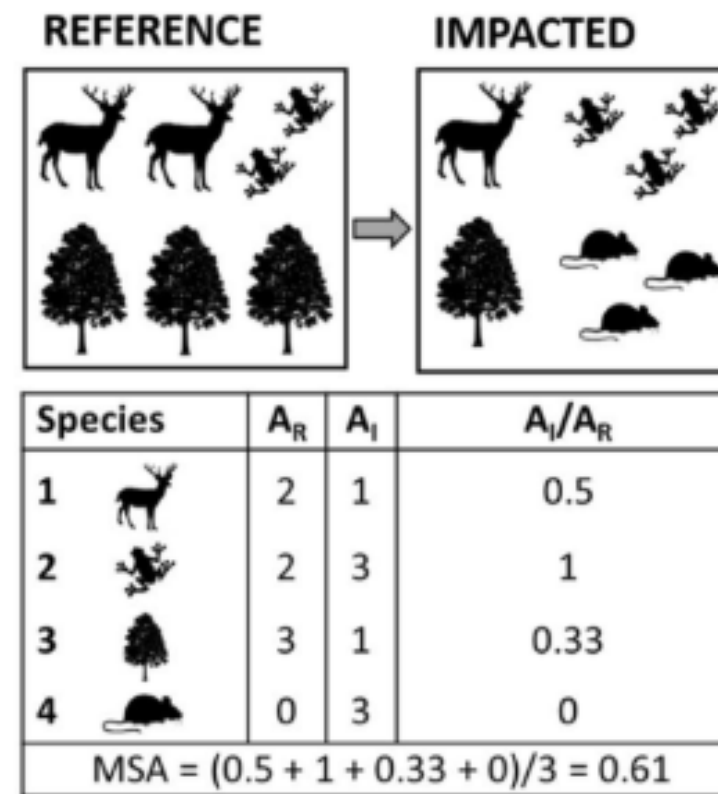
Introduction to GLOBIO and MSA

Figure 2. Graphical summary of the GLOBIO model and MSA metric

(a) GLOBIO model structure

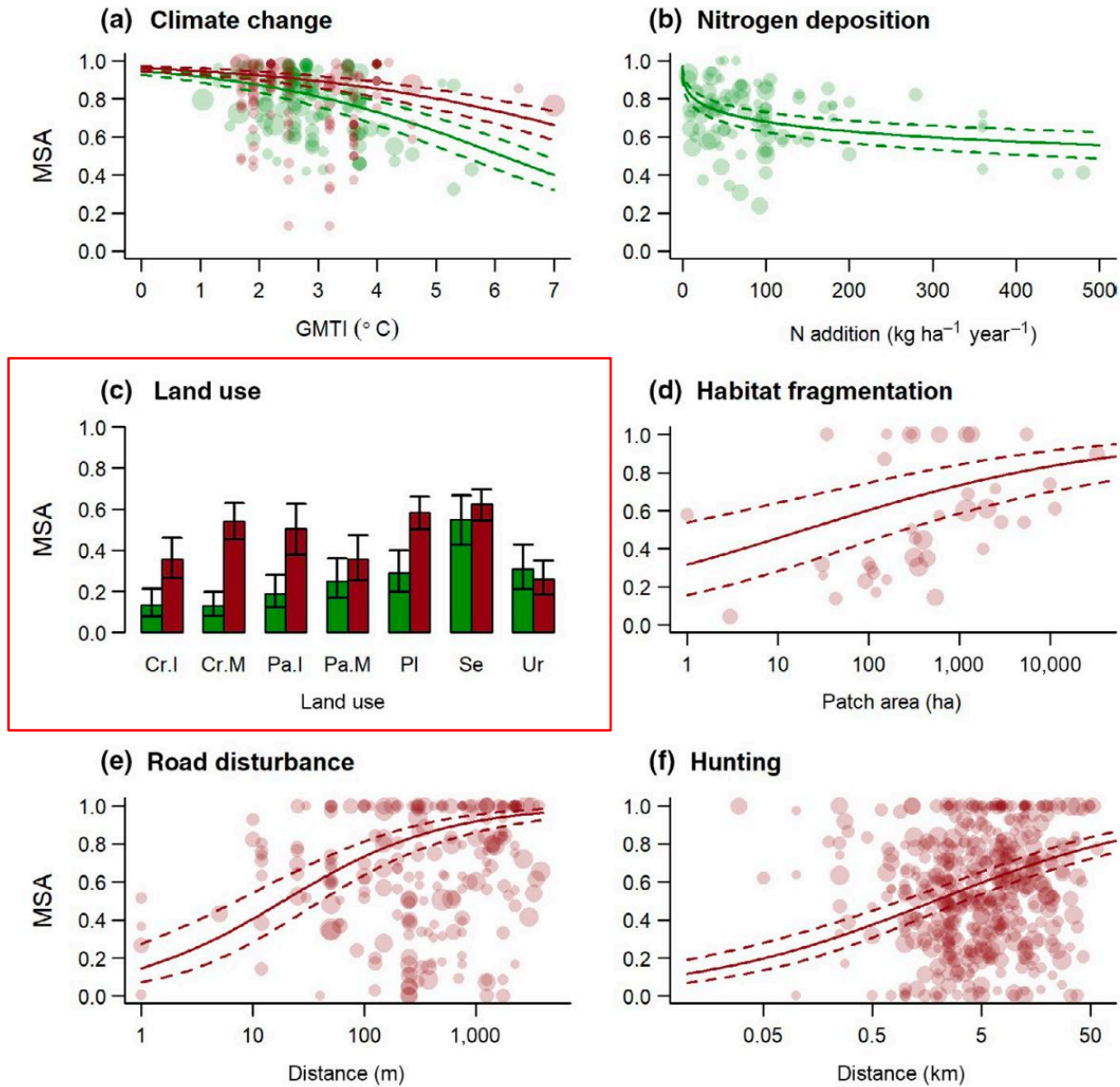


(b) Calculation of MSA



Source: Schipper et al. 2020

Figure 3. Pressure–impact relationships quantifying MSA per pressure



Source: Schipper et al. 2020

Figure 4. MSAland use values (GLOBIO 3.5)

Table 2.2 MSA_{LU} values assigned to GLOBIO land-use classes. Sources: Alkemade *et al.* 2009; Alkemade *et al.* 2013; GLOBIO reference database (www.globio.info).

GLOBIO land-use class	MSA _{LU}
Forest - Natural	1.0
Forest - Plantation	0.30
Forest - Clear-cut harvesting	0.50 ^a
Forest - Selective logging	0.70
Forest - Reduced impact logging	0.85
Burnt forest	1.0
Natural grassland	1.0
Pasture - moderately to intensively used	0.60
Pasture - man-made	0.30
Extensive cropland	0.30
Intensive cropland	0.10
Irrigated cropland	0.05
Woody biofuels	0.30
Bare area	1.0
Snow and ice	1.0
Urban area	0.05 ^b

^a Calculated as an average MSA for secondary vegetation over a varying number of years since clear-cut felling and/or land abandonment; ^b Value for densely populated cities without significant green space; based on expert judgement.

Source: Schipper et al. 2016

Figure 5. Simple biodiversity footprint calculation

$$10\text{ km}^2 \times (1 - 0.3) \text{ MSA-loss} \times \text{km}^2 / \text{km}^2 =$$
$$10\text{ km}^2 \times 0.7 \text{ MSA-loss} =$$
$$0.7 \text{ MSA-loss} \times \text{km}^2, \text{ interpreted as}$$
$$\text{“loss of } 0.7\text{ km}^2 \text{ of pristine habitat”}$$

Source: Author’s analysis and interviews

Concerns: time integration

Ecosystem degradation $\boxed{\text{[MSA-loss]}} \times \boxed{\text{km}^2} \times \boxed{\text{yr}}$

Figure 6. Importance of time integration in biodiversity footprint assessments



Source: Author's illustration

Concerns: time integration

My arguments why the GBS tool does in my opinion not meet the minimum scientific standards are the following:

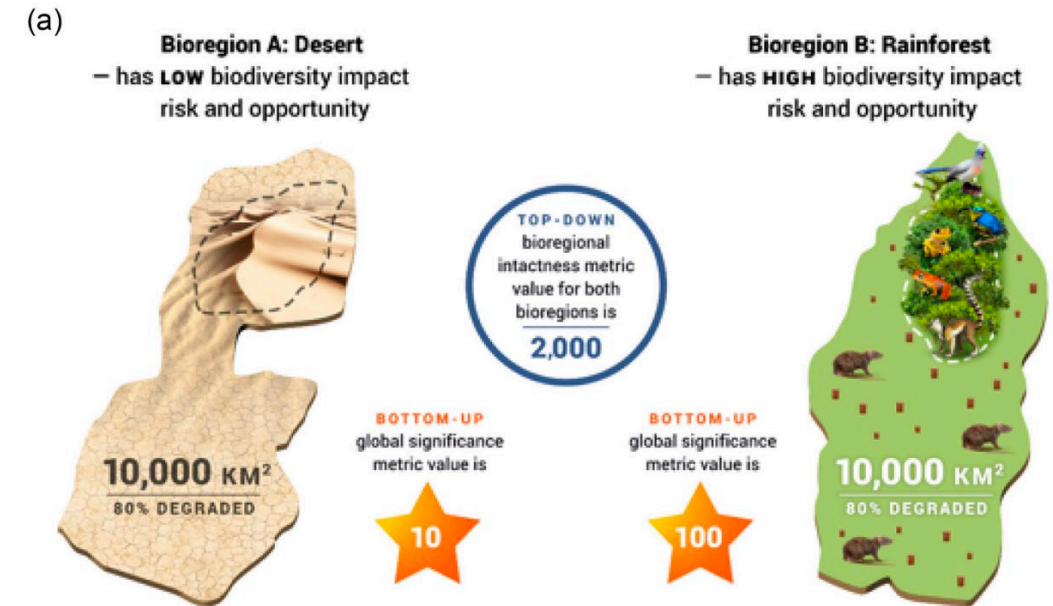
calculations, both land use and climate change matters. My biggest concern with the new GBS-tool is therefore that the focus of companies will be on reducing pressures that have an immediate impact, but largely neglecting pressures that may have larger biodiversity impacts on the long run. This is exactly why life cycle methods aim for integration of impacts in three dimensions: pressures, space and time. The new GBS-tool fails in my opinion to address the time dimension in an appropriate way. This is also the reason why I do not agree with your statement that the GBS-tool can be used with sufficient confidence to integrate the impact of land use and climate change pressures. The best the GBS-tool can offer at the moment is the integration of impacts of different land use types.

I hope this letter further clarifies my three main scientific concerns with the GBS-tool and why I do not recommend to use the tool for current use by companies, also not as a directional compass. The GBS-tool needs in my opinion (i) a more appropriate strategy to deal with time-integrated impacts, (ii) a better underpinned operational strategy to calculate MSA loss factors in practice for all environmental pressures, except land use, and (iii) major further scientific underpinning of the text on ecotoxicity.

Concerns: metric

- Placeless, “conservation-agnostic”
– fully intact desert has the same MSA value as a fully intact rainforest

Figure 7. Conservation-agnosticism of MSA



Source: Hawkins et al 2023

Concerns: metric

- Spatial unit-less
- Interviewer: “Can you help me read this table [referring to figure above] out loud? Is it correct to interpret your model as saying: everywhere in the world, one hectare of, for example, “intensive cropland” has an MSA value of 0.1?”
- Interviewee (GLOBIO modeler): “I mean, I would personally not put a spatial unit to these values because the meta-analysis is based on a lot of different field studies and they were all done in different ways. ... So, if you're estimating the abundance of plants, for example, usually what you do is you create a certain plot of a certain size. This can be like a 50 meter plot, or a 10 meter plot, or even a 100 meter plot. And you then count the numbers of species and their abundance. But if you are going for an assessment of birds, for example, you often just walk around. So that can be like hundreds of meters of walking, but it can also be a shorter walk. It can be that they just stand there until they hear a sound. So basically the data can be gathered in plots of different sizes. It can be gathered along transects lines. That's why there isn't really a spatial unit that you can put on it. The only thing that you can say is that this is a measurement of local biodiversity because it's very local, it's not like across the landscape. So that is why GLOBIO then has quite a high spatial resolution of 300 by 300 meters and it assumes that it can apply these MSA values to this spatial resolution, which is reasonable I think because ... I mean the plots are usually a little bit smaller, I would say, but I think it's still a reasonable thing to do. Otherwise, it's not possible.”

Concerns: metric

- Aggregatable thus unable to differentiate between vastly different types of impacts on nature
 - “For example, a footprint of -100 km² MSA means that:
 - all the original biodiversity is lost over an area of 100 km² for one year.
 - a lower proportion of biodiversity may be lost over a larger area, for example 10% over an area of 1000 km² for one year
 - or 10% over an area of 100 km² for 10 years”

Source: BNP AM Portfolio Biodiversity Footprint Report (2022)

Concerns: underlying pressure-impact model

Figure 8. MSA due to habitat loss by land use

Land use type	Plants			Birds & mammals		
	<i>MSA</i>	<i>95 % CI</i>	<i>n</i>	<i>MSA</i>	<i>95 % CI</i>	<i>n</i>
Cropland	0.19	0.13 – 0.27	9	0.43	0.35 – 0.51	17
Pasture land	0.25	0.17 – 0.34	14	0.47	0.38 – 0.55	14
Plantation forest	0.28	0.20 – 0.39	15	0.55	0.47 – 0.63	30
Urban land	0.25	0.17 – 0.35	3	0.24	0.18 – 0.32	5

Source: Schipper et al 2025

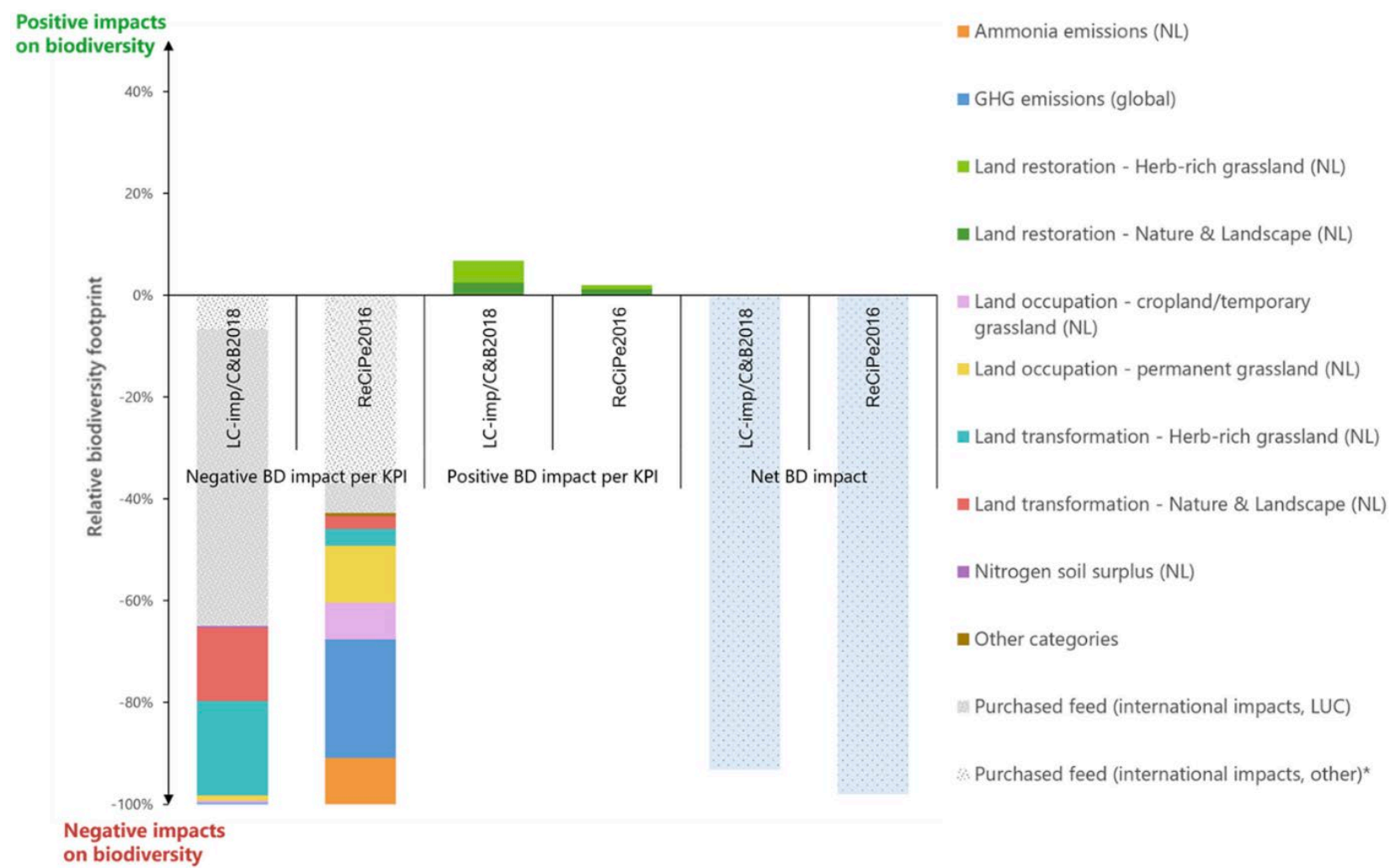
- Quantity of underlying meta-analysis data
- Cause-effect relationships are assumed to be “universal ... which implies that, all other pressures being equal, a loss in MSA due to a given pressure is the same everywhere” (Schipper et al 2025)
- Coarse land use classes --> unable to distinguish sustainable companies from less sustainable ones

Concerns: company pressure data

- The company pressure data that is then fed to pressure-impact models like GLOBIO and others (ReCiPe 2016, LC-IMPACT, ImpactWorld+) is often missing. It is estimated by linking company revenue data to environmentally extended multi-regional input output models (EE-MRIO), which often provide sector-country averages. This means that companies that belong to the same sector will be treated as having the same supply chains and will receive the same footprint score (PBAF report), scaled by the revenue of the company, even though they might diverge significantly in their practices and their value chains.

Scientists: science of biodiversity footprinting still in “infancy”

Figure 9. Contrast between the relative impacts on biodiversity due to different pressures for the same company, calculated using two different footprint models

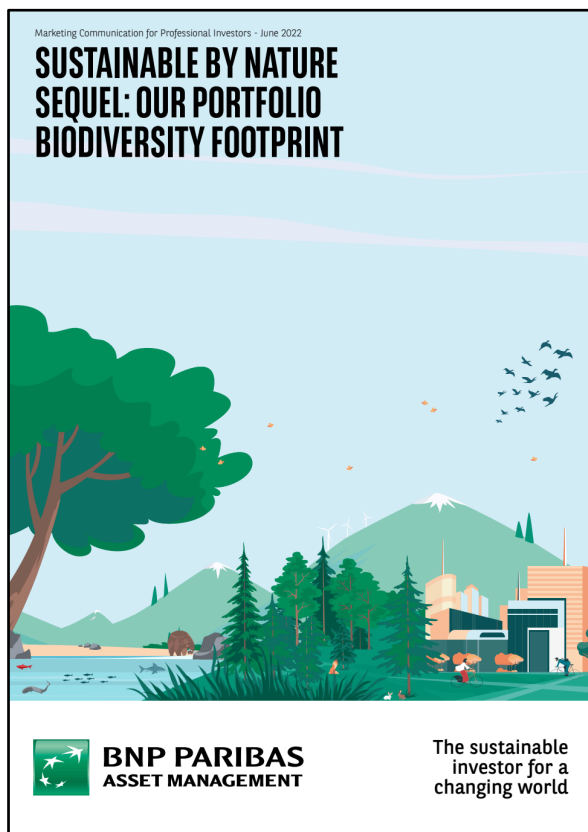


Source: Martínez-Ramón et al. 2024

Uses of footprinting

- To establish a baseline of current impacts that can inform target setting and impact mitigation strategies
- To comply with French and EU sustainability disclosure regulations (particularly as a proxy for “ecosystem condition” and “ecosystem extent”)
- To compare different companies’ impacts in order to compose “nature-positive funds,” biodiversity indices etc.
- (!) To measure “biodiversity gains” or “positive biodiversity impacts”
- To serve as a proxy for nature-related transition risks

Use – complying with sustainability disclosure regulations



A. Absolute biodiversity footprint of the companies in which we invest (without taking into account our ownership share)

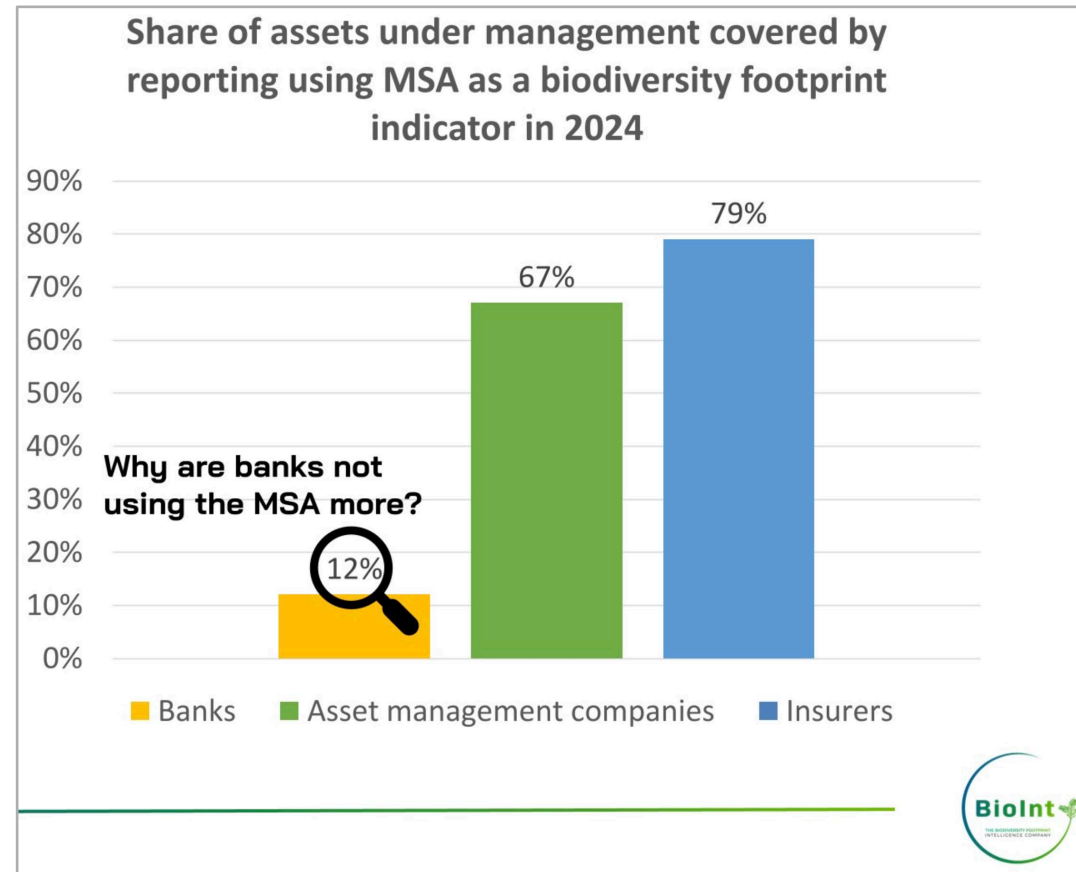
We estimate that the total absolute biodiversity footprint of the companies in which we are invested (without taking into account our percentage ownership) is approximately **-6 million km²MSA**, which means that the activities of these companies and their value chains potentially maintain a fully degraded area equivalent in size to most of Europe, annually.

B. Absolute biodiversity footprint of our Corporate AUM (taking into account our ownership⁸)

When seeking to attribute this figure to our share of investments, using the Partnership for Biodiversity Accounting Financials (PBAF)⁹ 'follow the money' principle and Enterprise Value¹⁰, we find that our financed absolute biodiversity footprint is approximately **-8 000 km²MSA**, which means that our investments potentially maintain a fully degraded area equivalent to five times the size of London, annually.



Figure 10. Share of AuM using MSA as a biodiversity footprint indicator (2022-2024)



Source: LinkedIn post by Joshua Berger, analysis based on 2022-2024 data on mandatory biodiversity reporting by financial institutions in France under Article 29 of the Climate & Energy Law of 2019

Use – selecting companies to construct “biodiversity indeces” and “nature-positive funds”

Equity

S&P 500 BIODIVERSITY INDEX (EUR)

AS OF NOVEMBER 28, 2025

Top 10 Constituents By Index Weight

CONSTITUENT	SYMBOL	SECTOR*
Apple Inc.	AAPL	Information Technology
Nvidia Corp	NVDA	Information Technology
Broadcom Inc	AVGO	Information Technology
Tesla, Inc	TSLA	Consumer Discretionary
Microsoft Corp	MSFT	Information Technology
Meta Platforms, Inc. Class A	META	Communication Services
JP Morgan Chase & Co	JPM	Financials
Alphabet Inc A	GOOGL	Communication Services
Alphabet Inc C	GOOG	Communication Services
Eli Lilly & Co	LLY	Health Care

*Based on GICS® sectors

Company Ecosystem Impact Intensity (CEII)

Aggregate

Ecosystem footprint (HSA)

EVIC

where:

EVIC

= Enterprise value including cash of the company

Source: S&P Biodiversity Indices Methodology (October 2025)

Use – comparing the nature impact of funds to benchmark funds

Figure 8: Selected fund-specific results*

Portfolio			Benchmark			Fund Difference vs Benchmark (%)
	CBF Coverage	Biodiversity footprint per million euro invested (km ² MSA, rebased at 100% coverage)		CBF Coverage	Biodiversity footprint per million euro invested (km ² MSA, rebased at 100% coverage)	
BNP Paribas Funds Sustainable Euro Corporate Bond Group	61%	-0.05	Bloomberg Barclays Euro Aggregate Corporate Index	58%	-0.06	-14%
BNP Paribas Actions Monde ISR	87%	-0.07	MSCI ACWI	88%	-0.06	+28%
BNP Paribas Funds Ecosystem Restoration	20%	-0.02	MSCI ACWI	88%	-0.06	-63%

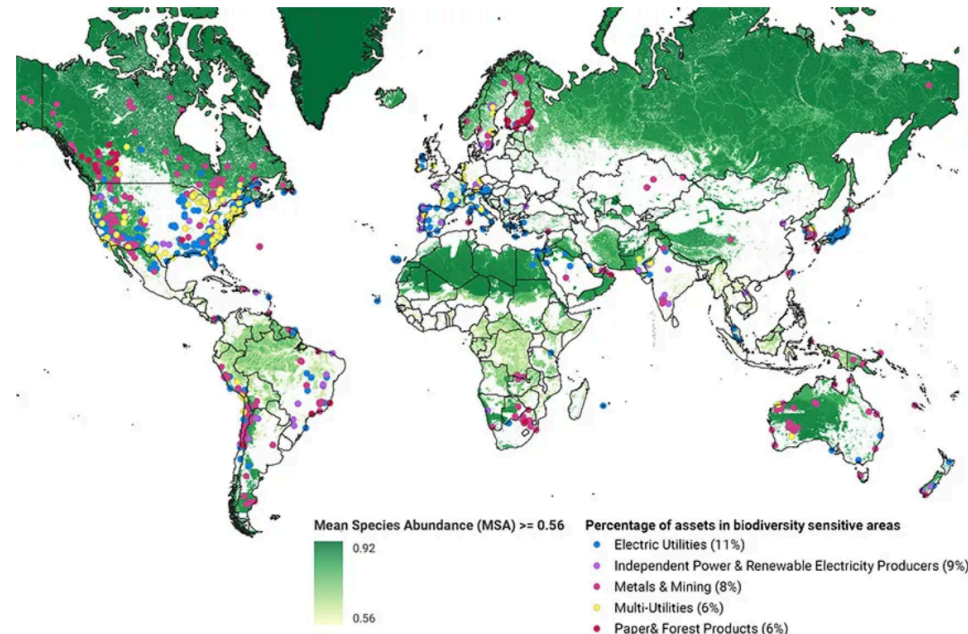
Source: BNP AM Portfolio Biodiversity Footprint Report (2022)

Use – proxy for transition risks for investors

Pinpointing location in our analysis

We used geospatial analysis and the MSCI Asset Location Database to identify the constituents of the MSCI ACWI Index that had physical assets in biodiversity-sensitive areas (shown below). To define an area as sensitive, we used the global, area-weighted mean for the Mean Species Abundance (MSA) metric for 2015, which is a proxy for local biodiversity intactness.^[1] Biodiversity-sensitive areas are intact ecosystems with minimal species loss that are recognized as important areas for conservation efforts and are more sensitive to biodiversity-loss impacts.

Industries with operations in biodiversity-sensitive areas



We found that 39% (1,103 companies) of index components had at least one asset (4,603 assets in total) located in a sensitive area with a high average share of assets across a diverse set of Global Industry Classification Standard (GICS®)⁵ industries.⁶ Proximity to sensitive areas could be reflected in upcoming reporting regulations and may be an impactful risk consideration for investors.

Use – proxy for transition risks for central banks and supervisors

WORKING paper



A “Silent Spring” for the Financial System? Exploring Biodiversity-Related Financial Risks in France

Romain Svartzman¹, Etienne Espagne², Julien Gauthey³, Paul Hadji-Lazaro⁴, Mathilde Salin^{1,5}, Thomas Allen¹, Joshua Berger⁶, Julien Calas², Antoine Godin², Antoine Vallier⁶

August 2021, WP #826

To approximate transition risks, we provide measures of impacts on terrestrial and freshwater (i.e. not marine) biodiversity of economic activities financed by French financial institutions (i.e. the “biodiversity footprint” of their portfolio). We find that the accumulated (or static) terrestrial biodiversity footprint of the French financial system is comparable to the loss of at least 130,000km² of ‘pristine’ nature, which corresponds to the complete artificialization of 24% of the area of metropolitan France. Land use change is the main pressure explaining these results. Moreover, the portfolio of French financial institutions has an annual additional (or dynamic) impact on terrestrial biodiversity that is comparable to the loss of 4,800km² of ‘untouched’ nature, corresponding to an annual complete artificialization of 48 times the area of Paris. Climate change is the main pressure explaining these results.

Alternative

- From impact-related indicators to pressure-related indicators
 - land- and sea-use change (including freshwater use)
 - GHG emissions
 - direct exploitation of natural resources (logging, fishing etc.)
 - pollution (nutrient loading, plastics, etc.)
 - invasive species
- From market-fixing to market-shaping financial policy?

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