ESG Thema

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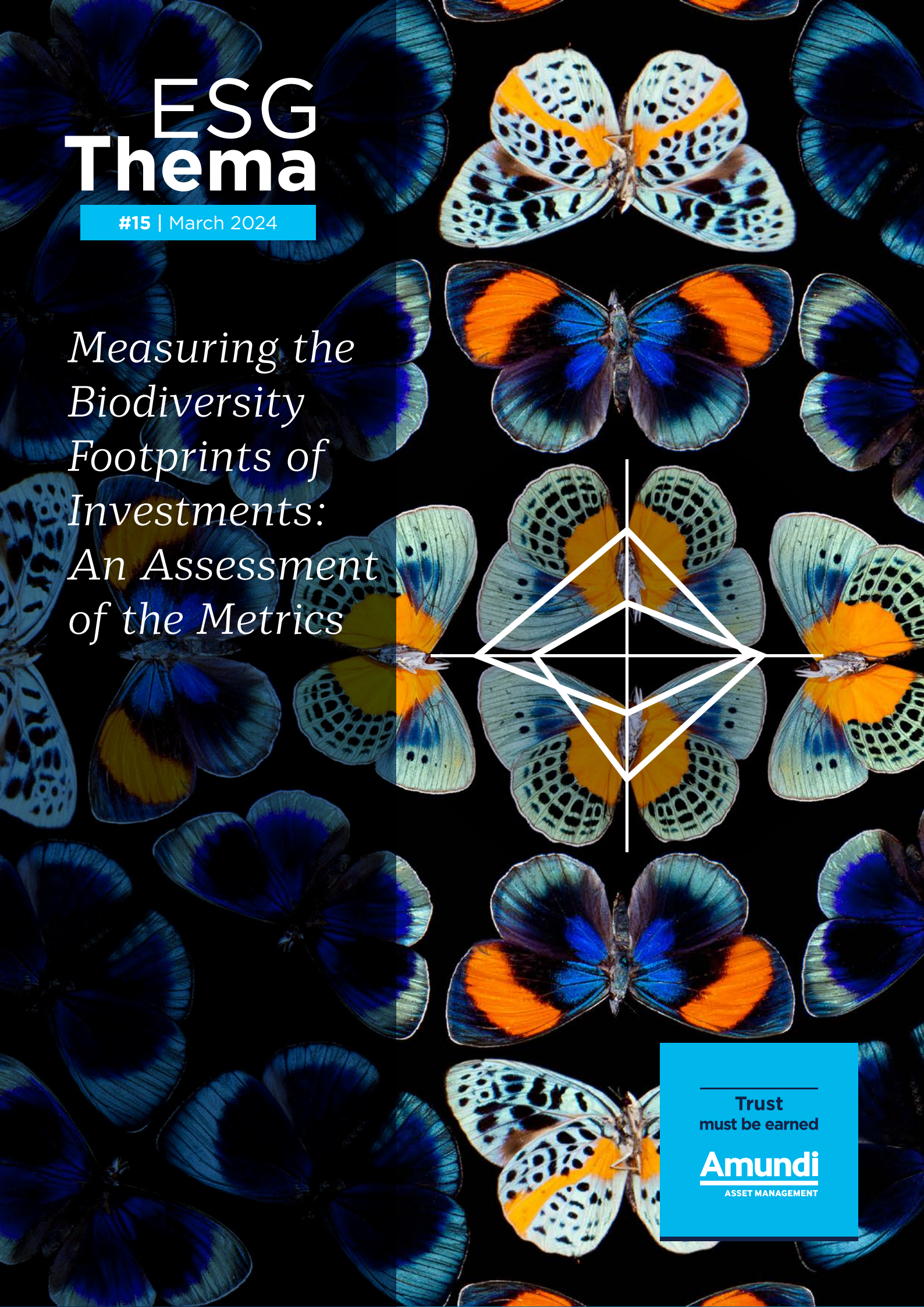
Measuring the Biodiversity Footprints of Investments: An Assessment of the Metrics



Key takeaways

- The urgency and scale of biodiversity loss are exposing a high number of companies across sectors to significant financial risks. In this context, it has become increasingly necessary for investors **to reliably assess the impact and dependence of companies on biodiversity.**
- As of today, there are significant hurdles to effectively account for biodiversity, such as challenges around data measurement and a lack of clear standards for reporting. However, work on the topic is moving fast: guidance is provided by the **Taskforce on Nature-related Financial Disclosures (TNFD)** and the **Global Reporting Initiative (GRI)** has published its Biodiversity standard to support organizations in disclosing their biodiversity-related impacts.
- To measure corporate biodiversity impacts, a biodiversity metric has emerged: the **Mean Species Abundance (MSA)**. It expresses the mean abundance of original species in a habitat compared to their abundance in an undisturbed habitat. The MSA is used by an increasingly high number of companies and financial institutions to measure biodiversity footprints.
- In this paper, we argue there is a **strong case for integrating the MSA into investment frameworks,** from risk management purposes, to impact assessment and compliance with emerging regulations.
- We then analyze the distributions of MSA scores in both equity and fixed income indices to **understand discrepancies in corporate biodiversity footprints across regions and sectors.** The aim is to help investors have a more precise view of the different biodiversity footprints of the various components of their portfolio.
- **Finally, we assess the strengths and limitations of the MSA metric, and suggest to combine it with other indicators** to ensure a more comprehensive integration of biodiversity measurements into investment frameworks.

Introduction: Accounting for biodiversity footprints in a changing regulatory landscape

Biodiversity has become a topic of increasing interest to investors. And for good reason: according to the WWF's Living Planet Report, **almost 60% of wild animal populations have been lost in the space of 40 years[1].**

Apart from the worrying environmental situation, one of the reasons investors are starting to be concerned is that **some companies are highly exposed to the risk of biodiversity loss.** According to the United Nations Environment Program Finance Initiative (UNEP-FI), 13 of the 18 sectors that comprise the FTSE 100 – and represent US$1.6 trillion in market capitalization – are associated with production processes that have high or very high material dependence on nature. Moreover, it is estimated that over 50% of global GDP is moderately or highly dependent on nature[2].

Moreover, **corporate biodiversity impacts are far-reaching.** A pilot study led by the Finance for Biodiversity Foundation revealed that a short list of top 250 high-impact companies on the MSCI World Index are potentially responsible for 73% of the biodiversity impact of the entire index[3].

These impacts result from five key drivers, which are identified by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) as climate change, land-use change, natural resource use and exploitation, pollution, and invasive species.

In light of these observati**ons, it has become increasingly necessary for investors to be able to reliably assess the impact and dependence of companies on biodiversity,** in order to direct investments towards biodiversity preservation and to minimize their exposure to biodiversity-related risks.

As of today, there are **significant hurdles to effectively account for biodiversity,** such as challenges around data measurement and a lack of clear standards for reporting. However, this complexity should not be an excuse for inaction. Work on the topic is moving fast: for example, guidance is provided by the **Taskforce on Nature-related Financial Disclosures (TNFD)[4]** and the **Global Reporting Initiative (GRI)** has published its Biodiversity standard to support organizations in disclosing their biodiversity-related impacts[5]. This gives companies and financial actors a concrete framework to help them comply with new transparency requirements, respectively the **Corporate Sustainability Reporting Directive (CSRD) and the Sustainable Finance Disclosure Regulation (SFDR).**

In this evolving context, a biodiversity metric has emerged to measure the footprint of corporates on biodiversity: the Mean Species Abundance (MSA).

1. WWF Living Planet Report, 2018
2. World Economic Forum, Davos 2020
3. https://www.financeforbiodiversity.org/wp-content/uploads/Top10_biodiversity-impact_ranking.pdf
4. Recommendations of the TNFD, September 2023 https://tnfd.global/recommendations-of-the-tnfd/#overview
5. Global Reporting Initiative – Biodiversity Standard 2024 https://www.globalreporting.org/standards/standards-development/topic-standard-project-for-biodiversity/

Among the indicators that use the MSA as a measure of local biodiversity intactness, there are several tools that can help investors determine the potential impact of portfolio companies on biodiversity, among which:

- The **Global Biodiversity Score (GBS)**, developed by Carbon 4 Finance and CDC Biodiversité,
- The **Corporate Biodiversity Footprint (CBF)**, developed by Iceberg Datalab and I Care & Consult.

The purpose of this paper is three-fold. Firstly, **we explore the characteristics of the MSA metric,** highlighting its strengths and potential areas for improvement. Then, **we analyze the distributions of MSA scores** in both equity and fixed income indices to understand discrepancies across regions and sectors. The aim is to help investors have a more precise view of the different biodiversity footprints of the various components of their portfolio. **Lastly, we assess how the MSA may be combined with other metrics** to support the integration of biodiversity measurements into investment frameworks.

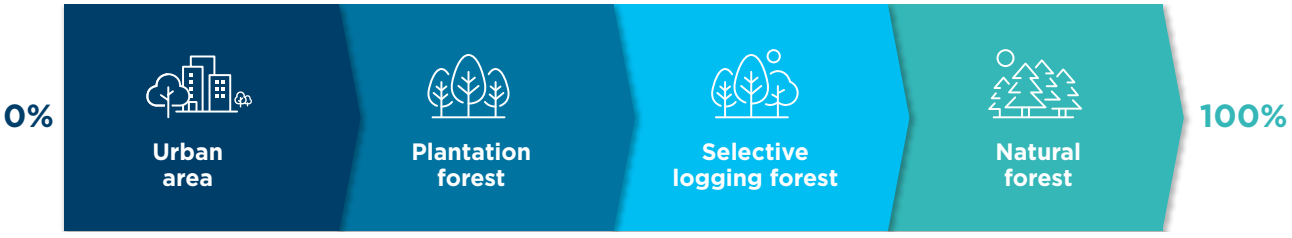
The MSA: an innovative metric to measure corporate biodiversity footprints, but with granularity limits

Introducing the MSA, a measure of ecosystem integrity, based on the GLOBIO model

The Mean Species Abundance (MSA) is a biodiversity metric which **expresses the mean abundance of original species in a habitat compared to their abundance in an undisturbed habitat.** The MSA metric considers both the number of species present in an ecosystem and the relative abundance of each species. In this sense, the MSA measures to which extent an ecosystem is intact and can be used to track changes in ecosystems over time.

MSA ranges from 0% to 100%, where 100% means that the species assemblage is fully intact, and 0% means that all original species are locally extinct. To give a concrete example, in 2018, the global average terrestrial MSA was about 66%. In other words, at that time, about 34% of global terrestrial MSA had already been lost[6].

Figure 1: The MSA measures ecosystem integrity on a scale from 0-100%



Source: Carbon 4 Finance.

6. Integrated Assessment of Global Environmentl Change with IMAGE 3.0 (pbl.nl) ; https://www.cdc-biodiversite.fr/wp-content/uploads/2022/06/20201005_SchneiderElectric-BFA_white-paper_laid-out_v4.pdf

The MSA is quantified based on data that describe changes in habitat composition in relation to specific pressures such as land use, road disturbance, fragmentation, hunting, atmospheric nitrogen deposition and climate change. Specific MSA metrics for each particular pressures are computed and an aggregated MSA, based on all pressures, is then calculated to stress the global impacts on biodiversity at a higher level (see Figure 2.a below).

Concretely, the objective of this measure is to determine the impact of companies on biodiversity using quantitative models, such as the GLOBIO model, and thus to **establish a link between the economic activities of companies and the pressures on biodiversity exerted by these same companies.**

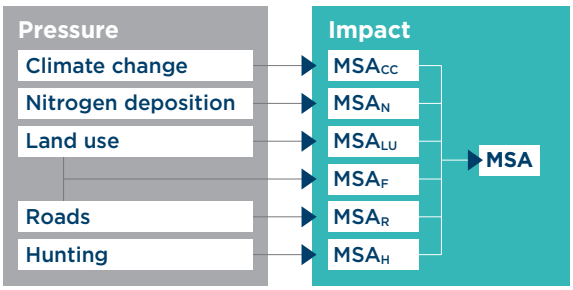
Developed by the **PBL Netherlands Environmental Assessment Agency,** the GLOBIO model is designed to inform and support policymakers by quantifying global human impacts on biodiversity and ecosystems. For the moment, the model has developed two sub-models that quantify **local terrestrial biodiversity intactness** – which focuses on specific land types conservation such as natural vegetation, forests, pastures, croplands and urban areas – and **freshwater biodiversity intactness** – which relies on three freshwater types (i.e. lakes, rivers and wetlands).

Example of a MSA calculation

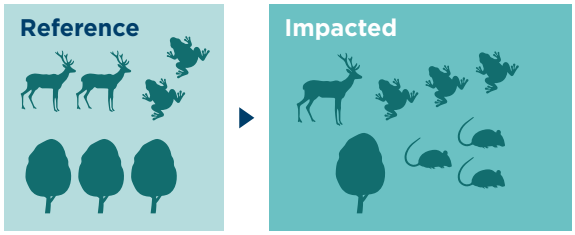
Let's try to calculate the MSA of a specific environment (see Figure 2.b below). As a reminder, the principle of the MSA is to measure the conservation of the reference ecosystem. Therefore, new species and increases in abundance are not accounted for.

Figure 2: GLOBIO Model Structure and Calculation of an environment's MSA score

(a) GLOBIO Model Structure



(b) Calculation of MSA



Species	A_R	A_I	A_I / A_R
1	2	1	0.5
2	2	3	1
3	3	1	0.33
4	0	3	0

MSA = (0.5 + 1 + 0.33 + 0)/3 = 0.61

The **MSA is calculated** by taking the arithmetic mean of the number of one species in the disturbed state divided by the number of the same species in the reference state. In this example, we obtain an MSA score of 0.61, meaning 34% of local species abundance has been lost.

Note

(a) shows the structure of the model, based on a set of pressure-impact relationships, with CC, climate change; LU, land use; F, fragmentation; R, road disturbance; N, nitrogen deposition; H, hunting. (b) shows the calculation of the MSA metric where A_R denotes individual species' abundance in an undisturbed reference situation, A_I the abundance of the species in the impacted situation, and A_I / A_R the truncated abundance ratio.

Please note that, in this example, A_I does not exceed A_R as we do not take into consideration the new species or increases in abundance in a given ecosystem.

Source: Schipper, AM, Hilbers, JP, Meijer, JR, et al. Projecting terrestrial biodiversity intactness with GLOBIO 4. Glob Change Biol. 2020; 26: 760– 771.

A strong case for integrating the MSA into investment frameworks

The integration of the MSA metric into investment frameworks can serve several purposes related to sustainability and biodiversity conservation.

Table 1: Reasons for integrating the MSA metric to investment frameworks

Impact Assessment	Risk Management	Corporate Engagement	Compliance
MSA can be used to **assess the biodiversity impact of portfolios or specific investments.** This can help investors identify companies or projects that are more sustainable (from a biodiversity perspective) and spot negative impacts on biodiversity to better manage investments	Integrating MSA into investment frameworks **can help identify and manage biodiversity-related risks.** By assessing the MSA of a company's operations or supply chain, investors can evaluate the potential impact of companies on biodiversity and thus guide investments accordingly.	Integrating MSA into investment frameworks can provide a basis for engagement with companies to lower their biodiversity impacts. By engaging with companies and encouraging them to improve their MSA, investors can help drive positive change and **promote better practices.**	Some investors may be required to comply with regulations related to biodiversity conservation. Integrating MSA into investment frameworks can help **ensure compliance with these regulations.** i.e. The French LEC 29 bill requires financial actors to publish the impact and dependencies of their investments on biodiversity[7].

For these reasons, MSA presents clear benefits for companies and financial institutions alike to start assessing their biodiversity footprint.

Interpreting MSA score distributions across sectors and regions

Computing different biodiversity footprints into an aggregated score

We have conducted an analysis of MSA score distributions within different equity and credit universes, using the BIA-GBS database from Carbon 4 Finance and CDC Biodiversité. **Its ambition is to compute a measure of biodiversity loss at company and portfolio level.**

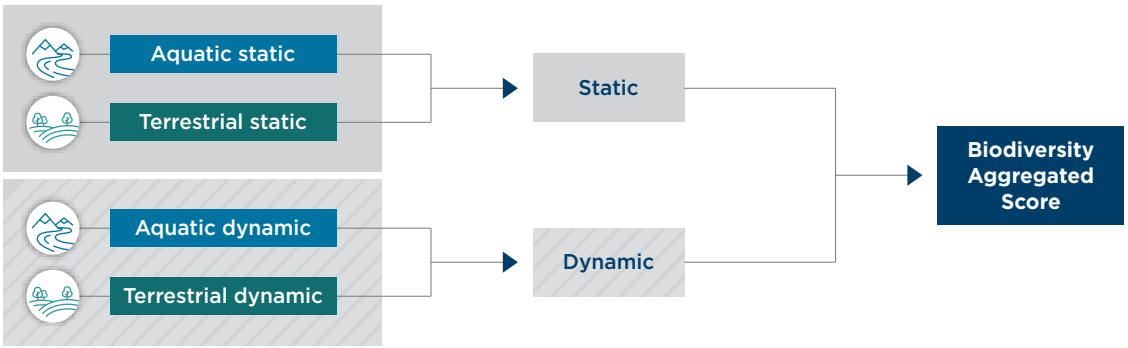
More precisely, **the model evaluates biodiversity impacts in MSA/km²** to measure the fraction of biodiversity integrity lost on a given surface. These impacts are always distinguished between accounting categories (static vs. dynamic) and ecosystems (terrestrial vs. aquatic):

- **The static footprint** includes all the persistent or long-lasting effects which remain over time, while **the dynamic footprint** is caused by changes or consumptions during a specific period assessed.
- **Terrestrial biodiversity** refers to ecosystems found on landforms and **aquatic biodiversity** refers to lakes, rivers and wetlands ecosystems (freshwater biodiversity)[8].

7. See France's Energy and Climate Law, Article 29: https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000039355992
8. Marine biodiversity is not currently covered by the BIA-GBS due to lack of scientific data

This results in four impact figures which are called "compartments" i.e. terrestrial static, terrestrial dynamic, aquatic static, and aquatic dynamic (see Figure 3 below).

Figure 3: 4 compartments of impacts are aggregated into one score in MSAppb*



Source: Carbon 4 Finance.

To go into more detail, there are two main steps to translate the MSA.km² into a biodiversity metric that aggregates all compartments of impacts.

The first step to calculate the aggregated score is to translate the MSA.km² into a MSAppb (part per billion[9]) metric, aggregating aquatic and terrestrial impacts. To do this, the terrestrial and aquatic MSA.m² impacts are divided by their respective share of surface area (130 million km² for terrestrial and 11 million km² for aquatic in the example below) in order to have comparable metrics. It is then multiplied by 10^8 to express it in parts per billion.

The second step requires aggregating static and dynamic impacts, to obtain the MSAppb* metric. This score allows for an easier comparison between sectors, companies or portfolios.

Figure 4: An example of translating impacts in MSA.km2 into impacts in MSAppb*

	Terrestrial 133 million km²		**Aquatic** 11 million km²	
Impacts in MSA.km² • Not comparable • Cannot be summed	**Static** 100 MSA.km²	**Dynamic** 1 MSA.km²	**Static** 10 MSA.km²	**Dynamic** 0.5 MSA.km²
Impacts in MSAppb • Comparable • Terrestrial and aquatic can be summed	**769 MSAppb**	**8 MSAppb**	**909 MSAppb**	**45 MSAppb**
	Static 1678 MSAppb		**Dynamic** 53 MSAppb	
Impacts in MSAppb* • Comparable • Static and dynamic can be summed	**34 MSAppb***		**53 MSAppb***	
	87 MSAppb*			

8. Marine biodiversity is not currently covered by the BIA-GBS due to lack of scientific data
9. 1 ppb corresponds to one billionth of the surface

Finally, we can divide **the MSAppb* metric by enterprise value** (biodiversity footprint) or **by turnover** (biodiversity intensity), in order to quantify the true impact of a company's activities and value chain on its environment.

In the analysis presented below, **we use the biodiversity intensity metric, which gives us the MSAppb*/b€ of turnover metric**.

MSA scores vary significantly by sector, region, impact scope and pressure

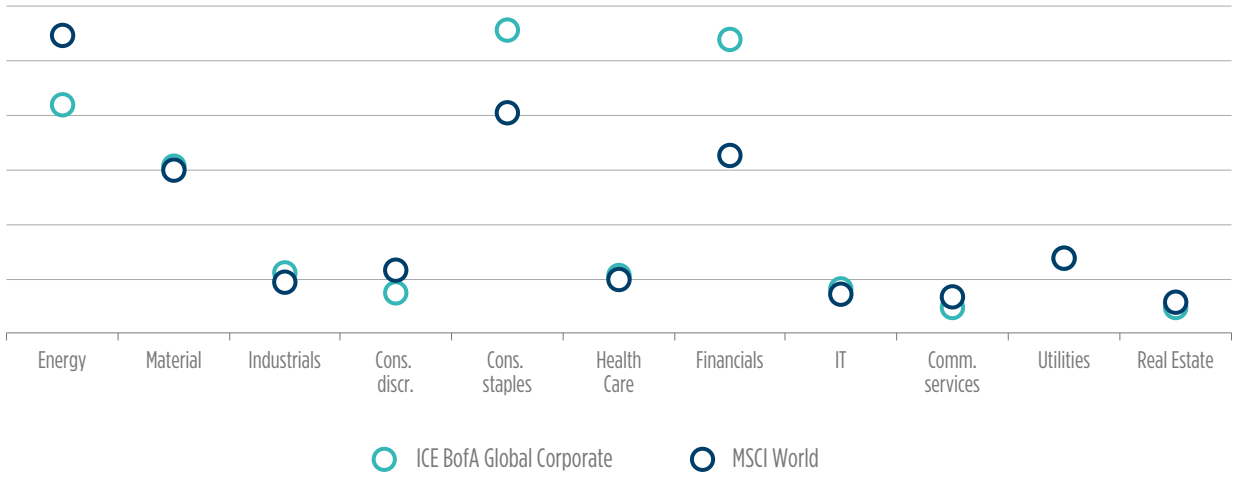
We have chosen in our analysis to use **the biodiversity intensity metric,** obtained by dividing impact value (MSAppb*) by turnover. To allocate a company's impact to a portfolio, this intensity is then multiplied by the amount held in the portfolio. It should be noted that **the lower the MSAppb*/b€, the lower the company's impact on biodiversity.**

MSA Scores by sector

We start our analysis by looking at **MSA score distributions by sector,** across a global credit and a global equity index.

Figure 5: MSA score intensity by sector (MSAppb*/b€ of turnover)

Key takeaway A wide range of MSA scores highlight strong sectoral biases, with relative homogeneity across global equity and credit universes.



Source: BIA-GBS, GBS 1.1.0, August 2023, Carbon 4 Finance.

Note: *All graphs in this analysis take into account MSA Scopes 1, 2 and 3. For more detailed analysis on Scopes, please refer to Figure 9 below.*

While it seems intuitive that the Energy and Consumer Staples sectors have high MSA scores due to the inherent impact of their activities on natural ecosystems, it is less instinctive for the Financials sector.

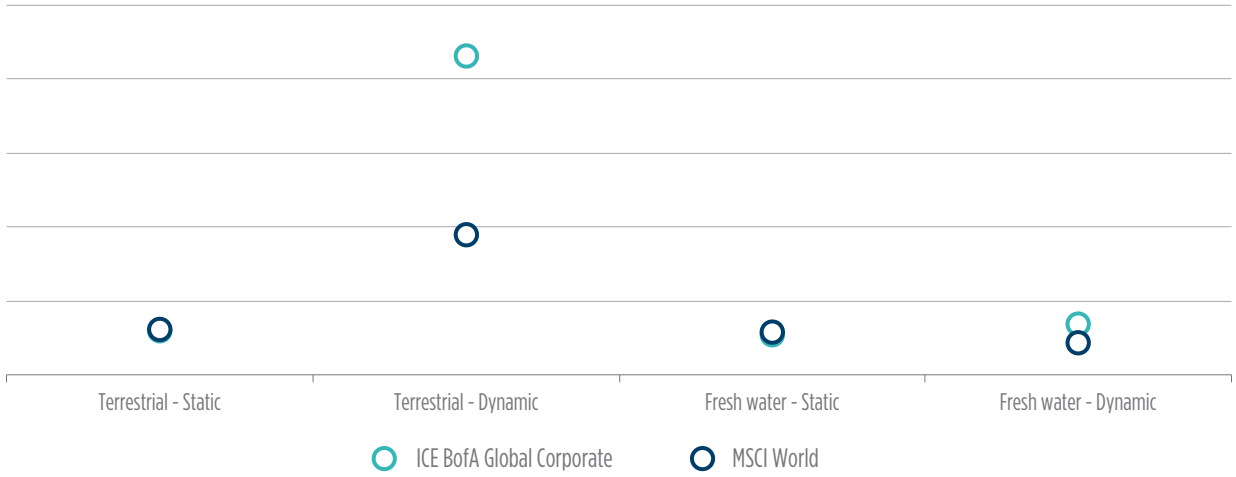
A potential explanation is that, in the computation of MSA intensity for banks and other credit entities, the BIA-GBS model **employs net banking income as the denominator,** which typically registers a lower average compared to the turnover of other corporate entities. As a result, this factor contributes to increasing the MSA intensity observed among companies within the banking sector.

MSA Scores by compartment of impact

Then, looking at compartments of impact (i.e. terrestrial static, terrestrial dynamic, aquatic static, and aquatic dynamic) **can also help us obtain a more comprehensive picture of companies' biodiversity footprint.** Figure 6 below shows MSA intensities by compartment and across two indices: a global corporate index and a global equity index.

Figure 6: MSA score intensity by compartment (MSAppb*/b€ of turnover)

Key takeaway Terrestrial dynamic impacts are the highest, especially in the global credit universe, due to different sector weights.



Source: BIA-GBS, GBS 1.1.0, August 2023, Carbon 4 Finance.

According to Figure 6, the ICE BofA Index has a total biodiversity intensity higher than the one of the MSCI World. **This is due to the significant weighting of Financial sector companies, particularly banks,** which is approximately five times greater than that of the MSCI world. Other sectors with high MSA scores, such as **Energy and Consumer Staples,** also have a higher weighting in the ICE BofA index.

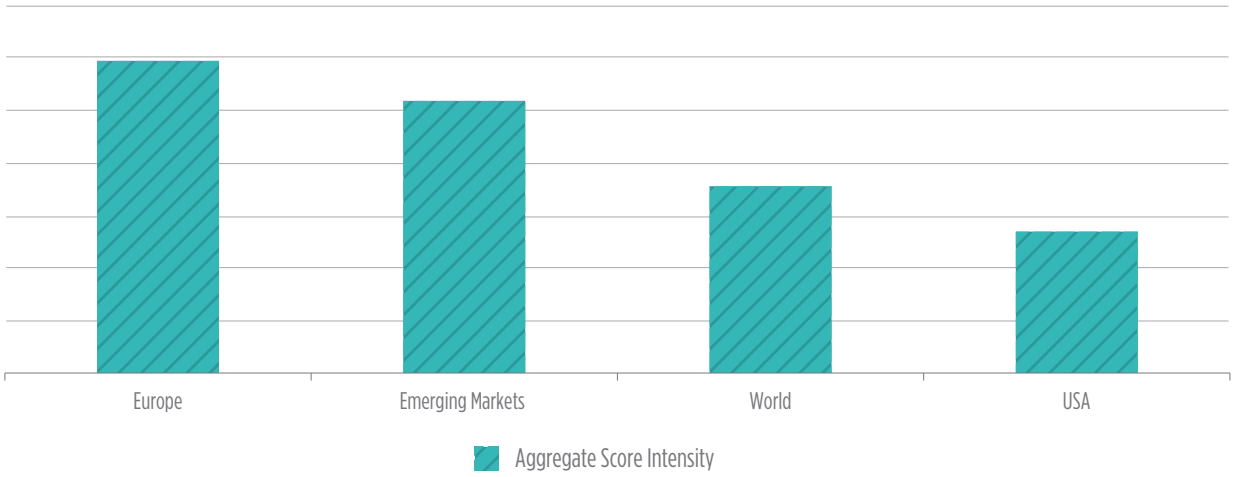
In terms of biodiversity compartments, there is a predominance of the Terrestrial Dynamic compartment's impact for both indices. The Fresh Water Dynamic compartment is the footprint that contributes the least to the total biodiversity footprint for both indexes.

MSA Scores by region

Moreover, biodiversity metrics hinge on the regions considered. To show this, Figure 7 provides a view of aggregated MSA score intensities across several equity indices.

Figure 7: Biodiversity intensities across equity indices (MSAppb*/b€ of turnover)

Key takeaway The biodiversity impact intensity varies across geographies and can be explained by strong sector biases.



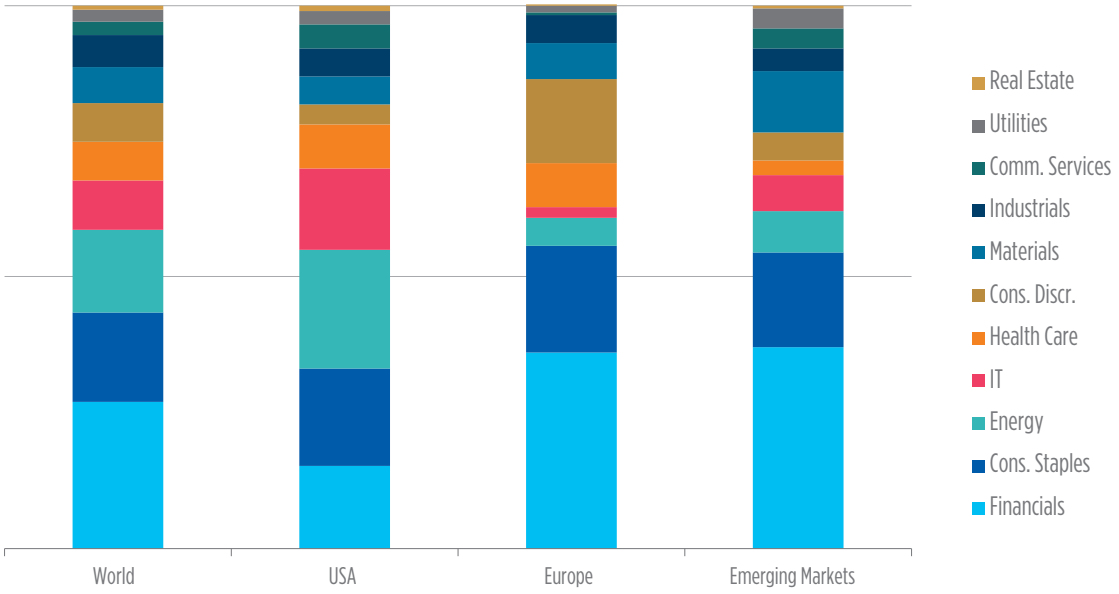
Source: BIA-GBS, GBS 1.1.0, August 2023, Carbon 4 Finance.

One of the reasons why the biodiversity impact intensities of Europe and Emerging Markets equity indices is so high compared to other regions **is the presence of a sector bias.** Indeed, in Europe and EM equity indices, there is a strong presence of companies belonging to sectors with a high biodiversity footprint, such as Consumer Staples, Materials, Energy, Industrials and Financials. The bias in favor of Technology companies in US indices explains the relatively lower aggregated MSA score intensities.

Then, another way to compare the MSA scores across geographies is thus to look at sector scores. Figure 7 below shows the distribution of MSA intensity scores by region and sector of activity.

Figure 8: Distribution of MSA scores across sectors and regions

Key takeaway A sector-based analysis indicates notable biodiversity footprint discrepancies across industries. Financials, Consumer Stapes and Energy have high biodiversity footprints across regions.



Source: BIA-GBS, GBS 1.1.0, August 2023, Carbon 4 Finance.

The graph above gives an overview of the sectors that have the biggest impacts on biodiversity. Some sectors seem to have, across regions, a greater impact on biodiversity than others. **The Financials, Consumer Staples and Energy sectors** contribute to more than half of the biodiversity intensity across indices.

The high intensities within the **Financial sector** mainly stem from banks, whose MSA scores are mechanically increased due to the denominator used to compute biodiversity footprints (net banking income), as explained above.

The **Consumer Staples** sector includes manufacturers and distributors of food, beverages and tobacco, and producers of non-durable household goods and personal products. **This sector contributes greatly to the global biodiversity intensity of each index since it has a high land use in its upstream value chain.**

On the contrary, some sectors, such as **Communication Services, Real Estate or Utilities, do not particularly contribute to the biodiversity impact of the indices.**

MSA Scores by biodiversity impact scope

We can also compare MSA scores across geographies while looking at the scopes considered in the analysis. The concept of scopes allows to consider the impacts of the entire value chain. **Scope 1** refers to biodiversity loss resulting from direct operations. **Scope 2** refers to biodiversity impacts due to energy purchases. Finally, **Scope 3** accounts for impacts due to other purchases (upstream) and to the use and end-of-life of products and services (downstream).

Figure 9: MSA score intensity by region and scope (MSAppb*/b€ of turnover)

Key takeaway Scope 3 biodiversity impacts account for the majority of the total biodiversity footprint, with relative variations by region.

Source: BIA-GBS, GBS 1.1.0, August 2023, Carbon 4 Finance.

It is striking that Scope 3 accounts for the majority of the total biodiversity footprint. This is because a large share of the value of issuers held by these indices comes from companies with manufacturing and processing activities (i.e. secondary sectors). Companies in such sectors do not necessarily impact biodiversity in their production process, but **tend to rely on inputs that themselves exert substantial pressures on biodiversity,** such as land-use pressure. An example would be companies in the pharmaceutical sector whose supply chain heavily depends on the natural world and thus tend to have a high scope 3 MSA intensity, compared to Scopes 1 and 2.

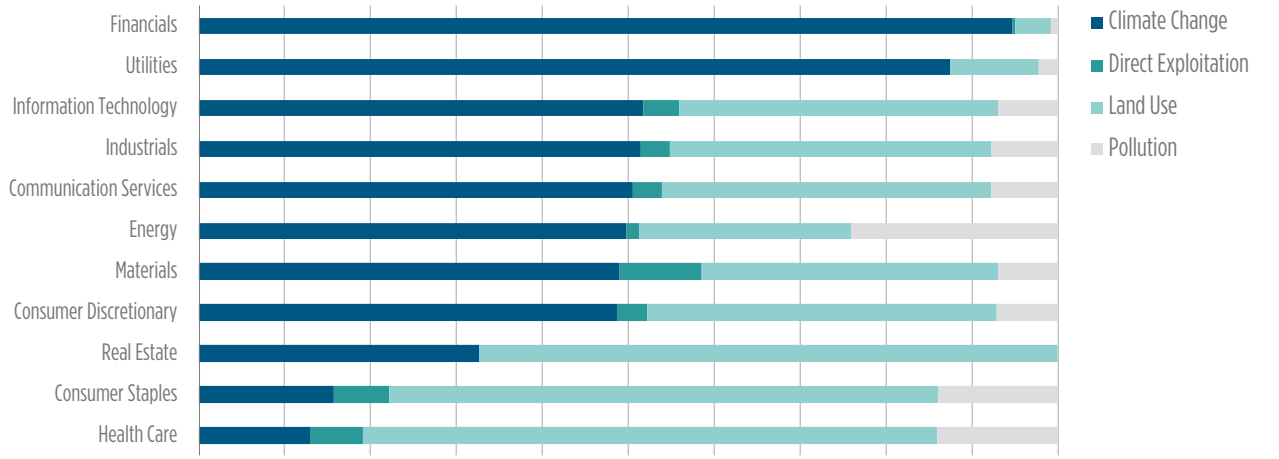
It is therefore crucial to take the full upstream Scope 3 data into account since the highest biodiversity impact often takes place at the beginning of the supply chain.

MSA Scores by pressure

Finally, the impact of an index on nature can also be analyzed through the prism of pressures. **Indeed, the MSA is a metric resulting from the aggregation of all impacts of environmental pressures.** Below, we have chosen to analyze four pressures (among the five IPBES pressures): climate change, land-use change, use and exploitation of natural resources, and pollution[10].

Figure 10: Biodiversity Pressure by Sectors (MSAppb*/b€ of turnover)

Key takeaway Depending on the sector, different pressures contribute to sectors' biodiversity footprints.



Source: BIA-GBS, GBS 1.1.0, August 2023, Carbon 4 Finance.

In Figure 10, we can see the contribution of the four main pressures for each sector of the MSCI World index. **In general, the "Climate change" pressure contributes the most to biodiversity loss.**

However, there are some notable differences between sectors. For instance, for the Consumer Staples and Healthcare sectors, the "land-use change" pressure contributes more heavily to total biodiversity footprint. Companies in such sectors (e.g. food processing) do not necessarily use much land in their production process, but tend to rely on inputs that themselves exert substantial land-use pressures on biodiversity (e.g. crops or cattle). As for the **Energy sector,** the main impact comes from the "climate change" pressure, being a sector that is the biggest contributor to carbon emissions.

10. We have not taken "invasive species" into account in our analysis due to lack of available data

The MSA is a widely used metric to report on biodiversity footprints, but it should be combined with other indicators for a more comprehensive assessment

Going forward, financial institutions and corporates will increasingly have to report on their biodiversity footprints. This is already the case in France for example, where the LEC 29 Law requires asset owners and managers to enhance their disclosure pratices when it comes to biodiversity impacts. As of today, **the MSA is the leading metric for ecosystem condition assessments for French corporates and financial institutions.** Focusing on the latter, they overwhelmingly use the MSA to report against mandatory biodiversity-related disclosures. Indeed, the MSA is used by financial institutions covering the following share of assets under management: 91% for banks, 89% for asset management companies, 79% for insurers[11].

The MSA is also used by several biodiversity measurement tools, covering most business applications and focus areas, such as BIA-GBS and ENCORE[12]. Furthermore, the mean species abundance metric is mentioned in the **Global Reporting Initiative's** Biodiversity Standard, as well as in the **Taskforce for Nature Related Financial Disclosures' (TNFD)** recommendations as an additional disclosure metric, further demonstrating its legitimacy and usefulness to meet disclosure requirements.

While this metric is not flawless and will continue to improve over time, it already possesses **multiple advantages from both a company and investor perspective,** as highlighted in the table below.

Table 2: Strengths and limitations of the MSA

Strengths	Limitations
Summarizing power: • MSA is interesting for aggregating biodiversity footprints caused by different pressures; • Data are available at different geographical and organizational levels; • The metric and model are designed to allow for aggregation from site level to corporate level.	**Missing parts of the model:** • MSA-based approaches do not yet cover the marine environment; • The metric only covers biodiversity at the ecosystem level, but not at the species or gene level. Therefore, the risk of extinction of species or the degradation of the diversity of genes are not accounted for. Other metrics can be used on these levels to complement the MSA; • MSA values are mostly based on global averages, thus, the method does not account for local specificities.
Ease of understanding for non-experts: • The gradual deterioration from a pristine ecosystem to a completely artificialized space is easily understandable for non-experts; • The metric gives a simplified and holistic view of the level of impact of companies on biodiversity.	**Reference in current biodiversity regulatory frameworks:** • The metric is not as well-known as the CO_2e metric in climate investing; therefore accelerating the learning curve of the investment community and the public sector on MSA and on biodiversity impact measurements at large will be a collective challenge.

11. https://climate-transparency-hub.ademe.fr/wp-content/uploads/2023/04/analyse_statistique_article29lec_mars2023_librairie-ademe.pdf
12. ENCORE: Exploring Natural Capital Opportunities, Risks and Exposure

Strengths	Limitations
Useful tool for companies to act on their own activities: • It can provide an early warning signal that can be acted upon by companies; • The absolute MSA.km² figures can be used for internal communication and assessment of the effectiveness of the measures taken by companies and investors to reduce their negative impacts on biodiversity.	**Granularity limits of the model:** • MSA gives an aggregated and holistic view of the impacts on biodiversity but this may be too simplistic to describe the intricate relationships within biodiversity; • Current tools relying on the MSA do not differentiate between active deforestation or deforestation dating from earlier periods; • As all species are weighted equally, if only one species compared to others is drastically decreasing, this may not fully reflect on the MSA score; • MSA involves a comparison with an "undisturbed" ecosystem, which does not capture restoration efforts that are not part of the natural trajectory of an ecosystem.
Credibility for assessment and reporting: • MSA is recognized as a top leading biodiversity metric by many stakeholders and regulators (EU, TCFD, Carbon 4 Finance); • Numerous approaches already rely on this metric (Biodiversity Impact metric, Global Biodiversity Score, Corporate Biodiversity Footprint, Biodiversity Footprint Methodology (BFM)); • It meets the criteria for an appropriate disclosure metric as set out by the TNFD.	**Implementation limits** (for current databases): • For investors only: As of today, most companies do not publish their biodiversity footprint. Current solutions for investors are mainly impacts and dependencies databases. For example, the BIA-GBS database (developed by Carbon 4 Finance and CDC Biodiversité[13]) uses two types of input data: companies' revenue by sectors and countries, and CO_2 emissions. Therefore, companies operating in the same segments and the same countries will be differentiated only by their carbon emissions data.
Flexibility and readiness: • The approach draws on primary data where it's available, but uses credible alternative data sources and assumptions where it is not; • The dataset is ready to use, no additional data collection effort is required.	

Still, as written above, the MSA does not provide a complete picture of companies and financial institutions' biodiversity impacts. For example, it does not tell us much about biodiversity significance, such as the risk of extinction of species, it does not account for protected or key biodiversity areas, and does not cover ecosystem services. **The MSA should thus be complemented with other key indicators and metrics, such as those listed in the TNFD's recommendations published in September 2023.**

The TNFD initiative is considered by many institutions and experts to be a catalyst for market actors to take biodiversity considerations into account. The TNFD framework contains guidance for companies and financial institutions "to develop and deliver a risk management and disclosure framework for organizations to report and act on evolving nature-related risks and opportunities, with the ultimate aim of supporting a shift in global financial flows away from nature-negative outcomes and toward nature-positive outcomes"[14].

The Framework contains a list of core indicators for Nature Exposure that can be monitored by all companies (see Table 3 below). The TNFD recommends that organizations report against all of these global core indicators or provide explanations as to why they have not reported.

13. Biodiversity Impact Analytics powered by the Global Biodiversity Score (BIA-GBS). 15. TNFD, 2023
14. TNFD, 2023

Table 3: TNFD core global disclosure indicators for nature-related dependencies and impacts

Metric number	Driver of nature change	Indicator
	Climate change	Greenhouse gas emissions
C1.0	Land/freshwater/ocean-use change	Total spatial footprint
C1.1	Land/freshwater/ocean-use change	Extent of land/freshwater/ocean-use change
C2.0	Pollution/pollution removal	Pollutants released to soil split by type
C2.1	Pollution/pollution removal	Wastewater discharged
C2.2	Pollution/pollution removal	Wastewater generation and disposal
C2.3	Pollution/pollution removal	Plastic pollution
C2.4	Pollution/pollution removal	Non-GHG air pollutants
C3.0	Resource use/replenishment	Water withdrawal and consumption from areas of water scarcity
C3.1	Resource use/replenishment	Quantity of high-risk natural commodities sourced from land/ocean/freshwater
C4.0	Invasive alien species and other	Measures against unintentional introduction of invasive alien species (IAS)
C5.0	State of nature	Ecosystem condition and Species extinction risk

Source: Taskforce for Nature Related Disclosures (TNFD), 2023.

These core indicators mark a first step for corporate and investor transparency around biodiversity. **In parallel, the TNFD has published reporting recommendations for financial institutions by providing a list of metrics classified by category** (Potential dependency, Potential impact, Physical risk, Transition risk, etc.). These metrics include the **Potentially Disappeared Fraction (PDF), the Biodiversity Intactness Index (BII) or the Species Threat Abatement and Restoration (STAR)** units. More details on these indicators can be found in the Appendix of this paper.

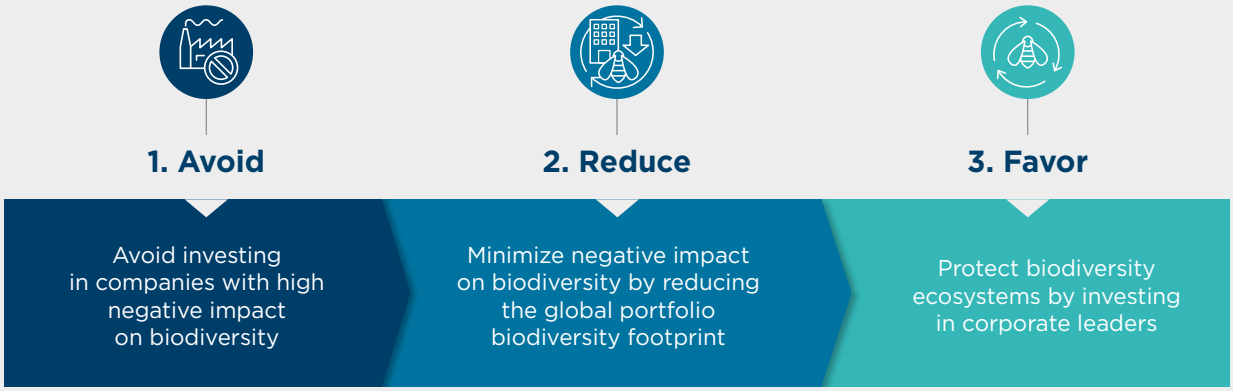
It is worth noting that the use of these indicators in portfolio construction should vary according to which objective(s) the investment strategy is meant to target. Some metrics can be used to exclude worst-performing companies from portfolios (i.e. "Avoid"), to mitigate risk by monitoring the biodiversity footprint of selected companies (i.e. "Reduce"), or to favor certain companies over others in portfolio construction ("Favor") such as "solutions providers".

As an example of integration of these metrics in portfolios, **we provide below an overview of Amundi's biodiversity investment framework.** For more information on our investment approach to biodiversity, please refer to our dedicated Investment Insights paper on the matter.

Focus on: Amundi's Biodiversity Investment Framework

Amundi has developed an investment framework to measure and monitor the impact of investment portfolios on biodiversity. With this framework, our ambition is to develop new thematic investment strategies focusing specifically on biodiversity matters.

Our approach relies on 3 pillars:



As part of the "Reduce" pillar, **we use the MSA to measure the portfolio's biodiversity impact,** with an aim to reduce this footprint over time. We also combine it with an **inhouse biodiversity metric** which allows us to respond to some of the aforementioned limitations of the MSA. Indeed, this proprietary metric uses company-level data (rather than sector-level data), enabling us to have a more granular view on companies' biodiversity footprint. Moreover, the different criteria used in the score are weighted according to their level of materiality within their sector of operation, allowing us to more accurately measure the impact of companies on relevant biodiversity criteria.

Source: Amundi, Integrating biodiversity into portfolios: a bespoke framework.

Conclusion

Biodiversity is becoming a concern for investors. The scale of biodiversity loss is indeed troubling: human activities have significantly diminished the variety of plant and animal species. Addressing the impact of business operations on our natural capital is crucial in resolving this crisis. Moreover, acting in support of biodiversity can also limit the negative effects caused by climate change on our societies[15].

To reduce the impact of businesses on biodiversity, it is important to incentivize companies to limit their environmental footprint. One way to achieve this is using the **Mean Species Abundance (MSA)** metric, which serves as an initial step in measuring and monitoring companies' activities impact on biodiversity. **By employing predefined models, the MSA provides a comprehensive overview of the impact that companies' activities have on biodiversity.**

While specific targets for MSA scores have not yet been established for companies, MSA scores vary across industries and companies. **They are thus useful to understand the multi-faceted facets of corporate biodiversity footprints.** At portfolio level, a better MSA score (i.e. a lower score) would reflect investments in activities with lower negative impact on biodiversity, and it can thus be used in portfolio construction to serve this purpose.

However, the MSA has inherent limits that need to be considered when integrating the metric into investment frameworks. As aforementioned, it relies on biodiversity loss ratios linked to a company's revenue breakdown to determine its score, offering a general indication of its impact without directly taking into account its practices. **Therefore, it is necessary to supplement the MSA with other metrics to ensure a more accurate assessment of companies.** The TNFD has notably provided examples of additional metrics that can be used alongside the MSA.

One of the main challenges faced by financial institutions in evaluating companies' impact on biodiversity is the scarcity of available data. Fortunately, an increasing number of global and national initiatives – such as the French LEC 29 bill – have already recognized the need for mandatory reporting on companies' biodiversity impacts. **It is highly likely that other public authorities will enforce such reporting requirements in the future, greatly facilitating the assessment of companies' impact on biodiversity and thus addressing the challenge of data scarcity.**

All in all, although there is still much work to be done to enhance the reliability and applicability of the MSA metric, **the emergence of biodiversity scores is a positive development for the investment industry,** together with other recent advancements such as the TNFD's recommendations.

15. United Nations, Biodiversity – our strongest natural defense against climate change

Appendix: A comparison of different biodiversity metrics

Potential Dependency

The first thing to do for financial institutions is to assess the overall dependencies of sectors and companies on biodiversity. In particular, it makes it possible to avoid financing sectors considered to have too many dependencies on biodiversity. On the contrary, it can also help to target sectors that have strong dependencies on biodiversity and support companies in these sectors that stand out, in order to help them reduce these dependencies.

Metric	What they measure	Pressure Points	Comments	Investment Strategy
Natural Capital Finance Alliance & The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) **Exploring Natural Capital Opportunities, Risks and Exposure** (ENCORE)	Map that informs users how sectors are dependent upon which biodiversity risk and to which impact drivers these sectors contribute to (loss of biodiversity).	Dependency rather than impact risk: gives an idea of exposure of sectors to natural capital risk. • Biological resource use • Biological interactions • Natural hazards • Climate change impacts	First step for financial institutions to explore natural capital-related risks within their activities and integrate these into risk management processes.	**AVOID**
WWF Biodiversity Filter tool (Scape risk)	WWF BRF employs a risk hierarchy to group indicators in thematically relevant risk categories. 0-5 scale, assessing a specific aspect of biodiversity at a specific site for a specific industry.	Measures Dependencies of companies to risk categories and risk types that align with major frameworks, such as TNFD or SBTN.	Aligned with TNFD and SBTN. Problem of aggregation: to benchmark, one must first determine a method of company-specific risk aggregation and then a method of aggregating group risks.	**REDUCE & AVOID**

Potential Impact

In order to assess the potential impact of companies on biodiversity, financial institutions can rely on footprint metrics. These metrics are based on quantitative models with the aim of converting the environmental pressures exerted by companies on biodiversity (climate change, land transformation, water acidification) into biodiversity metrics. These biodiversity metrics are proving to be more concrete and direct indicators of the impact of companies on biodiversity. However, most companies are currently unable to provide the data needed to implement the models. Existing data is therefore only modelled and does not truly reflect reality, **but it does allow to rank companies within a sector to better direct investments to support biodiversity loss.**

There are currently many models (ENCORE, IBAT, BIM, etc.) that calculate the impact of companies on biodiversity using different metrics (MSA, PDF, STAR) but which sometimes give different results in terms of both content and form. It is therefore necessary for companies and institutions to know what they need to measure, even if it means using several footprint metrics to complete the analysis and obtain a complete assessment of the companies.

Metric	What they measure	Pressure Points	Comments	Investment Strategy
Mean Species Abundance (MSA)	Compares a reference ecosystem with a disturbed one to measure how species are affected	• Climate Change • Land/sea change • Direct exploitation • Pollution	Can be expressed in many ways: • Total MSA.km^2 • Total MSAppb* • MSAppb* by EVIC • MSAppb* by Turnover	**REDUCE & AVOID**
Potentially Disappeared Fraction (PDF)	Rate of species loss due to environmental pressures. A PDF of 0% corresponds to a pristine environment, while 100% represents full disappearance of species.	• Climate change • Freshwater acidification • Marine eutrophication • Marine acidification • Freshwater eutrophication • Terrestrial acidification • Water availability • Freshwater ecotoxicity • Land transformation • Land occupation	PDF and MSA are similar in form, but while PDF computes the number of species disappeared, MSA tries to aggregate the number of species alive or unaffected. Quantitative metrics which can be expressed in two ways: financed absolute biodiversity footprint (loss/km^2/year) or biodiversity intensity per unit of capital employed (MSA per million EUR of capital employed).	**REDUCE & AVOID**
Biodiversity Intactness Index (BII)	Estimated percentage of the original number of species and their abundance that remains in any given area, despite human impacts. Combines satellite imagery, data collected in the field and algorithmic modelling. Assumes values between 0 and 100, where 100 means that the function of an ecosystem is intact, while 0 indicates an ecosystem that is completely depleted.	• Climate change • Land use • Land use intensity • Ecosystems • Species abundance	Highlights local and global trends but does not address specific species losses. The index offers a quick way of assessing the state of biodiversity, and reveal general trends without the need for extensive field work. Derives from two models: 1) How human activity has impacted the total abundance of species in an area 2) Analyses how similar each site's ecological composition is to sites that are undisturbed by human activity.	**FAVOR & AVOID**

Metric	What they measure	Pressure Points	Comments	Investment Strategy
Species Threat Abatement and Restoration (STAR)	STAR estimates the contribution of two kinds of action to reduce species extinction risk – threat abatement and habitat restoration It is based on the IUCN Red List of Threatenend Species. Each species has a global STAR threat-abatement score that varies with species' extinction risk: the higher the extinction risk, the higher the STAR score if the species is preserved. Individual species scores are summed to give the total global STAR threat abatement score in a site, corporate footprint or country. STAR scores range from 0 to 1000 where 0 means species are at a high risk of extinction and urgent action is needed to prevent its decline.	• Species' extinction (IUCN Red list) • contribution of conservation or restoration actions	Makes it possible to identify actions that will yield benefits for threatened species, and enables actors to add up their total contributions to prevent biodiversity loss. Can apply to any location, the method is in the public domain.	**FAVOR**

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