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# Pressure switch: why corporates should disclose their contribution to pressures on biodiversity, not aggregated outcome metrics

Klaudia Prodani and Laudine Goumet

## Summary

Financial actors are increasingly attempting to measure their impact on nature and related financial risks. Drawing on their experience with climate, they often seek a single aggregated biodiversity metric for reasons of simplicity and pragmatism. However, this carbon-inspired approach to biodiversity is unnecessary and harmful. There is a broad scientific consensus that no single metric can capture the multiple dimensions of biodiversity.

The growing use of aggregated biodiversity footprints in finance risks producing misleading signals for financial practitioners, who sometimes treat these aggregated impact metrics as proxies for nature-related transition risks. Current biodiversity footprinting methods are coarse, highly model-dependent and often unable to distinguish between the best- and worst-performing companies within the same sector.

Moreover, different footprinting models account for different direct drivers (pressures) of biodiversity loss and, accordingly, often lead to different footprint estimates for the same company. Market participants can easily use this divergence to claim that more time is needed to devise better methods and metrics, thereby delaying action.

Instead of waiting for improved metrics, policymakers should require more easily understandable, verifiable and actionable disclosures of corporations' contributions to the five direct drivers (pressures) of biodiversity loss. These include: land-/sea-use change, greenhouse gas emissions, direct exploitation of organisms, pollution and the introduction of invasive species.

Pressure disclosures would be better proxies for nature-related transition risks than aggregated biodiversity footprints. Nonetheless, improved disclosures and the successful management and supervision of nature-related financial risks are far from sufficient by themselves. Addressing biodiversity loss and environmental degradation will require moving beyond the risk paradigm.

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## The growing recognition of biodiversity loss as a source of financial risk

**Since the early 2020s, nature-related financial risks have emerged as a concern for central banks and financial supervisors.** After initially focusing on 'biodiversity' and 'biodiversity-related financial risks', their terminology gradually converged on 'nature' and 'nature-related financial risks'. In 2023, the Network for Greening the Financial System (NGFS), a grouping of 149 central banks and supervisors, decided to adopt an "integrated approach" by using the term "nature-related financial risks", which encompasses climate, biodiversity, ecosystem services, water, soil and minerals (NGFS, 2023: 5).

Nature-related financial risks include physical risks and transition risks. Physical risks such as the collapse of pollination or fisheries, soil degradation, water scarcity, and the loss of natural flood and coastal protection can reduce revenues and raise costs in exposed sectors. They can also weaken debt-servicing capacity and collateral values, increase defaults and, ultimately, propagate into broader credit tightening and systemic financial risk. Transition risks arise from anticipated policies designed to protect nature – and, accordingly, are more likely to affect companies that have significant impacts on nature (NGFS, 2023).

**Central banks, financial regulators and supervisors have begun to engage with nature-related financial risks in advanced and emerging economies alike.** The Dutch, French, Brazilian, Mexican and Malaysian central banks, among others, have assessed their financial systems' dependence on ecosystem services, as well as their impact on biodiversity (Network for Greening the Financial System–International Network for Sustainable Financial Policy Insights, Research and Exchange [NGFS–INSPIRE], 2022). Alongside these assessments, several central banks have used public communications to emphasise that nature and biodiversity loss can present significant macroeconomic and financial risks.

**In this context, European policymakers incorporated biodiversity considerations into the 'sustainable finance package' legislation they adopted in the early 2020s.**[1] The resulting regulations adopted the 'double materiality' approach,[2] requiring financial institutions to report on biodiversity impacts, dependencies, risks and opportunities. This has, to some extent, encouraged the use of aggregated biodiversity footprinting metrics. In particular, France's Article 29 and 2021 Implementing Decree require financial market participants to publish an analysis of their contribution to reducing the pressures[3] and impacts on biodiversity. In a departure from the usually method-agnostic approach of such regulations, Article 29 was the first to suggest that financial actors can make "mention of the use of a biodiversity footprint indicator". Beyond corporate sustainability concerns, prudential frameworks in the EU are beginning to address nature-related risks more explicitly.

**This growing interest in biodiversity and nature has created an expanding market for commercial providers of biodiversity footprints.** Commercially available biodiversity footprints are typically model-based assessments that claim to capture a company's *potential* impacts on biodiversity in the form of a single number. They rely on a set of impact or characterisation factors often derived from generalised pressure–impact relationships,[4] which are frequently estimated using global

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[1] This includes the Sustainable Finance Disclosure Regulation (SFDR); the Corporate Sustainability Reporting Directive (CSRD), especially its ESRS E4; and France's Article 29 of the Law on Energy and Climate.

[2] The double-materiality approach considers both the risks corporations may face due to environmental degradation and the negative impacts they may have.

[3] In the context of biodiversity, pressures or direct drivers (terms that are used interchangeably) are factors that impact nature directly. The five main pressures causing biodiversity loss are: land-/sea-use change; greenhouse gas emissions; direct exploitation of organisms (e.g. logging, fishing); pollution; and the introduction of invasive species.

[4] Pressure–impact relationships are quantitative relationships that relate pressures on biodiversity (such as land use) to a biodiversity impact metric such as Mean Species Abundance, often by establishing regression models. Table 1 below shows the pressure–impact relationships for the pressure of land use.

datasets. These factors quantify, for example, the amount of biodiversity loss associated with a unit of pressure – such as the loss of Mean Species Abundance (MSA) per square kilometre of land converted for human use, per km of road, per kilogramme of ammonia emitted, or per kg of carbon dioxide or $CO_2$ equivalent emitted (Schipper et al., 2025).

**This industry impulse to come up with a single number may do more harm than good.** The UN Convention on Biological Diversity defines biodiversity as "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". Less formal definitions from early conservation scientists further highlight biodiversity's broad and multifaceted nature. One of the founders of conservation biology, the late Michael Soulé, defines biodiversity as "life in all of its dimensions and richness and manifestations" (Soulé, in Takacs, 1996), while the late marine ecologist G Carleton Ray says that biodiversity encompasses "the history of life in all its forms over the entire time it's existed on our planet" (Ray, in Takacs, 1996). Accordingly, there is a broad scientific consensus that no single metric can capture the complexity of the composition, structure and function of biodiversity (Turnhout and Purvis, 2020). Despite evidence that different footprinting models provide different scores for the same company (Martínez-Ramón et al., 2025), biodiversity footprints currently inform a wide variety of financial decisions – including by serving as a proxy for companies' transition risks, which are difficult to quantify (Svartzman et al., 2021).

**As central banks and financial supervisors seek to integrate biodiversity- and nature-related financial risks into prudential frameworks, this paper opens the black box of commercial biodiversity footprinting.** We explore the limits of such approaches, showing why practitioners and policymakers should be cautious in using and interpreting these tools.

"No single metric can capture the complexity of the composition, structure and function of biodiversity."

## Unpacking commercial biodiversity footprinting

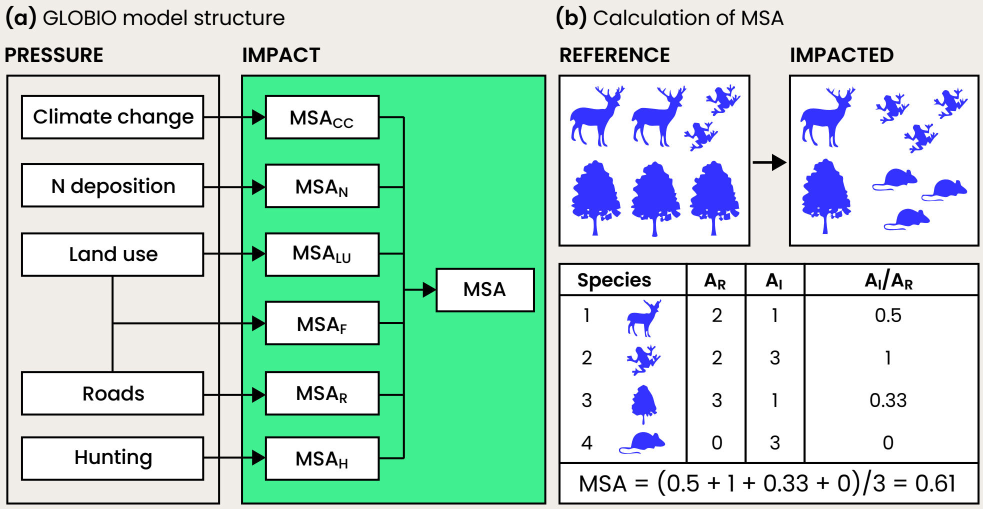
**While the emerging market for 'nature intelligence' encompasses a wide variety of assessment methods, model-based biodiversity footprints are among the most extensively used methods to assess the biodiversity impacts of companies and other financial actors.** Indeed, these methods provide a single, purportedly comprehensive number. They place limited data demands on the assessed entity, as they can be computed by combining secondary datasets (in which sectors are represented by average input mixes and average impact intensities) with generalised pressure–impact relationships. This facilitates comparative assessments, as these pressure–impact relationships are often assumed to be universally applicable (that is, all other pressures being equal, a given pressure is considered to result in the same loss of biodiversity anywhere in the world).

**It is widely recognised that the use of different biodiversity footprint models can produce different results for the same company, leading to the development of very different biodiversity strategies depending on the choice of the footprint model** (Martínez-Ramón et al., 2025). As the Partnership for Biodiversity Accounting Financials emphasises, current model-based biodiversity footprints are only rough estimates of potential rather than actual impacts (Partnership for Biodiversity Accounting Financials [PBAF], 2024; Bromwich et al., 2025). Therefore, these footprints should be used with caution, if at all.

**Nonetheless, biodiversity footprints inform several consequential practices in green finance.** They serve as a proxy for nature-related transition risks, because actors that have bigger impacts are generally expected to face higher transition risks (Svartzman et al., 2021). Furthermore, some commercial providers claim that they can serve as a proxy for 'ecosystem condition' and 'ecosystem extent' in both the Nature Positive Initiative's Nature Measurement Protocol and the disclosures required under European Sustainability Reporting Standard (ESRS) E4, pursuant to the Corporate Sustainability Reporting Directive (CSRD). Biodiversity footprints also inform target setting by establishing a baseline of potential impacts (PRé Sustainability and CREM, 2022).[5] Moreover, they are used to measure the biodiversity performance of nature-themed funds against their benchmarks (BNP Paribas Asset Management, 2022). They also inform the structure of biodiversity indices (see, for example, the recently discontinued S&P 500 Biodiversity Index). Additionally, they might start to shape biodiversity offsetting and credit strategies. This can be seen in the fact that some commercial providers claim that biodiversity footprints can be used to assess biodiversity loss as well as biodiversity 'gains' (CDC Biodiversité, 2023). Such claims are particularly concerning in light of some scientists' warnings that current biodiversity footprinting methods are unable to measure positive biodiversity impacts (Crenna et al., 2020).

**Many commercial footprinting tools are based on information derived from the global biodiversity model GLOBIO and use the related metric MSA,[6] but GLOBIO is a global biodiversity model that scientists initially developed to assess the potential biodiversity impacts of future development scenarios at the global and regional – not corporate – levels** (Alkemade et al., 2009). Created by the Netherlands Environmental Assessment Agency (PBL), GLOBIO was later used by scientists to assess biodiversity footprints at the national and sectoral levels, but not at the corporate level. As illustrated by our subsequent analysis and the example of a biodiversity footprint calculation in Figure 2, there are good reasons to contest commercial providers' use of GLOBIO and MSA to estimate footprints that can then inform the financial decisions of companies and other financial actors (IPBES, 2026; Solinnen, 2020).

**Figure 1. Summary of GLOBIO4 model and Mean Species Abundance metric**




*Source: Schipper et al. (2020).*

"GLOBIO is a global biodiversity model that scientists initially developed to assess the potential biodiversity impacts of future development scenarios at the global and regional – not corporate – levels."

[5] These organisations are particularly attentive to, and forthcoming about, the limitations of biodiversity footprinting – as is the bank assessed in PRé Sustainability and CREM (2022).

[6] Biodiversity footprints computed through different models (e.g. ReCiPe 2016, LC-impact, Impact World+) and metrics (most notably, the Potentially Disappeared Fraction of Species) suffer from similar types of limitations. A comparison of their differing characteristics is beyond the scope of this policy brief.

GLOBIO consists of a set of universal pressure–impact relationships that link a degree of pressure – such as land-use change, nitrogen emissions or climate change – to a degree of impact on MSA. These relationships are derived by fitting regression models. The underlying data for establishing these pressure–impact relationships are drawn from a systematic review that pools peer-reviewed empirical studies conducted around the world, whereby MSA values linked to a particular pressure are quantified for both an impacted site and an undisturbed reference site nearby (see Figure 1).

Scientists define the MSA as a "dimensionless metric between 0 and 1" that "expresses the mean abundance of original species in disturbed conditions relative to their abundance in undisturbed habitat, as an indicator of the degree to which an ecosystem is intact" (Schipper et al., 2025: 2; Schipper et al., 2016: 4). An MSA value of 1 indicates an undisturbed ecosystem, while a value of 0 indicates that all original species are locally extinct.

Table 1 details the pressure–impact relationships for the pressure of land use. There are several versions of GLOBIO and GLOBIO-derived impact factors: most commercial providers of biodiversity footprints rely on the MSA values from GLOBIO 3.5 shown in the Table. Providers use these values to calculate company-level biodiversity footprints.[7] Figure 2 provides a simple illustration of how providers calculate the biodiversity footprint associated with a company's occupation of 10 km$^2$ of extensive cropland in a given year.

"Most commercial providers of biodiversity footprints rely on Mean Species Abundance values from GLOBIO 3.5."

**Table 1. Mean Species Abundance land-use values based on GLOBIO 3.5**

| GLOBIO land-use cases | $MSA_{LU}$ |
|---|---|
| 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).*

[7] MSA-based impact factors (described above) have only recently become available. Interviews conducted by one of the authors of this paper suggest that many commercial providers instead rely on the pressure–impact relationships (MSA land-use values) shown in Figure 2.

**Figure 2. Simple biodiversity footprint calculation**

10km² x (1-**0.3**) MSA-loss x km² / km² =
10 km² x 0.7 MSA-loss =
7 MSA-loss x km², interpreted as 'loss of 7 km² of pristine habitat'

*Sources: Authors' analysis and interviews.*

**Financial practitioners, policymakers and supervisors should understand the limitations of such commercial footprints.** These limitations relate to the metrics that these footprints are expressed in, the underlying models that they rely on, and the modelled company and financial actor pressure data that are often fed into footprinting tools.

**MSA-based commercial biodiversity footprints have significant limitations, including their failure to account for conservation value; the diversity of impacts that can lead to the same footprint score; and the timeframes during which impacts occur.** First, MSA is conservation-agnostic: a fully intact desert has the same MSA score as a fully intact rainforest because MSA measures intactness – the absence of human disturbance – rather than the degree to which an area contains unique ecosystems, endemic species or species at risk of extinction (Hawkins et al., 2024). Second, when expressed as a footprint in the form of 'MSA-loss x km²', the quantity of land impacted and the extent of biodiversity degradation become interchangeable. As analysts at BNP Paribas Asset Management (2022: 6) explain:

> *A footprint of -100 km² MSA means that all the original biodiversity is lost over an area of 100 km² for one year. In practice, 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.*

These seemingly equivalent footprints have vastly different ecological, social and economic implications.

In addition, as Professor Mark Huijbregts explains, a leading commercial provider of MSA-based footprints "does not appropriately integrate biodiversity impacts over time", instead opting to account for these impacts through a stock and variation of stock approach (or static and dynamic impact approach) that might lead companies to focus "on reducing pressures that have an immediate impact, but largely [neglect] pressures that may have larger biodiversity impacts in the long run" (Solinnen, Office Français de la Biodiversité, 2020). Such footprints would, for example, assign the same biodiversity footprint to short- and long-lived pollutants. Time-integrated MSA-based impact factors have recently become available (Schipper et al., 2025). Yet it is unclear how widely they will be used, as many third-party providers appear to have a strong preference for the simplicity of measures that lack time integration.

**The limitations that stem from the underlying pressure–impact models used to create commercial footprinting tools relate to the differences in which biodiversity pressures these models include, and from their adoption of broad land-use categories that make it difficult to meaningfully distinguish between actors.** A variety of direct drivers (pressures) of biodiversity loss are included in pressure–impact models, influencing the types of impacts that are accounted for in the resulting

"A variety of direct drivers (pressures) of biodiversity loss are included in pressure–impact models, influencing the types of impacts that are accounted for in the resulting footprints."

footprints. For instance, unlike many Life Cycle Assessment models, GLOBIO does not include the pressures of ecotoxicity or water use. Only one model – the GLAM (Global Life Cycle Impact Assessment Method) – includes the pressure of plastic pollution. Moreover, the broad land-use classes that feature in many of these models make it difficult to distinguish more sustainable actors from less sustainable ones. For example, due to small sample sizes for some levels of land-use intensity, the latest MSA-based impact factors combine the previously differentiated land-use types of 'intensive cropland' and 'extensive cropland' into 'cropland' (Schipper et al., 2025).[8] Both a monoculture plantation and an agroforestry farm would, therefore, be assigned the same MSA value.

**Lastly, reliance on data based on estimates of companies' contributions to pressures on biodiversity, often derived from sector averages, reduces the accuracy of biodiversity footprint calculations and obscures meaningful differences between companies within the same sector.** The simple footprint calculation described in Figure 2 requires access to company-specific pressure data, such as the data point on 10 km$^2$ of extensive cropland. In practice, such information is often withheld to avoid scrutiny linked to environmental and human rights concerns. This lack of information is even more acute when conducting footprint assessments of large financial actors.

As a result, commercial footprint providers often estimate company pressure data by linking company revenue data to environmentally extended multiregional input–output models (EE-MRIO), which frequently provide sector-country averages. The use of such averages means that the best- and worst-performing companies in each sector will receive the same scores, because they will be treated as having the same supply chains (PBAF, 2024). For financial supervisors, such footprint estimates can be misleading: they cannot reliably distinguish between more harmful and less harmful actors nor meaningfully identify concentrations of nature-related financial risk.

"Companies and financial actors could use a limited set of proxies for nature impacts and nature-related transition risks by disclosing their contributions to the five main direct drivers (pressures) of biodiversity loss."

## From modelled biodiversity outcomes to the underlying causes of biodiversity loss

**Given the ways in which financial decisions are often made, it is easy to understand the appeal of using a single metric, but this approach is unnecessary and harmful in the case of biodiversity.** As with environmental, social and governance (ESG) ratings, reliance on a single metric will only fuel distracting critical scrutiny and produce a backlash from market participants, who can easily use evidence of divergence between model-based aggregated footprint scores to claim that more time is needed to devise better methods and metrics, thereby delaying action.

**Instead, companies and financial actors could use a limited set of proxies for nature impacts and nature-related transition risks by disclosing their contributions to the five direct drivers (pressures) of biodiversity loss: land-/sea-use change; greenhouse gas emissions; direct exploitation of organisms (e.g. logging, fishing); pollution (e.g. nutrient loading, plastics, hazardous waste); and the introduction of invasive species.** Such a move would align with scientists' growing calls to move away from modelled biodiversity outcome metrics and towards pressure metrics (Stockholm Resilience Centre and Mistra FinBio, 2025).

[8] 'Intensive cropland' refers to agricultural land characterised by high input use (such as fertilisers, irrigation and mechanisation) and high yields per unit area, whereas 'extensive cropland' denotes lower-input, lower-yield systems that are often integrated into semi-natural elements or rotational fallow. GLOBIO defines intensive cropland as cropland that exceeds a certain nitrogen application threshold.

**This shift would build on existing practice: financial practitioners are already inputting pressure data into aggregated footprints.** A focus on pressures would also address several pressing problems. In comparison to an aggregated and modelled outcome metric, pressure data is easier to understand and verify, and harder to present as evidence for misleading claims about 'offsetting' negative impacts. Pressure data is also a better proxy for transition risks, as policies to protect nature have always addressed a wide variety of domains (e.g. land conversion, nutrient pollution, water abstraction) rather than a single biodiversity outcome. Nonetheless, pressure data will have some of the same limitations as footprinting unless it is *specific to companies and locations*, features that financial and sustainability disclosure regulators should strongly encourage. One such limitation, for example, could be an inability to account for whether pressures occur in an area that contains unique ecosystems, endemic species or species at risk of extinction.

**Finally, better disclosures of nature impacts and the successful management of associated risks are far from enough to address biodiversity loss by themselves** (Irvine-Broque and Dempsey, 2023). Much ecological destruction and related nature risks remain outside financial portfolios (Prodani et al., 2025). Even when portfolios are exposed to nature-related risks, financial actors' efforts to mitigate these risks can involve offloading them onto more vulnerable actors and communities (Dempsey et al., 2022). For example, credit rating agencies may downgrade the sovereign debt of the countries that are most vulnerable to climate impacts and most dependent on biodiversity and ecosystem services, further constraining these countries' abilities to invest in climate change mitigation, adaptation and social spending. Lastly, framing inaction on nature as a source of transition risk may be counterproductive, as shifting political priorities can turn environmental action into a transition risk in itself, undermining firms' incentives to embrace greener practices.

> "Better disclosures of nature impacts and the successful management of associated risks are far from enough to address biodiversity loss."

Addressing the underlying causes of biodiversity loss and environmental degradation will require moving beyond the risk paradigm (Gurung et al., 2025). Rather than focusing solely on risk identification and risk management, a more effective approach would be to incorporate environmental objectives more directly into financial policy and financial decision-making processes (see also Smoleńska and van 't Klooster, 2021; van 't Klooster and Prodani, 2025).

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## About the authors

**Klaudia Prodani** is a PhD candidate at the University of Twente and a fellow in the Business and Biodiversity Assessment of the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES).

**Laudine Goumet** is a Policy Analyst at CETEx.

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