Finance for Biodiversity Foundation

Methodology

Assessmment of the biodiversity impacts and dependencies of globally listed companies

October 2024

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1. Introduction

1.1. Background

Financial institutions are increasingly concerned about the implications of the loss of biodiversity for their investments and their role in contributing to it. Many are now keen to engage with companies with high dependencies and impacts[1] on biodiversity to encourage improved management of their interactions with biodiversity.

Building on the success of Climate Action 100 (CA 100), the Finance for Biodiversity Foundation (FfB Foundation) co-founded the collaborative engagement programme Nature Action 100 (NA 100). NA 100 is an investor-led program that aims to drive greater corporate ambition and action to reverse nature and biodiversity loss. It does this through signatories collaboratively engaging with the companies with the highest biodiversity impacts. The NA 100 now consists of more than 200 investors, representing over US$28 trillion in assets under management, and one hundred companies selected based on different criteria, including FfB Foundation's Pilot Multi-Tool Study (2023).

To facilitate effective interactions between investors and companies, these and other investor engagement initiatives and processes require comprehensive biodiversity impact and dependency data from the companies. This new project aims to fill this gap by offering detailed biodiversity impact and dependency results for the majority of the MSCI All Country World (MSCI ACWI) companies, which captures large and mid-cap representation across 23 developed markets and 24 emerging markets countries, thus covering approximately 85% of the global equity set. Using a footprinting approach, this project delivers biodiversity impact and dependency results at multiple levels, including industry, company, drivers of nature change, scope, and ecosystem services (ES). The data produced will be used by FfB Foundation members for engagement purposes and other nature-related goals.

1.2. Objectives

To perform a full-scale multitool analysis of the biodiversity impacts and dependencies of the MSCI ACWI and NA 100 companies and industries using four main biodiversity footprinting tools. The project aims to deliver key information for more informed and efficient engagement between financial institutions and companies. Additionally, it offers recommendations and methodological insights on measurement, data and other relevant fields.

1.3. This document

This document sets out the methodology of the biodiversity footprint assessment of the MSCI ACWI and NA 100 companies. It explains the methods used to calculate the impact and dependency scores for these companies and industries, as well as the dominant drivers of

[1] Aiming for simplicity and clarity, in this document the term 'Driver' is employed as a synonymous term or representative of the terms direct 'drivers of biodiversity loss' / 'drivers of nature change', while acknowledging the latter covers also positive impacts.

nature loss, scopes and dependencies. Furthermore, the document provides a comprehensive explanation of the limitations of the approach. This document, and the project overall, are intended to align with existing key global initiatives, standards and projects in biodiversity assessment and footprinting, including the European Commissions Align Project, EU Business and Biodiversity (B&B) Platform's measurement guides (for companies and financial institutions), the Taskforce on Nature-related Financial Disclosures (TNFD) footprinting approach, the Partnership for Biodiversity Accounting Financials (PBAF) standard, and the 'Step 1. Assess' of the Science Based Targets Network, among others.

2. Biodiversity footprint tools: an overview

2.1. Introducing the tools

The four tools involved in the assessment are listed in Table 1 below. The table illustrates that the question each tool aims to address and the scope of their analyses vary, revealing distinct nuances in their approaches. It is important to address and control for these variations in the analysis as much as possible. Whie all four tools were used in the assessment of potential impacts across the MSCI ACWI and NA100 lists, dependencies on ES were assessed using only two tools: Corporate Biodiversity Footprint (CBF) and Biodiversity Impact Analytics-Global Biodiversity Score (BIA-GBS).

Table 1. Description of the tools included in the assessment

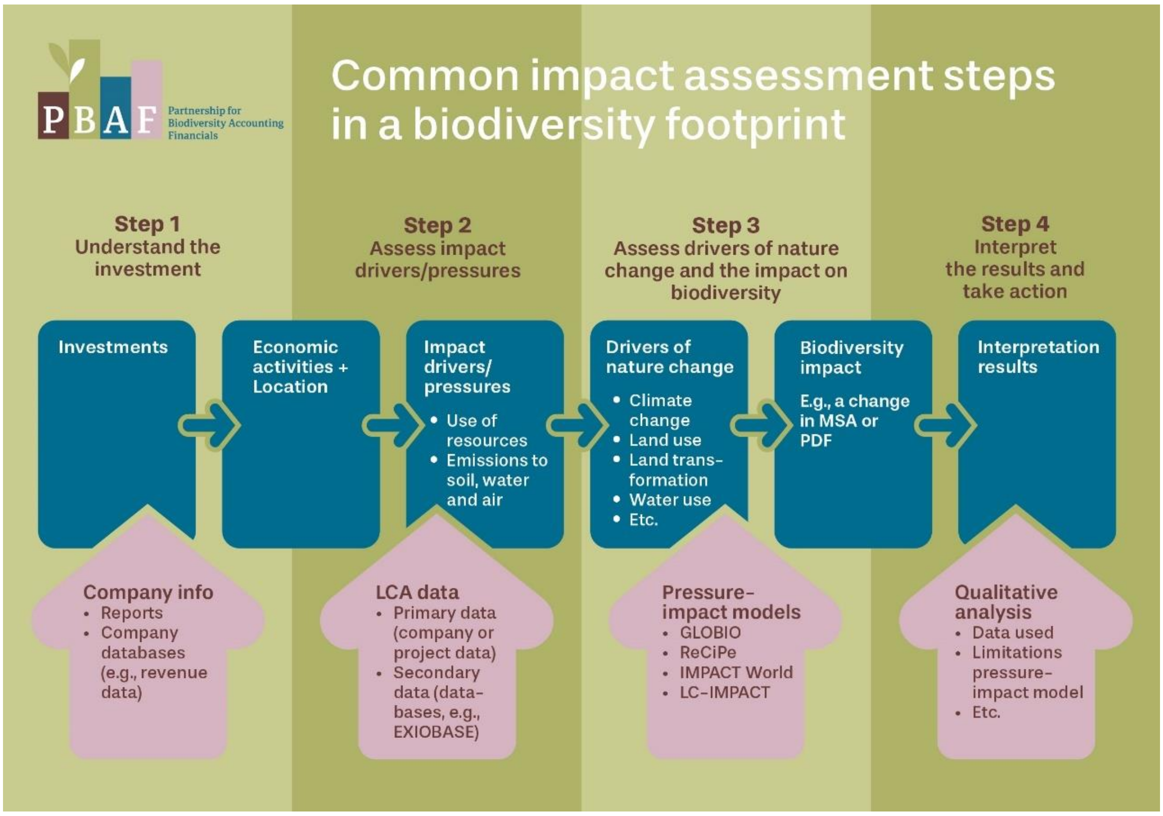
Tool	Organisation	Question the tool strives to answer with its analysis	Involvement in this analysis
Biodiversity Impact Analysis-Global Biodiversity Score (BIA-GBS)	CDC Biodiversité Carbon4Finance	Question addressed: What is the current state of remaining biodiversity and how much damage is being caused during the period assessed? Drivers: Climate change, pollution, land use, resource exploitation (water) Model: GLOBIO v3.6 (adapted), Exiobase v3.8 Scopes: 1 & 2 reported separately; scope 3 up & downstream reported together Time: Static and dynamic footprint Metric: MSA	Impacts and dependencies
Corporate Biodiversity Footprint (CBF)	Iceberg Data Lab	Question addressed: What is the impact on biodiversity that the issuer exerts due to its activities throughout the value chain? Drivers: Climate change, air and water pollution, land use Model: GLOBIO V3 (adapted), Wunderpus improved from Exiobase Scopes: All scopes if material (reported separately) Time: Time integration Metric: km2.MSA.yr	Impacts and dependencies
Biodiversity Footprint for Financial Institutions (BFFI)	PRé Sustainability CREM	Question addressed: What are the current and future impacts of all annual activities of a company and its supply chain on biodiversity? Drivers: Climate change, pollution, land use, resource exploitation (water) Model: ReCiPe 2016, EXIOBASE V3.4 Scopes: Scope 1, 2 and 3 (upstream) (reported together) Time: Time integration Metric: PDF	Impacts
Global Impact Database's Biodiversity Impact Data (GID)	Impact Institute	Question addressed: What biodiversity loss is a company responsible for through its annual activity, including its own operations, up- and downstream value chains? What is the monetary value of this biodiversity impact? Drivers: Climate change, pollution, land use Model: GLOBIO V4 & ReCiPe 2016, Exiobase v 3.4, GTAP, Eora Scopes: Scope 1 and scope 3 downstream reported separately, scope 2 & 3 upstream reported together Time: Time integration Metric: PDF & MSA and EURO	Impacts

All four tools address the impacts on biodiversity at the company level, offering options for aggregation (by industry, industry group, headquarter) and disaggregation (by driver, scope). The tools aim to answer the question "What is the current state of remaining biodiversity and how much damage is being caused during the period assessed?". Moreover, the BIA-GBS and CBF tools also assess dependencies on ES at the company level.

Inevitably, the results of impact assessments performed by the various tools are different. Given the emerging stage of development of such approaches, it is too soon to state that one particular approach is the most appropriate or stronger. Hence, the results of all the tools are taken forward through an average and normalisation process.

Figure 1 provides an overview of the most common steps followed in impact assessments when using a footprinting approach. The first three tools (BFFI, BIA-GBS and CBF) broadly follow this common four-step process, although they use different data sets and models. In contrast, the GID starts with the overall impacts of the economy on biodiversity and apportions impacts to individual companies using various databases, hence it is top-down rather than bottom-up. Furthermore, the GID includes the step of economic valuation of biodiversity impact, through calculating the economic value of the associated loss of ES.

Figure 1. Common impact assessment steps in a biodiversity footprinting (new PBAF Standard, 2024)



2.2. Metrics, models and input data

2.2.1. Metrics

The assessment tools use two main metrics: Mean Species Abundance (MSA – used by CBF and BIA-GBS) and Potentially Disappeared Fraction of species (PDF – used by BFFI). GID combines both metrics in their assessment. MSA estimates biodiversity intactness relative to undisturbed ecosystems. It compares the actual abundance of native species in a given ecosystem to their (estimated) abundance if the ecosystem was in an undisturbed state. Undisturbed ecosystem is understood here as being equivalent to a pristine state, intact and undisturbed by human activity. PDF is another measure of ecosystem quality. It estimates the potential decline in percentage of species richness lost on 1 m^2 (land) or in 1 m^3 (water) over a time period in a specific area due to environmental processes. It does not measure species diversity change or species population change.

2.2.2. Models behind tools

BFFI, BIA-GBS, CBF and GID all draw from underpinning pressure-impact models: ReCiPe and/or GLOBIO (Table 2). Exiobase, while not a pressure-impact model, is a commonly used global input-output environmental database for analysing the links between economic sectors and products with consumption and production processes.

The scope, analysis and underpinning data differ between the models. For instance, there are disparities in how GLOBIO and ReCiPe handle impacts that persist over time. Under a 'time integration' approach, future impacts are treated as if they occur at the time the footprint is undertaken and are included in it. GLOBIO's approach does not differentiate between present and future (or static and dynamic) impacts across time. This necessitates footprinting tools to independently incorporate these time variables (see section 2.3.3).

Table 2. Assessment of models underlying the impact assessment calculation

Model	Purpose	Developers	Model specifications	Tools using the models
GLOBIO	Designed to support policy decisions	Dutch Environmental Agency (PBL) Formerly GRID Arendal and UNEP-WCMC	• Calculates terrestrial biodiversity intactness based on: land use, road disturbance, fragmentation, hunting, nitrogen deposition, climate change • Calculates aquatic biodiversity intactness based on: land use, flow alteration, eutrophication, water temperature • Further models are now available on species • No consideration of time integration but the use of GLOBIO does not prevent from including time integration into footprinting	CBF (v3) BIA-GBS (V3.6) GID (v4)
ReCiPe	Developed for LCA and footprint calculations	National Institute for Public Health and the Environment, PRé,	• 18 midpoint impact categories (global warming, water use, freshwater ecotoxicity, freshwater eutrophication, tropospheric ozone formation, terrestrial ecotoxicity, terrestrial acidification, land	BFFI (2016) GID (2016-0104a)

		Radboud, NTNU-Trondheim. University, Norwegian University of Science and Technology	use/ transformation, marine ecotoxicity, marine eutrophication) ● 3 endpoint impact categories (Ecosystem quality, Damage to human health and Resource scarcity). ● For biodiversity assessment, only impact categories related to the ecosystem quality are considered. ● Includes time integration	
EXIOBASE		EXIOBASE consortium	● Multi-Regional Environmentally Extended Input-Output Table ● Provides detailed information on the flows of goods and services between different industries and regions of the world economy	BIA-GBS CBF BFFI (v3) GID (3.8.2)

Whilst these models form the basis of the assessment (step 2 in Figure 1) they have been tailored and extended by tool developers. For some tools, the models are now quite different from the original base model. It is therefore challenging to attain an understanding of the implications of the use of different versions of the models. A detailed review of the methods adjusted by the tool developers for application in their methodology is too time consuming for this assessment.

More information on each tool can be found in the FfB Foundation's Guide on Biodiversity Measurement Approaches (3rd Edition). Please note that a 4th Edition will be made available during the second half of October 2024.

2.2.3. Input revenue data

Revenue data is one of the main input data types used by the footprinting tools. The environmental impact of the company (and its supply chain) can be calculated based on revenue made in different industries. This data is commonly used by tools to contextualize and apply industry-specific data regarding impacts and dependencies at the company level.

There are several points of potential divergence in the way in which the different tools use company revenue to calculate impacts that could result in different results:

- Different revenue input figures are used, sometimes from different years;
- Different allocation of revenue to countries is made based on which impact is assessed;
- Different allocation of revenue to subindustries is made based on which impact is assessed.

All the four tools use Exiobase[2] (CBF, BIA-GBS, BFFI and GID) to assess the economic and physical outputs of revenues by industry and country. Some tools use additional tools to assist

[2] Exiobase is a global, detailed Multi-Regional Environmentally Extended Supply-Use Table (MR-SUT) and Input-Output Table (MR-IOT). It was developed by harmonizing and detailing supply-use tables for a large number of countries, estimating emissions and resource extractions by industry. Subsequently the country supply-use tables were linked via trade creating an MR-SUT and producing a MR-IOTs from this. The MR-IOT that can be

in this assessment, e.g., GID uses GTAP (Global Trade Analysis Project)[3]. The environmental impact of the company (and its supply chain) can be calculated based on revenue made in different industries.

2.3. Coverage of impacts

2.3.1. Driver coverage across tools

Different tools cover different drivers (see Table 3). Most of them cover the main drivers of biodiversity loss identified by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2019), or the so-called direct drivers of nature change in the Recommendations of the TNFD, i.e., land, water and sea use change; resource use; climate change; pollution; and invasive alien species. However, the sub-drivers included within these high-level categories vary across the tools. For instance, the levels of reporting are detailed to more specific pressure levels in some tools but not others. Furthermore, none of the tools can currently address invasive alien species impacts quantitatively, although some do so qualitatively, and many forms of pollution and resource use (besides water use) are often underestimated by footprinting tools.

Table 3. Coverage of different drivers across the four footprinting tools. Drivers integrated into the methodology and modelling of the tools are marked with (✓), while drivers that can be provided by tools as output results (i.e. the tools can generate scores for these) are marked in light green. Note that this project only provides results for the main drivers of nature loss (dark green).

Drivers	CBF	BFFI	BIA-GBS	GID
Pollution	✓	✓	✓	✓
Terrestrial acidification	✓	✓		✓
Terrestrial eutrophication	✓		✓	
Freshwater eutrophication		✓	✓	✓
Marine eutrophication		✓		✓
Terrestrial ecotoxicity		✓		✓
Freshwater ecotoxicity	✓	✓		✓
Marine ecotoxicity		✓		
Photochemical ozone formation		✓		✓
Solid waste	✓			
Noise, light and disturbance	✓		✓	✓
Climate change	✓	✓	✓	✓
Effects of climate change on freshwater ecosystems		✓		✓
Effects of climate change on terrestrial ecosystems	✓	✓	✓	✓
Effects of climate change on marine ecosystems				
Hydrological disturbance due to climate change			✓	

used for the analysis of the environmental impacts associated with the final consumption of product groups. It includes data for 163 industrial and service sectors across 43 countries (90% of the World's economy) and 5 "rest of the World" regions (10% of the economy).

[3] A global data base describing bilateral trade patterns, production, consumption and intermediate use of commodities and services.

Land use	✓	✓	✓	✓
Land use change/land transformation	✓	✓	✓	
Land occupation	✓	✓	✓	✓
Land use change in river and wetland catchments			✓	
Encroachment	✓		✓	✓
Fragmentation	✓		✓	✓
Wetland conversion			✓	
Resource use		✓	✓	✓
Water use		✓	✓	✓
Other resource use e.g., fish, wild-caught animals/plants				
Others				
Marine use				
Invasive alien species				

It is important to note that there are varying confidence levels in the different sub-drivers as a result of the models used in deriving pressure-state relationships. Climate change models, for example, are inherently more abstracted from on-the-ground impacts than land use; the data behind different drivers varies, where some are based on large well established and maintained databases like PREDICTS (GLOBIO land use); and others are based on meta-analyses of a relatively small number of papers (GLOBIO fragmentation). Although beyond the scope of this study, this should be considered in interpreting the results of these analyses.

2.3.2. Scope coverage across tools

The scope coverage varies across tools. The following are the definitions of the different scopes considered in this study:

- Scope 1: Direct impacts from sources owned or controlled by the company, such as emissions from company-owned vehicles and facilities.
- Scope 2: Indirect impacts from the generation of purchased electricity, heat, or steam consumed by the company.
- Scope 3: All other indirect impacts that occur in the value chain of the company, including those from suppliers, product use, waste disposal, and transportation.

The next figure shows the scope disaggregation for each of the four tools. A relevant aspect regarding the scope coverage is that not all tools integrate all scopes and that some tools aggregate or disaggregate scopes based on their own characteristics. If one tool does not cover one particular scope (e.g., scope 3 downstream by BFFI), or if this tool is not disaggregated at such level of detail (e.g., BFFI for scopes 1, 2 or 3 upstream), that tool is not used for obtaining results at the scope level (e.g., BFFI not considered for generating impact scores disaggregated by scope) and only tools that allow disaggregated scores by scope are considered.

Table 4. Scopes of impact coverage and disaggregation by tool.

Scopes	BIA-GBS	CBF	BFFI	GID
Scope 1 – direct operations	✓	✓		✓
Scope 2 – electricity purchased	✓	✓	✓ [3] (reported together)	✓ (reported together)
Scope 3 – upstream	✓ (reported together) [2]	✓		
Scope 3 – downstream		✓ [1]	-	✓ (not use phase)

(1) For CBF, downstream impacts are calculated for all companies but are only included in the analysis when material. (2) For BIA-GBS, downstream impacts are only addressed climate-change-related drivers based on a proprietary model developed by Carbon4 Finance. For upstream impacts, all drivers are included. (3) BFFI does not disaggregate scopes in their results figures but cover scopes 1, 2 and 3.

2.3.3. Persistence of impacts over time

Different impacts have different lifetimes in the environment. CO_2 emissions, for example, will eventually be absorbed by plants or oceans, whilst land that is converted will eventually become more biodiverse.

The persistence of impacts over time is addressed differently across the tools. The way they are accounted for, either by multiplying the impact by the lifespan (time integration) or by making the distinction between dynamic and static impacts (BIA-GBS), implies different uses. The time horizons of an assessment are often calibrated to the time preference of the user of the tool and the type of financing activities of the client's financial institution. Tools using the PDF metric (i.e., BFFI) and CBF deal with this issue by integrating impacts over time —i.e., treating them as if they happen at one point in time (now) even if they take several years to materialise.

The BIA-GBS does not integrate over time but instead takes the persistence of impacts into account through the distinction between a dynamic and a static footprint. These are defined as follows:

- 'Static footprint' includes all the 'persistent' or 'long-lasting' effects which accumulate over time. These can result from spatial drivers such as land use, fragmentation, and encroachment, be linked to existing facilities and the persistent effect of past emissions or pollutants still impacting biodiversity today e.g., greenhouse gas emissions and water pollution respectively. Static impacts are stocks of (past) accumulated losses.
- 'Dynamic footprint' is the footprint caused by changes in drivers, consumptions or restorations during the period assessed. They are a variation of the stock of impacts during the period assessed.

The importance of accounting static and dynamic impacts separately lies in avoiding double counting. In this regard, the BIA-GBS tool uses the MSAppb metric to aggregate static and dynamic impacts. For both footprints, it is important to note that spatial data is not yet used in the analysis, so the footprint is a global footprint rather than tracking the condition of specific ecosystems in specific locations.

Table 5 describes the treatment of the persistence of impact over time by the different tools. Differences in treatment of time will influence the footprint result. Overall, key areas of divergence in the treatment of time are:

- GID, CBF and BFFI use time integration to quantify future impacts of current emissions (i.e., area under the curve), whereas BIA-GBS quantify past cumulated negative impacts which remain over time and were generated before the period assessed and flows of negative impacts during this period.
- Use of different time periods to calculate persistence of impacts may result in some tools calculating higher figures for a certain driver than others
- The period used to calculate the persistence of impacts over time varies across the tools for air pollution and land use.

Table 5. Treatment of persistence of impacts over time across four impact assessment tools

Driver	BIA-GBS	CBF	BFFI	GID
Pollution				
Air pollution	• Static and dynamic impact: cumulative negative impact stock considered as static impact, and additional impacts occurred during the period of assessment as dynamic impact	• All future impacts of NOx and SOx are factored into the calculation	• From ReCiPe, time integration occurs over the period emission persists • Smog is included. Time horizon is not important, only short-living	• From ReCiPe, time integration occurs over the period emission persists
Water pollution	• Static and dynamic impact (as above)	• All future impacts are factored in	• From ReCiPe, time integration occurs over the period emission persists • Toxicity: 100 years	• From ReCiPe, time integration occurs over the period the emission persists
Climate change				
Climate change	• Only dynamic impact. GHG emissions are accounted for as dynamic impacts on the year they are emitted, and	• GLOBIO damage function (integration of future impacts of current emissions)	• From ReCiPe, time integration over 100 years (GWP100 yr, IPCC)	• From ReCiPe, time integration over 100 years

	as static impacts after the year emission took place	• 100-year time horizon		
Land use				
Land use change and land transformation	• Dynamic impact	• Integration of future impacts due to the time lag for land recovery • The recovery time for forests is assumed to be 73.5 years and for all other ecosystems 33.9 years.	• Time integration over time land takes to recover (recovery time: 33.9 years)	Implicitly included in land occupation
Land occupation	• Static impact • Compare biodiversity on occupied land with pristine ecosystem.	• Time integration used, assumes occupation will prevent land from going back to its previous state*, for 1 year	• Time integration time land is used (here: one year assessment period)	• Biodiversity loss is an ecological opportunity cost for one year of land use. Measure land use est. area needed for one year of economic output.

* Not always compared to going back to natural state. It depends on the activity assessed. E.g., If it is assumed the state before intervention was already degraded, time is not calculated for going back to natural state.

2.3.4. Reference states

Another point of difference between the tools is the ecosystem state that is used as a reference when assessing the impact of land occupation. For example, BIA-GBS compares biodiversity on occupied land with the biodiversity in a pristine ecosystem to calculate the impact of land occupation. In contrast, the reference state used in CBF is case-specific. Suppose it is assumed that the state before intervention was already degraded. In that case, CBF uses this degraded state as a reference and does not consider the recovery time needed for the ecosystem to return to its natural state. On the other hand, in ReCiPE, upon which the BFFI tool is based, the reference state follows the concept of potential natural vegetation (PNV), which describes the expected state of mature vegetation that would develop if all human activities were to be stopped at once. The BFFI takes the current, late-succession habitat stages as reference, which are widely used as target in restoration ecology and serve as a proxy for the PNV. Thus, a site-specific reference situation is considered and impacts are calculated per biogeographic region, and then averaged globally.

2.4. Coverage of dependencies

A company's dependency on ES can give rise to physical risks depending on the company location, level of dependency and the current and future status of the ES. In addition to the physical risks to companies, the decline in ES due to company activities, either directly or through the ecosystems that support them, can also lead to significant impacts and risks for the society.

Currently, assessments provide insight into sector-level potential dependencies on ES, tailoring them to specific companies through understanding the production processes within those companies, the ecosystem dependency profile of those processes and the company revenue attributable to those processes. Assessments tailored for investors are not yet able to relate these potential dependencies to the company location given a lack of company location data. Although it is not possible to get a good understanding of physical risks linked to ES dependencies without understanding company location and the status of the ES in that location, i.e., are they declining or being sustainably used, such assessments can still be used to target industries and companies for engagement to encourage greater disclosure on ES assessments and management.

2.4.1. Ecosystem services coverage across tools

Only two tools routinely assess company dependencies on ES: BIA-GBS and CBF. Both assessments are based on the Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) tool. Dependencies are viewed through the lens of the ES that businesses depend on and adjusted for financial materiality based on the industry's share of financial flows. The coverage of dependencies and the metrics derived from the resulting analysis are similar but different in their detail. For a definition of the ES used in this study, please access the ENCORE definitions or Annex 1 in this report.

Approaches to calculating dependencies differ from one tool to the other in the following ways:

- Coverage of scopes: both tools cover scope 1 and one covers scope 3 (upstream);
- Coverage of ES: one tool also covers cultural services;
- Metrics used: one tool offers critical and average dependency scores, the other average and "at risk". Only the average approach from both tools is used in this study for alignment purposes.

The coverage of these tools of dependencies is included in Table 6 below.

Table 6. Summary of coverage, data source and metrics on dependencies across footprinting tools

Tool	Ecosystem service coverage (CICES)	Data source	Metrics
BIA-GBS	Provisioning and maintenance & regulating Total = 21	• ENCORE • EXIOBASE (for scope 3 calculation only)	• Average dependency (numerical) by scope and ES • Critical dependency (numerical) by scope – proportion of a company's

			activity or value chain critically dependent on at least one ES (i.e. very high materiality)
CBF	Provisioning, maintenance & regulating and cultural Total = 26	• ENCORE • Expert input for cultural services	• Biodiversity dependency score: scores from 0-100 for the three different types of ES and mean average of the three is calculated • High dependency score or dependency at risk released in Q2 2024 and included in this study

The ES considered and analysed in this study are listed in Figure 2.

Figure 2. The typology of ecosystem services used in this study and covered by the footprinting tools

Provisioning

- Animal based energy
- Fibres and other materials
- Genetic materials
- Ground water
- Surface water

Cultural

- Spiritual Experience
- And Sense Of Place
- Information For Cognitive Development
- Inspiration For Culture Art Design
- Recreation And Tourism
- Aesthetic Information

Regulating and maintenance

- Bio-remediation
- Buffering and attenuation of mass flows
- Climate regulation
- Dilution by atmosphere and ecosystem
- Disease control
- Filtration
- Flood and storm protection
- Maintain nursery habitats
- Mass stabilisation and erosion control
- Mediation of sensory impacts
- Pest control
- Pollination
- Soil quality
- Ventilation
- Water flow maintenance
- Water quality

2.4.2. Dependencies scope coverage across tools

The scope coverage varies across tools. Table 7 shows the scope disaggregation for each tool.

Table 7. Scopes of dependency coverage and disaggregation by tool

Scopes	CBF	BIA-GBS
Scope 1	✓	✓
Scope 2 (=electricity purchased)	-	(included in scope 3 upstream)
Scope 3 - upstream	-	✓
Scope 3 - downstream	-	-

2.5. Addressing variations between the tools in the analysis

The differences between the tools outlined above makes it challenging to compare the results. Table 8 outlines these key variations and sets out how they were addressed within the analysis.

Table 8. Key variations across the biodiversity footprinting tools and efforts taken to reduce their impact in the analysis

Area of divergence	Implication	Treatment in analysis
Different tools use different metrics	Challenges in comparing results from different tools	Average normalised impacts and dependencies calculated to enable comparison of results
Different underlying models used	Coverage of drivers and resulting impacts vary	Not possible to reduce the variation
Year and source of Input revenue data varies	Different years of revenue included in the analysis leading to different impact/ dependency scores	Minimise the number of revenue data sets used
Driver coverage varies	Coverage of drivers and resulting impacts vary	Transparency on driver coverage and the number of tools that address each driver
Variation in impact scope	Company results and ranking will be significantly different depending on the inclusion or exclusion of scope 3 results into the analysis	Core analysis based on tools that can disaggregate scopes and transparency on the number of tools in the scope calculation in the results
Persistence of impacts over time treated differently	Footprint results will be influenced by how impacts over time are treated	Average normalised impacts and dependencies calculated to enable comparison of results
Different reference states used	Not clear	Not possible to reduce the variation
ES coverage varies	Coverage of ES and resulting dependency score will be different between different tools	Transparency on ES coverage and the number of tools that address each driver, e.g., cultural services which are only covered by one tool are analysed separately
Variation in scope for ES	Company results and ranking will be significantly different depending on the inclusion or exclusion of scope 3 results into the analysis	Transparency on the number of tools covering each scope for the ES results calculation

Encouraging consistency of treatment of variation or alignment across the different tools will be important to promote tool alignment in the future.

3. Methodology

3.1. Boundaries of the analysis

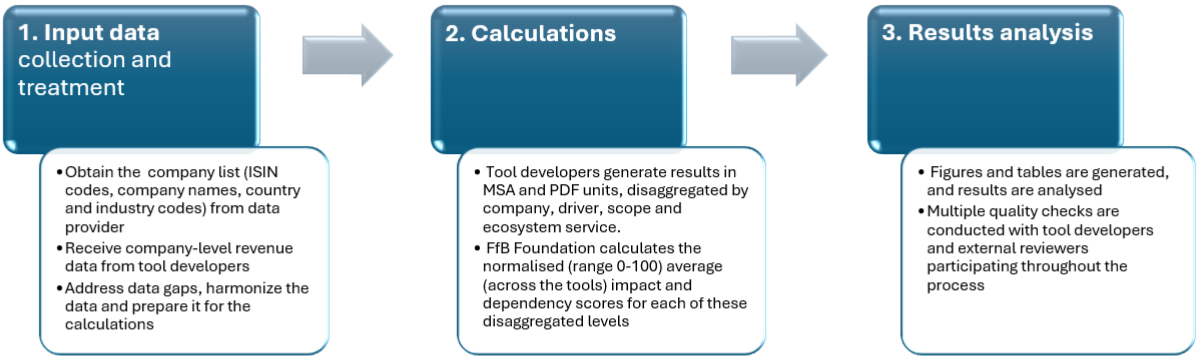
The analysis was undertaken on the MSCI ACWI universe, excluding the finance sector, and ensuring the inclusion of the list of the NA 100 companies. The MSCI ACWI captures large and mid-cap representation across 23 developed market countries and 24 emerging market countries. The index covers approximately 85% of the global investable equity opportunity set, with 2,921 constituents on December 29th, 2023. The finance sector was excluded from the analysis in line with the CA 100+ methodology and the stated purpose of the NA 100 within which the focus is corporate —rather than investor— engagement. As a result, the final number of companies analysed was 2,349.

It is important to note that the primary objective of this study is not to provide a sectoral or company-level MSCI ACWI benchmark. Instead, it uses the MSCI ACWI universe as a representative sample of companies spanning both developing and developed markets.

3.2. Results calculation process

The steps of the analysis are outlined below and represented in Figure 3:

Figure 3. Methodological steps of the study



3.2.1. Input data collection and management

Variation in input data was reduced by standardising: 1) the list of companies assessed, 2) the revenue data associated with those companies as far as possible, and 3) ensuring gaps and duplications in the data were consistently addressed.

Ensuring coverage of the same companies

Tool developers were provided with the MSCI ACWI company list to ensure all were working from the same initial company list. Additional companies were added to this list that were on the NA 100 company list, but not on the MSCI ACWI.

Reducing variation in revenue data

To control for variations in the input revenue data which forms the basis of the footprinting calculation, the approach was to cover as many companies as possible with one data provider and use additional providers to cover the remaining companies. IDL provided revenue data which was then used by IDL, PRé Sustainability and Impact Institute as a basis for their calculations. Comparison of IDL's revenue data with the MSCI ACWI and NA 100 lists showed that some companies were missing. Thus, PRé Sustainability and Impact Institute supplied almost 100 revenues among the missing companies, which were used by them and IDL. CDC Biodiversité and Carbon 4 Finance used their own revenue figures derived from individual company data due to methodological reasons linked to the BIA-GBS computation. Table 9 below sets out the key data providers and tool developers using them.

Table 9. Revenue data coverage by tool developers

Data provider	Number of companies addressed	Proportion of MSCI-ACWI	Used by
IDL	2 369	81.07 %	CBF, BFFI, GID
BIA-GBS	2 369	81.07 %	BIA-GBS
BFFI	55	2,02 %	CBF, BFFI, GID
GID	39	1,33 %	CBF, BFFI, GID

Addressing data gaps and harmonising ISIN and NACE codes

Each security is assigned a unique International Securities Identification Number (ISIN): a 12-digit alphanumeric code. The ISIN identifier was used to link the four ranked MSCI ACWI lists and identify and address gaps and duplications in the data. The following amendments were made to the data:

- Some companies had duplicate ISIN codes representing different equity issuances/stock market listings. This complexity posed challenges in ranking and analysing the datasets. Ensuring that each company was assigned only one ISIN was crucial. Where duplicates were identified, the approach is as follows:
    - Where there is an obvious parent company, the parent company entry is retained and the duplicate is removed.
    - Where the parent company among two companies is unknown, one ISIN number is selected as the parent company following expert opinion and a record of the subsidiary ISIN is retained. In most cases, the parent company selection does not affect results as the revenue value for both cases is the same or very similar.
    - Where two ISIN numbers represent the same company but with different revenues, the revenues and impact figures are summed for the calculation — this case is different from the previous one, where revenue values are the same.
- Different tools used different Nomenclature of Economic Activities (NACE) codes for the same company. A company may encompass multiple NACE codes owing to its involvement in diverse sectors. The applied methodology assigned the Global Industry Classification Standard (GICS) codes (2023 structure) to the companies and the codes were consistently applied across all data sets.

- Some tools held no data for companies identified as potentially having a large biodiversity footprint by others. These companies were retained within the list.
- Those drivers regarding companies not covered by one or more tools are not considered for calculating normalised impact results.

3.2.2. Company-level calculations and considerations

The methodology outlined below initiates with the receipt of data from various footprinting tools. The methods used to generate the data before its consolidation are elaborated upon by the tool developers in their public disclosures. The steps involved in the analysis remained consistent for evaluating both impacts and dependencies.

Calculation of the average normalised impact and dependency scores (AVNI and AVND)

First, each tool developer provides values for each company in the MSCI ACWI constituents and additional NA 100 companies. Impact and dependency data (where produced) were provided as totals, ranked numbers and split by driver, ES and scope and classified by company, ISIN number and GICS industry classification. Second, from the results provided by each tool, normalised absolute values are calculated (scale 0-100) for each company, separately for each tool and in its unit (MSA or PDF), to enable cross-tool comparison and to adjust for the different metrics used. The normalised impact score of company is calculated as follows for each tool, where the impact score of a company is the result of the sum of the footprints of all drivers (e.g., climate change, land use, water use, pollution):

$$\text{Normalised impact of company A} = \frac{\text{Impact score of company A (MSA/PDF)}}{\text{Impact score (MSA/PDF) of company ranked \#1}} \times 100$$

Third, the average normalised impact score is then calculated based on the previously calculated normalised score for each company and the number of tools providing results for the companies (i.e. if one tool does not show results for one company, then that tool is not counted in the formula below).

$$\text{Average normalised impact value (AVNI) of Company A (value between 0 and 100)} = \Sigma \frac{\text{Normalised impact of Company A}}{\text{Number of tools with results for company A}}$$

The resulting score is referred to as 'Average Normalised Impact Score (AVNI)'. The AVNI scores represent **absolute impact values**, i.e., the total impact on biodiversity of each company, regardless of the company size, revenue or other variables. Additionally, absolute values can be converted to **intensity values** by dividing the company's AVNI score by the revenue of that company. Thus:

$$\text{Intensity AVNI of Company A} = \Sigma \frac{\text{Absolute AVNI score of Company A}}{\text{Revenue value of Company A}}$$

The absolute and intensity approaches are used to analyse the results at the company and sectoral levels. Both approaches have their own strengths and are useful depending on the goal and use of the analysis. If the goal is to identify opportunities for targeting highly intense impact companies within a sector or engage with those companies with the highest impact per unit of revenue —regardless of the company size or overall impact on biodiversity— the intensity approach may be more useful. On the other hand, if the goal is to understand and mitigate the total biodiversity impact of a portfolio (i.e., the objective is to reduce the overall footprint of the financial institution's portfolio on biodiversity), the absolute approach might be more appropriate. Using both approaches complementarily can provide a more comprehensive view of biodiversity impact.

Dependency data is normalized (i.e. AVND) using the same steps, except for the final intensity calculation, as dependency scores already represent an intensity value.

Analysing and identifying dominant drivers and dependencies

The approach used calculated:

- Three high-level direct drivers of biodiversity loss or nature change (climate change, land use and pollution) using four tools, and the driver water use using three tools. This level of disaggregation is consistent with current disclosure frameworks, which require the same high-level disclosures and avoids overwhelming investors with technical detail (more detailed pressures, e.g., ecotoxicity, eutrophication). Mention that, for those results disaggregated by scope (e.g., climate change under scope 3), only the tools that provide such disaggregation are considered for calculating the AVNI values. For instance, if one tool covers scope 3 in general (without differentiating between up and downstream) this one is not considered for scope 3 downstream results (or upstream).
- Detailed pressures for the internal document are calculated by the tool/pressure inclusion as shown in Table 3. This enables analysis of alignment across tools and ensures disaggregated results are available should investors wish further detail.

The 10 highest impact and highest dependency companies were identified for each driver and each ES within the scope of the assessment.

Analysing and identifying dominant scopes

Reflecting the different treatment of scopes across the four footprinting tools, the analysis:

- Removed any results from the assessment which could not be disaggregated into different scopes. Pre Sustainability's results were not included in the scope assessment for this reason. Grouping with aligned data resulted in: Scope 1; CBF, BIA-GBS & GID. Scope 2; CBF & BIA-GBS. Scope 3-upstream; CBF. Scope 3-downstream; CBF & GID.
- To allow comparison and aggregation of the results of the tool developers, average normalised scores were calculated for each scope and presented separately.
- Dominant scopes were identified for each company for both the impact and the dependency.

- The ten highest impact and dependency companies were identified at the scope level: while scopes 1, 2 and 3 (upstream and downstream) were used for impacts, scopes 1 and 3 (upstream) were utilised for dependencies.

Quality check

The quality check was based on two actions: first, the tool developers were informed of the companies in the top 250 list that were identified as high impact only by their tool. Companies within the top 80 of one tool and ranked lower than 150 by all other tools (for companies with a combined ranking of 1-150) or lower than 250 by all other tools (for companies with a combined ranking 150-250) were flagged as potential outliers. Second, a check on any extreme values based on the individual drivers, for example if the highest value of a company was five times larger than the second highest. These companies were reviewed by the tool developers.

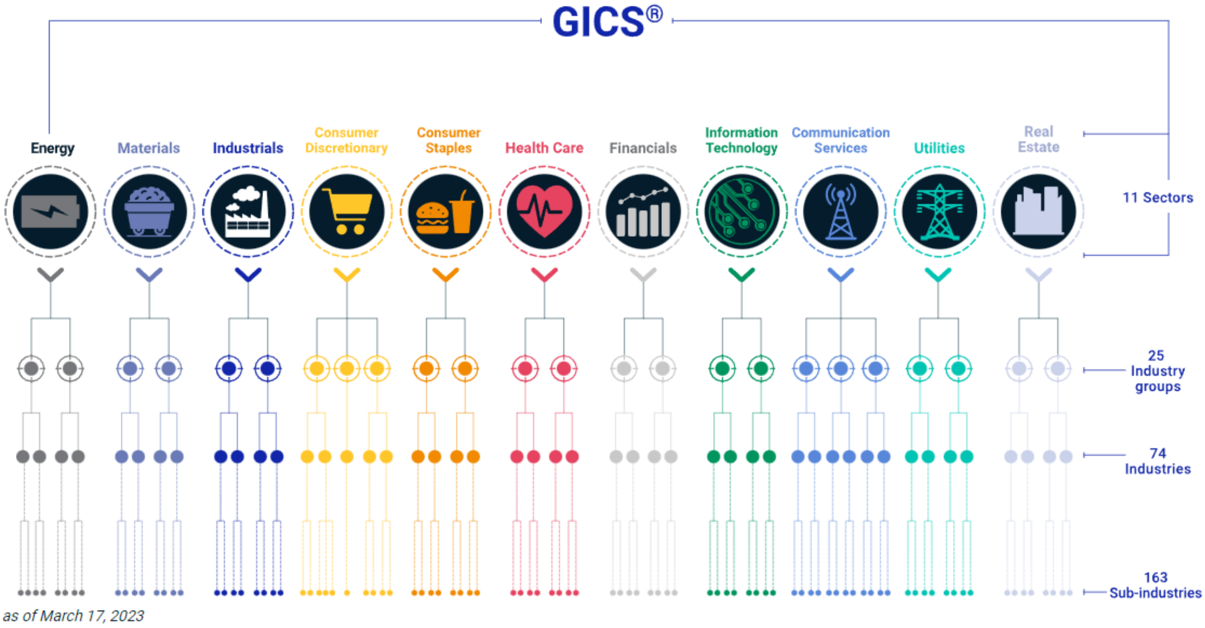
The datasets from the tool developers showed a fair number of duplicates where the revenue data for a particular 'parent' company was the same as one of their 'sub'-company. Where this was the case, the sub-company data was removed from the dataset for that particular tool. The lead company was determined based on a weighting factor provided by MSCI. This method was supported by the tool developers, considering that the sub-company's revenue was already included in the parent company's revenue.

Cultural services are only included for approximately 760, the rest hold no data or show no impact.

3.2.3. Sectoral-level calculations and considerations

The analysis performed uses the GICS® classification, a four-tiered, hierarchical industry classification system (see Figure 4). The classification consists of 11 sectors (GICS Level 1) which are further divided into industry groups (GICS Level 2), industries (GICS Level 3), and sub-industries (GICS Level 4). The equity real estate investment trusts (REITs) and financial sector overall is excluded from the analysis.

Figure 4. GICS levels: sectors, industry groups, industries and sub-industries. Source: MSCI (2023)



For the four tools included in the portfolio level analysis (BFFI, BIA-GBS, CBF and GID), it is useful to know how limitations in the coverage of drivers and scopes might lead to the under or overestimation of the impact of companies in some industries. This analysis based on qualitative expert judgement is shown in Table 10. For more information on the drivers (not) covered by each tool, please see Table 3.

Table 10. Industries identified by developers for which impacts are under or overstated

Tool	Industries
BIA-GBS	• Probably underestimated: Construction, as part of the material flow, is not considered in the evaluation • Underestimated: Chemicals, as ecotoxicity is only covered partially (eutrophication), and downstream (only covered for climate change-related drivers) • Underestimated: Maritime industries (aquaculture, marine shipping, fishing, offshore (deep-sea) drilling and mining offshore renewables, offshore extraction and construction) as impact on marine biodiversity is not covered
CBF	• Underestimated: Maritime industries (aquaculture, marine shipping, fishing, offshore (deep-sea) drilling and mining offshore renewables, offshore extraction and construction), as the impact on marine biodiversity is not covered • Probably underestimated: International transportation, as the impact of invasive species is not covered • Probably overestimated: Paper/forestry companies, due to methodological reasons
BFFI	• Underestimated: Maritime industries (aquaculture, marine shipping, fishing, offshore (deep-sea) drilling and mining offshore renewables, offshore extraction and construction) as impact on marine biodiversity is not covered • Possibly underestimated: Agriculture & chemicals, due to high uncertainties in impact assessment methodologies surrounding the ecotoxicity of pesticides • Probably underestimated: International transportation and other potential sectors, as impact of invasive species is not covered
GID	• Underestimated: Maritime industries (aquaculture, marine shipping, fishing, offshore (deep-sea) drilling and mining offshore renewables, offshore extraction and construction) as impact on marine biodiversity is not covered • Not covered: invasive species, and pesticide use

A review of the industries identified as having a 'very high' materiality rating within the ENCORE tool in 2022 identified additional industries for which potential impacts may be understated as a result of the drivers excluded by the tools. The analysis shown in Table 11 below is high level and indicative only. Detailed analysis of the driver definitions used by ENCORE and the links to the industries could confirm these initial findings.

Feedback from tool developers suggests that companies that have high levels of ecotoxicity may also be underrepresented. This driver was not listed in ENCORE and could not be included in the analysis shown in Table 11.

Table 11. Analysis of ENCORE driver-industry relationships to determine implications of driver exclusion from biodiversity footprinting models

Driver not covered by some/all of the tools	Industries potentially underrepresented (from ENCORE)	Tool might underrepresent these industries for these drivers			
		CBF	BFFI	BIA-GBS	GID
Marine use Area of aquaculture by type, area of seabed mining	Oil and Gas, Agriculture (fisheries), Construction, Marine support services (ports), Marine commercial transportation	✓	✓	✓	✓
Water use Volume of ground or surface water consumed	Mining, Oil and Gas, Manufacturing (particularly glass, paper, steel, plastics), Energy (nuclear), Agriculture	✓			
Disturbance Decibels and duration of noise, lumens and duration of light	Transportation (rail, air, marine), Mining, Oil and Gas, Energy production/transmission, Manufacturing		✓		
Waste Volume of solid waste (non-hazardous, radioactive) and disposal method (note: will be partly covered in pollution)	Manufacturing (pharma, construction, rubber), Oil and Gas, Mining		✓	✓	✓

3.3. Analysing alignment and divergence across tools

Coverage of impactsSections 2.2 and 2.3 have compared the different characteristics across tools for both impacts and dependencies. The following analysis was undertaken to understand the implications of the variability of the tools for the results:

We calculated the top 250 overlap as a measure of the level of variability between the four tools regarding the impact scores for these companies (see Figure 5). This exercise was not performed for dependencies as only two tools were used to calculate dependencies.

The top 250 overlap indicates how many tools (1-4) the company is identified in the top 250 companies with the highest impact scores. Thus, Figure 5 shows the very high (4 tools), high

(3 tools), moderate (2 tools) or low (1 tool) overlap between tools regarding the companies ranked in the top 250, where a very high overlap means that all four tools considered one company to be in the top 250 rank (for all tools). The difference between the two graphs is that the top graph displays the number (or proportion) of companies ranked in the top 250 by 1, 2, 3, or 4 tools, while the bottom graph presents the same data based on revenue percentage.

32% of the companies occurring within the top 250 impacting companies were identified by all four tools and 54% by three tools. In contrast, 22% of the companies were only included in the top 250 by a single tool. The revenue-based analysis (bottom graph) shows a higher alignment between tools, since the 32% of the top 250 companies identified by the four tools cover 54.2% of the total revenue from the top 250 ranking. This figure rises to 72.3% if we consider three out of four tools.

The existing misalignment across tools is anticipated given the differences in the drivers addressed by each tool, the scopes used, and the models applied to calculate and assign biodiversity impact to companies.

Figure 5. Levels of overlap across tools regarding the top 250 companies and their revenue

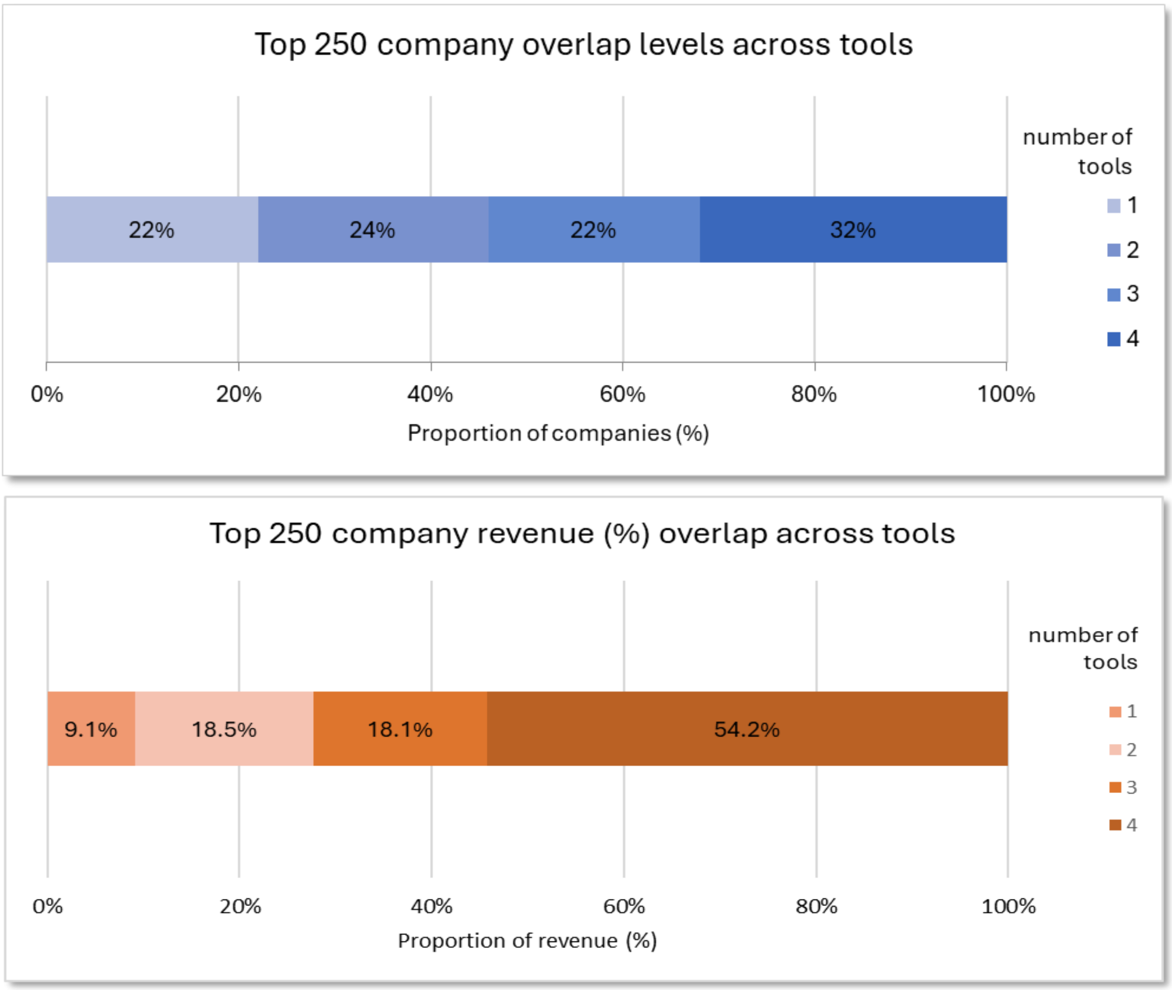


Table 12 shows the alignment and discrepancies across the four tools for both impacts and dependencies. It looks at the industries, top drivers, top ES and the dominant scopes in the 5 highest-ranking companies within each tool.

Table 12. Alignment and discrepancies regarding impacts and dependencies across the four tools

Tool	IMPACTS			DEPENDENCIES		
	Industries from top 5 companies	**Drivers from top 5 companies**	**Dominant scope from top 5 companies**	**Industries from top 5 companies**	**ES from top 5 companies**	**Dominant scope from top 5 companies***
BIA-GBS	Food, beverage & tobacco Energy	Land use Climate change Water use	Scope 3 (upstream) Scope 3 (downstream)	Food, beverage & tobacco	Surface and ground water (prov.) Fibres and other materials (prov.) Erosion control (reg.)	Scope 1 Scope 3 (upstream)
CBF	Consumer Staples Health Care Energy	Land use Pollution Climate change	Scope 3 (upstream) Scope 3 (downstream) Scope 1	Food, beverage & tobacco Materials	Surface and ground water (prov.) Fibres and other materials (prov.) Erosion control (reg.)	Scope 1
BFFI	Utilities Capital goods	Climate change Pollution	No scope disaggregation	-	-	-
GID	Energy Food, beverage & tobacco	Climate change Land use Water use	Scope 1 Scope 3 (downstream) Scope 3 (upstream)	-	-	-

**Note: CBF only covers scope 1 dependencies whilst BIA-GBS covers scopes 1 and 3.*

For impacts there is some alignment on the industries identified in the top 5 companies, greater alignment on the drivers selected (although this is to be expected given the drivers listed are high level), and variation on the scopes that are identified as priorities. This reflects the differences between the underlying models. There is greater alignment for the dependency data, as is expected given that both approaches are based on the ENCORE tool.

3.4. Limitations of the analysis

In reviewing the results, the reader should be aware of the following limitations to the analysis:

1. **Actual versus potential impacts:** Although grounded in widely used, scientifically credible calculation models, biodiversity footprint calculations are largely based upon revenue figures allocated to different geographies and industries which are then used to calculate the modelled impact on biodiversity. The BIA-GBS tool includes actual company impact data for greenhouse gas emissions. However, in most tools, the impact figures are based on companies' potential impact on biodiversity rather than their actual impact on the ground.

2. **Actual versus potential dependencies:** Both tools base their dependency methodologies upon the ENCORE tool which provides a qualitative assessment of the relationship between ES, production processes and industries. These relationships are generic, industry-level relationships. Although ENCORE represents one of the most credible and widely used sources of data on industry dependency, location specific data and analysis is required to provide actual dependency information. Hence, the dependency assessments represent a potential rather than an actual dependency.
3. **Diversity/variety in footprinting methodologies:** Different tools use different base revenue data to feed their models and draw the boundaries of assessments in different ways. For example, some tools cover the value chain (scope 3) while others do not, or some differentiate between scope 3 upstream and downstream while others aggregate both together or do not cover downstream impacts (see Figure 4). Furthermore, tools allocate revenue to industries in different ways and through different models, thus obtaining different impact results. This variability results in different rankings of companies with each tool. In this assessment, this variability was reduced by using a common revenue data set in three of the four tools. The BIA-GBS tool was unable to do so due to the nature of its internal process/model. Significant variation still exists, however, which we address by using average normalised impact scores.
4. **Coverage:** Not all tools address all drivers on biodiversity and different tools address different ES. Footprinting tools are known to under-represent impacts on the marine environment and do not account for impacts of alien invasive species. Furthermore, some do not include resource exploitation (including water use). From a dependency perspective, one tool includes cultural ES, another does not and one covers scope 3 upstream dependencies whilst another does not. This difference may impact the comparison of overall dependency figures between the two tools. We analysed all available scopes and services, indicating the number of tools the results pertain to.
5. **Company representation and coverage:** The MSCI ACWI is an equity index (listed companies), therefore the analysis does not include non-listed companies such as private issuers and smaller cap companies, which also have significant footprints on biodiversity. Additional coverage of these missing target companies is needed to obtain the full spectrum of impacts and dependencies at the global scale.
6. **Industry classification:** There might be some gaps while performing sectoral analysis. For instance, the use of GICS, belonging to MSCI, or another classification, such as NACE, may allocate a company to one sector or another. Furthermore, company allocation also depends on the granularity and classification level used. For example, NACE includes a few levels (i.e., Level 1: 21 sections identified by alphabetical letters A to U; Level 2: 88 divisions identified by two-digit numerical codes (01 to 99); Level 3: 272 groups identified by three-digit numerical codes (01.1 to 99.0)), while the GICS structure comprises 11 sectors, 25 industry groups, 74 industries, and 163 subindustries.

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2020; CDC Biodiversité

Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE)
ENCORE Partnership (Global Canopy, UNEP FI, UNEP-WCMC)

3. Methodology

The Global Industry Classification Standard (GICS®)
MSCI and S&P Dow Jones

Definitions, Acronyms and Abbreviations

Definitions

Average Normalised Impacts: Average scores calculated across all four tools based on a normalised absolute impact value calculated to enable cross-tool comparison and to adjust for the different metrics used. The normalised impact score of company is calculated as:

$$X = \frac{\text{Impact score of company x}}{\text{Impact score of company ranked \#1}} \times 100$$

Average Normalised Dependencies: Average scores calculated across all four tools based on a normalised absolute dependency value calculated to enable cross-tool comparison and to adjust for the different metrics used. The normalised dependency score of company is calculated as:

$$X = \frac{\text{Dependency score of company x}}{\text{Dependency score of company ranked \#1}} \times 100$$

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.

(Convention on Biological Diversity (CBD), Article 2, 1992).

Dependencies: Aspects of environmental assets and ES that a person or an organisation relies on to function. A company's business model, for example, may be dependent on the ES of water flow, water quality regulation and the regulation of hazards like fires and floods; provision of suitable habitat for pollinators, who in turn provide a service directly to economies; and carbon sequestration.

(TNFD, 2023 adapted from SBTN, 2023 SBTN Glossary of Terms)

Drivers of biodiversity loss / Drivers of nature change: Human activities that directly and indirectly change the state of the environment. The five main direct drivers of nature change referred by the TNFD correspond to the drivers of biodiversity loss as outlined by IPBES. These are land and sea use change, direct exploitation of resources, climate change, pollution, and invasion of alien species.

(Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) IPBES Glossary; Taskforce on Nature-related Financial Disclosures (TNFD), TNFD Glossary – Recommendations of the TNFD).

Note: Aiming for simplicity and clarity, in this document the term 'Driver' is employed as a synonymous term or representative of the drivers of biodiversity loss or drivers of nature change, acknowledging that the latter incorporates considers impacts.

Ecosystem services: The contributions of ecosystems to the benefits that are used in economic and other human activity.

(TNFD, 2023 from United Nations et al (2021) System of Environmental-Economic Accounting – Ecosystem Accounting)

Footprinting: Measurement of the quantified impact of a portfolio, asset class or company measured in terms of biodiversity change as a result of production and consumption of particular goods and services.

(PBAF 2022, PBAF Standard V2)

Impact and dependency scope levels:

Scope 1: Refers to all direct impacts on biodiversity.

Scope 2: Refers to indirect biodiversity impacts from consumption of purchased electricity, heat or steam.

Scope 3: refers to other indirect impacts on biodiversity not covered in Scope 2 that occur in the value chain of the reporting company, including both upstream and downstream impacts. Scope 3 impacts could include the extraction and production of purchased materials, outsourced activities).

(Adapted from TCFD Glossary, 2021)

Driver: See the term 'Drivers of biodiversity loss / Drivers of nature change'.

Nature: The natural world, with an emphasis on the diversity of living organisms (including people) and their interactions among themselves and with their environment.

(Adapted from Díaz, S et al (2015) The IPBES Conceptual Framework – Connecting Nature and People).

Note: Although the broader concept of nature could be appropriate in many contexts and sections of this document, we specifically use and focus on the term biodiversity to align with footprinting tools, which adopt a biodiversity approach rather than one based on nature or natural capital.

Nature Action 100: Global investor engagement initiative focused on driving greater corporate ambition and action to reverse nature and biodiversity loss

Tool developers: Entities involved in the development and implementation of biodiversity footprinting tools.

(Finance for Biodiversity Foundation, 2024)

Acronyms and Abbreviations

AVNI: Average Normalised Impacts

AVND: Average Normalised Dependencies

BFFI: Biodiversity Footprint for Financial Institutions

BIA-GBS: Biodiversity Impact Analytics powered by the Global Biodiversity Score,

CBF: Corporate Biodiversity Footprint

FfB: Finance for Biodiversity Foundation

FfB members: Signatories of the FfB Pledge that are members of the FfB Foundation and committed to sharing knowledge and best practices and collaborating on biodiversity via the FfB working groups

Finance for Biodiversity Foundation

FfB Pledge: Financial institutions that have signed the Finance for Biodiversity Pledge and are committed to sharing knowledge and best practices, engaging with companies, assessing impact, setting targets, and disclosing publicly before 2025

GICS: Global Industry Classification Standard

GID: Global Impact Database

IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

MSCI ACWI: Morgan Standley Capital International All Country World Index

NACE: Nomenclature of Economic Activities

NA 100: Nature Action 100 (see 'Definitions')

PBAF: Partnership Biodiversity Accounting Financials

TNFD: Task Force on Nature-related Financial Disclosures

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Contributing authors to the methodology document

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- Mark Wildschut, Wildcap

Tool developers

The biodiversity footprint tools used in this study and the companies that own them are:

- CDC Biodiversité and Carbon4 Finance – Biodiversity Impact Analytics powered by the Global Biodiversity Score, BIA-GBS
- Iceberg Data Lab – Corporate Biodiversity Footprint, CBF
- PRé Sustainability and CREM – Biodiversity Footprint for Financial Institutions, BFFI
- Impact Institute – Global Impact Database, GID

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Annex: Ecosystem service definitions

The following table presents, in alphabetical order, the definitions of the 26 ecosystem services discussed in this study. These definitions were sourced from ENCORE, which uses a simplified interpretation of the CICES framework, and were also provided by the FfB Foundation Secretariat team for cultural ecosystem services

Table 13. List of ecosystem services assessed in this study

Ecosystem service	Overview
Aesthetic information	This service encompasses the appreciation of the beauty and appearance of natural landscapes, which contributes to the mental and emotional well-being of individuals. It involves the visual enjoyment of landscapes, seascapes, and other natural features that people find attractive or inspiring
Animal-based energy	Physical labour is provided by domesticated or commercial species, including oxen, horses, donkeys, goats and elephants. These can be grouped as draught animals, pack animals and mounts
Bio-remediation	Bio-remediation is a natural process whereby living organisms such as micro-organisms, plants, algae, and some animals degrade, reduce, and/or detoxify contaminants.
Buffering and attenuation of mass flows	Buffering and attenuation of mass flows allows the transport and storage of sediment by rivers, lakes and seas.
Climate regulation	Global climate regulation is provided by nature through the long-term storage of carbon dioxide in soils, vegetable biomass, and the oceans. At a regional level, the climate is regulated by ocean currents and winds while, at local and micro-levels, vegetation can modify temperatures, humidity, and wind speeds.
Dilution by atmosphere and ecosystems	Water, both fresh and saline, and the atmosphere can dilute the gases, fluids and solid waste produced by human activity
Disease control	Ecosystems play important roles in regulation of diseases for human populations as well as for wild and domesticated flora and fauna.
Fibres and other materials	Fibres and other materials from plants, algae and animals are directly used or processed for a variety of purposes. This includes wood, timber, and fibres which are not further processed, as well as material for production, such as cellulose, cotton, and dyes, and plant, animal and algal material for fodder and fertiliser use.
Filtration	Filtering, sequestering, storing, and accumulating pollutants is carried out by a range of organisms including, algae, animals, microorganisms and vascular and non-vascular plants.
Flood and storm protection	Flood and storm protection is provided by the sheltering, buffering and attenuating effects of natural and planted vegetation.
Genetic materials	Genetic material is understood to be deoxyribonucleic acid (DNA) and all biota including plants, animals and algae.
Ground water	Groundwater is water stored underground in aquifers made of permeable rocks, soil and sand. The water that contributes to groundwater sources originates from rainfall, snow melts and water flow from natural freshwater resources.

Information for cognitive development	This refers to the contributions of ecosystems to education and learning. Natural environments serve as resources for formal and informal education, providing opportunities for scientific research and cognitive development through direct interaction with nature
Inspiration for culture, art and design	Ecosystems provide inspiration for cultural expressions, including art, folklore, national symbols, and design. This service captures the role of nature in inspiring creative works and cultural practices, which are essential components of human culture
Maintain nursery habitats	Nurseries are habitats that make a significantly high contribution to the reproduction of individuals from a particular species, where juveniles occur at higher densities, avoid predation more successfully, or grow faster than in other habitats.
Mass stabilisation and erosion control	Mass stabilisation and erosion control is delivered through vegetation cover protected and stabilising terrestrial, coastal and marine ecosystems, coastal wetlands and dunes. Vegetation on slopes also prevents avalanches and landslides, and mangroves, sea grass and macroalgae provide erosion protection of coasts and sediments.
Mediation of sensory impacts	Vegetation is the main (natural) barrier used to reduce noise and light pollution, limiting the impact it can have on human health and the environment.
Pest control	Pest control and invasive alien species management is provided through direct introduction and maintenance of populations of the predators of the pest or the invasive species, landscaping areas to encourage habitats for pest reduction, and the manufacture of a family of natural biocides based on natural toxins to pests.
Pollination	Pollination services are provided by three main mechanisms: animals, water and wind. The majority of plants depend to some extent on animals that act as vectors, or pollinators, to perform the transfer of pollen.
Recreation and tourism	This service includes the benefits people derive from recreational activities and tourism in natural environments. It encompasses activities like hiking, birdwatching, and visiting parks and natural reserves, which contribute to physical health, relaxation, and social well-being
Soil quality	Soil quality is provided through weathering processes, which maintain bio-geochemical conditions of soils including fertility and soil structure, and decomposition and fixing processes, which enables nitrogen fixing, nitrification and mineralisation of dead organic material.
Spiritual experiences and sense of place	Ecosystems contribute to spiritual enrichment and provide a sense of place. This service involves the use of natural sites for religious and spiritual activities, and the deep emotional connection people have with certain landscapes or ecosystems that are integral to their cultural identity and heritage
Surface water	Surface water is provided through freshwater resources from collected precipitation and water flow from natural sources.
Ventilation	Ventilation provided by natural or planted vegetation is vital for good indoor air quality and without it there are long term health implications for building occupants due to the build-up of volatile organic compounds (VOCs), airborne bacteria and moulds.

Water flow maintenance	The hydrological cycle, also called water cycle or hydrologic cycle, is the system that enables circulation of water through the Earth's atmosphere, land, and oceans. The hydrological cycle is responsible for recharge of groundwater sources (i.e. aquifers) and maintenance of surface water flows.
Water quality	Water quality is provided by maintaining the chemical condition of freshwaters, including rivers, streams, lakes, and ground water sources, and salt waters to ensure favourable living conditions for biota

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