



TACKLING BIODIVERSITY RISKS

A BIODIVERSITY RISK ASSESSMENT GUIDE FOR
COMPANIES AND FINANCIAL INSTITUTIONS

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About WWF

WWF is one of the world's largest and most experienced independent conservation organisations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.



About Climate & Company

Climate & Company is one of Europe's leading sustainable finance think-tanks. We are a group of mission-driven experts on climate and biodiversity finance and policy from key EU institutions, the academic world and the banking and investment sectors. As a team, we make sustainable development a reality by acting as bridge-builders between the private and public sectors, supporting evidence-based policy-making, and creating international partnerships and fora for international knowledge exchange.

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LIST OF ABBREVIATIONS

BIA-GBS	Biodiversity Impact Analytics powered by the Global Biodiversity Score
BIAT	Biodiversity Impact Assessment Tool
BII	British International Investment
BRF	Biodiversity Risk Filter
CBD	Convention on Biological Diversity
CBF	Corporate Biodiversity Footprint
CSRD	Corporate Sustainability Reporting Directive
DEG	German Development Finance Institution
EFRAG	European Financial Reporting Advisory Group
ENCORE	Exploring Natural Capital Opportunities, Risk and Exposure
ESG	Environmental, Social and Governance
ESRS	European Sustainability Reporting Standards
EU	European Union
FTSE 100 index	Financial Times Stock Exchange 100 index
GBF	Global Biodiversity Framework
GBS	Global Biodiversity Score
GBSFI	Global Biodiversity Score for Financial Institutions
IBAT	Integrated Biodiversity Assessment Tool
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPSF	International Platform on Sustainable Finance
IUCN	International Union for Conservation of Nature
MSCI ACWI	Morgan Stanley Capital International All Country World Index
NGFS	Network for Greening the Financial System
PRI	Principles for Responsible Investment
SBTN	Science-based Targets Network
SFI	Spatial Finance Initiative
TCFD	Task Force on Climate-related Financial Disclosures
TNFD	Taskforce on Nature-related Financial Disclosures
TNFD-LEAP	TNFD's Locate, Evaluate, Assess, Prepare approach
UNEP FI	United Nations Environment Programme Finance Initiative
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
WEF	World Economic Forum
WRF	Water Risk Filter

FOREWORD

WWF GERMANY AND WWF SWITZERLAND



Christoph Heinrich

Our global economy depends on nature. According to the World Economic Forum, more than 50 per cent of global GDP is moderately or highly dependent on nature and its services. This means that the biodiversity crisis is not only an environmental issue but also an economic and social one. Yet, biodiversity is declining at an unprecedented rate, with ecosystem services on the verge of collapse in one-fifth of countries.

There is a growing acknowledgement in corporate boardrooms today that nature and the economy are inextricably linked. As a result, understanding and managing corporate impacts and dependencies on nature is increasingly becoming a priority for companies and financial institutions. Both corporate and financial actors are working to meet growing expectations to assess, disclose and address their impacts and dependencies on nature, for example, through establishing Science-based Targets for Nature or engaging in the Taskforce on Nature-related Financial Disclosures framework. That expectation is also enshrined in the new Kunming-Montreal Agreement, which adopts a new 2030 mission “To take urgent action to halt and reverse biodiversity loss to put nature on a path to recovery for the benefit of people and the planet”.

To fully integrate nature-related dependencies and impacts and the resulting risks and opportunities into economic decision-making, companies and financial institutions need to understand the location-specific context in which they operate. This will enable them to manage these risks and opportunities and support an economic shift towards nature-positive outcomes.

To help companies and financial institutions to begin to understand their biodiversity-related risks, WWF has developed a groundbreaking, freely available online tool: the WWF Biodiversity Risk Filter. This new biodiversity risk assessment tool builds on WWF’s leading water risk assessment tool - the WWF Water Risk Filter – and combines information on the locations of a company’s operations and those of its supply chain with critical data on biodiversity and other relevant indicators at those locations, coming from over 50 biodiversity-relevant global data sets. Both tools are available through the WWF Risk Filter Suite. In addition, WWF and Climate & Company developed specific methodological guidance for financial institutions to address their specific needs when assessing biodiversity risks.

This report presents a case study on how the WWF Biodiversity Risk Filter, with the support of the methodological guidance, can be applied to a representative investor portfolio of listed companies. The case study demonstrates how the WWF Biodiversity Risk Filter can add value to companies and financial institutions as a tool for risk hotspot identification and prioritizing areas for action. It also shows that the location-specific information needed for companies and financial institutions to assess biodiversity risk is indeed already available. There is no reason to leave biodiversity risks unaddressed.

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FOREWORD

CLIMATE & COMPANY



Ingmar Juergens

The world is facing an unprecedented crisis: the loss of biodiversity, nature and ecosystems. The consequences are far-reaching and devastating. From the extinction of species to the disruption of entire ecosystems, the effects of this crisis are being felt around the world. The loss of nature has a direct impact on human health and well-being, as well as on the health of our planet. With the loss of species comes the loss of essential services that ecosystems provide to humanity. These services provide society with benefits like clean air and water, food production, disease control and climate regulation. A reduction in ecosystem services can have serious negative impacts on human well-being and on economic production and activity. In light of this existential threat, it is essential for companies and financial institutions to understand the material importance of biodiversity and ecosystem services.

Supported by pioneering work from central banks, civil society and science, governments and regulators have been becoming increasingly aware of the risks of nature and biodiversity loss. Dynamically evolving regulatory frameworks are making these risks increasingly material for companies and their investors. The forthcoming European Sustainability Reporting Standards will require accurate nature risk reporting for over fifty thousand companies in the EU. Most recently, Target 15 of the Global Biodiversity Framework adopted at the UN’s Convention on Biodiversity’s 15th conference of the parties in Montreal asks companies and financial institutions to “regularly monitor, assess, and transparently disclose their risks, dependencies and impacts on biodiversity”. Such firm commitments and associated legal requirements will guide our economies’ sustainable transition and facilitate the shifting of financial resources.

Investors aware of the real exposure of their assets to biodiversity risk will be in the position to re-allocate funds towards less risky and more sustainable assets. This, however, requires the ability to evaluate biodiversity risk for companies and individual assets at their specific locations. Until now, many conversations around managing such risks have been characterised by concerns about insufficient data and understanding, hampering this type of analysis.

The Biodiversity Risk Filter fills an important knowledge gap by developing a tool and underlying methodology to help companies and financial institutions measure and act on biodiversity risk. Climate & Company is proud to have contributed by developing methodological guidance, especially for financial institutions, to make the assessment work at scale. The resulting case study shows that in principle, a nature-related risk assessment is possible using existing data solutions, even for broad market portfolios. The Biodiversity Risk Filter tool and related methodological guidance allows companies and financial institutions to globally evaluate heterogeneous biodiversity risks across all industries. By understanding the economic importance of biodiversity, nature and ecosystems, companies and financial institutions can make informed decisions that will increase incentives for companies to take action against the destruction of ecosystems, to protect the environment and to ensure their long-term economic viability.

Ingmar Juergens
CEO and Co-Founder - Climate & Company

KEY TERMS

Term	Definition
Abiotic	A non-living part of an ecosystem that shapes its environment. In a terrestrial ecosystem, examples include temperature, light and water. In a marine ecosystem, abiotic factors include salinity and ocean currents. Abiotic and biotic factors work together to create the overall ecosystem (National Geographic, 2022).
Biodiversity	The variability among living organisms from all sources, including, among other things, 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 (CBD, 1992). In other words, biodiversity is the part of nature that is alive, and includes every living thing on earth (see also the definition of nature, below).
Biodiversity footprint	The impact of a commodity or company on global biodiversity, measured in terms of biodiversity change as a result of production and consumption of particular goods and services.
Biodiversity loss	The reduction or disappearance of any aspect of biological diversity in a particular area through death (including extinction), destruction or manual removal. It can refer to many scales, from local population declines to global extinctions, resulting in reduced total diversity at the same scale (IPBES, 2022a).
Biodiversity-related opportunities	Activities that create positive outcomes for organisations and biodiversity by avoiding or reducing impacts on biodiversity or by contributing to its restoration. Biodiversity-related opportunities can go beyond common sustainable business archetypes to include actions that companies can take to influence the threats and pressures driving biodiversity loss and degradation globally, both within their value chains and in the places where they operate (WWF, 2022a).
Biodiversity-related risks	Potential threats posed to an organisation linked to its and other organisations' impacts on biodiversity and dependencies on ecosystems. These can derive from physical, transition and systemic risks.
Biotic	A living organism that shapes its environment. In a freshwater ecosystem, examples include aquatic plants, fish, amphibians and algae. In a terrestrial ecosystem, examples include terrestrial plants, fungi, insects, amphibians and mammals. Biotic and abiotic factors work together to create the overall ecosystem (National Geographic, 2022).
Business importance of site	The economic importance of a specific company location (i.e., site) in relation to the overall company performance. The business importance of a site can be determined on the basis of financial variables, such as revenues or sales, or on the basis of expert opinion.
Dependencies on biodiversity	Aspects of ecosystem services that an organisation or other actor relies on to function. An organisation might be dependent upon an ecosystem's regulation of water flow and quality, the resilience it provides against hazards like fires and floods, the pollination of crops it enables by providing a suitable habitat for pollinators, or its provision of timber or fibres. ¹
Direct drivers of biodiversity and ecosystem change	Drivers, both natural and human-induced, that unequivocally affect biodiversity, ecosystems and nature directly (also referred to as pressures). These drivers in turn affect the provision of ecosystem services with consequences for people, the economy and society. The main direct drivers of biodiversity and ecosystems loss are land, water and sea change, climate change, pollution, natural resource use and exploitation and invasive species (IPBES, 2022b).
Ecosystem	A dynamic complex of plant, animal and microorganism communities and their non-living environment, interacting as a functional unit (CBD, 1992; IPBES, 2019a).
Ecosystem condition	The quality of an ecosystem measured by its abiotic and biotic characteristics. Condition is assessed by an ecosystem's composition, structure and function which, in turn, underpins the ecological integrity of the ecosystem and supports its capacity to supply ecosystem services (TNFD, 2022a).
Ecosystem function	The flow of energy and materials through the biotic and abiotic components of an ecosystem. This includes processes such as biomass production, trophic transfer through plants and animals, nutrient cycling, water dynamics and heat transfer (IPBES, 2019a).

Term	Definition
Ecosystem (Biodiversity) integrity	The ability of an ecosystem to support and maintain ecological processes and a diverse community of organisms. The ecological integrity of ecosystems, as it is also known, is measured as the degree to which a diverse community of native organisms is maintained, and is used as a proxy for ecological resilience, or the capacity of an ecosystem to adapt in the face of stressors while maintaining its functions and services of interest (IPBES, 2022a).
Ecosystem services	<p>The contributions of ecosystems to the benefits that are used in economic and other human activity (UN , 2021). TNFD (2022c) defines ecosystem services as falling into one or more of the following categories:</p> <ul style="list-style-type: none"> Provisioning services represent the contributions to benefits that are extracted or harvested from ecosystems (e.g., timber and fuel wood from a forest, fresh water from a river). Regulating and maintenance services result from the ability of ecosystems to regulate biological processes and to influence climate, hydrological and biochemical cycles, and thereby maintain environmental conditions beneficial to individuals and society. Provisioning services are dependent on these regulating and maintenance services (e.g., the provision of crops depends upon relatively stable climate, hydrological and biochemical cycles). Cultural services are the experiential and intangible services related to the perceived or actual qualities of ecosystems whose existence and functioning contributes to a range of cultural benefits (e.g., the recreational value of a forest or a coral reef for tourism).
Impacts on biodiversity	Changes in the state of nature which may result in changes to the capacity of nature to provide social and economic functions. Impacts can be positive or negative. They can be the result of an organisation's or another party's actions and can be direct, indirect or cumulative (TNFD, 2022a).
Materiality	A concept that defines why and how certain issues are important for a company or industry sector. A material issue can have a major impact on the financial, economic, reputational or legal aspects of a company, as well as on the system of internal and external stakeholders of that company. Although the concept applies in a wide variety of contexts (e.g., accounting, reporting, etc.), in this report materiality refers to biodiversity and water aspects affecting the financial performance of companies ("outside-in") and how they and their activities impact biodiversity and nature ("inside-out") (TNFD, 2022c; IPSF; Climate & Company, 2021).
Nature	The natural world, with an emphasis on the diversity of living organisms (including people) and their interactions among themselves and with their environment (TNFD, 2022a). In other words, nature is all life on Earth (i.e., biodiversity), together with the geology, water, climate and all other inanimate components that comprise our planet (see also the definition of biodiversity, above).
Natural capital	The stock of renewable and non-renewable natural resources (e.g., plants, animals, air, water, soils and minerals) that combine to yield a flow of benefits to people (Capitals Coalition, 2016).
Nature loss	The loss and/or decline of the state of nature. This includes, but is not limited to, the reduction of any aspect of biological diversity, e.g., diversity at the genetic, species and ecosystem levels in a particular area through death (including extinction), destruction or manual removal (TNFD, 2022a).
Nature-related opportunities	Activities that create positive outcomes for organisations and nature by avoiding or reducing impacts on nature or by contributing to its restoration. Nature-related opportunities can occur i) when organisations mitigate the risk of natural capital and ecosystem service loss and ii) through strategic transformation of business models, products, services or investments that actively works to halt or reverse the loss of nature, including by the implementation of nature-based solutions (or support for them through financing or insurance) (TNFD, 2022a).
Nature-related risks	Potential threats posed to an organisation linked to its and other organisations' impacts and dependencies on nature. These can derive from physical, transition and systemic risks (TNFD, 2022a).
Scape risk	The term scape is used to refer collectively to landscapes, seascapes and river basins (freshwater systems). Scape risk is informed by a company's geographic location, it's industry sector and the integrity of biodiversity and ecosystems at the geographic location.

1 INTRODUCTION

BOX 1: BIODIVERSITY AND NATURE - CLOSE, BUT NOT QUITE THE SAME

BIODIVERSITY

According to the officially adopted definition by the Convention on Biological Diversity, biodiversity is

“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.”

In other words, biodiversity is the part of nature that is alive, and includes every living thing on Earth.

Source: (CBD, 2022)

NATURE

Nature is all the existing systems created at the same time as the Earth, all the features, forces and processes, such as the weather, the sea and mountains.

In other words, nature is all life on Earth (i.e., biodiversity), together with the geology, water, climate, and all other inanimate components that comprise our planet.

Source: (CBD, 2022)

1.1 BIODIVERSITY AND ITS MATERIALITY

Biodiversity is the natural variety of life on earth. It is the plants, animals and ecosystems that support the functioning of ecosystem services on which human wellbeing depends.

Biodiversity, through the ecosystem services it supports, provides us with the food we eat and the clothes we wear, it filters the water we drink and the air we breathe, it offers resilience to and protection from natural disasters and climate change and it provides the natural spaces to live in and enjoy (NCSA and UNEP-WCMC, 2018). Biodiversity enables nature to be productive, resilient and adaptive. Just as diversity within a portfolio of financial assets reduces risk and uncertainty, diversity in a portfolio of natural assets increases their resilience to shocks and reduces the risks to ecosystem services (Dasgupta, 2021).

Biodiversity and nature are the foundation of the global economy. The World Economic Forum (WEF, 2020) estimated that more than half of annual global GDP, or US\$44 trillion, is highly or moderately dependent on nature and the ecosystem services it provides. The UN Environment Programme Finance Initiative (UNEP FI, 2018) found that 13 of the 18 sectors that comprise the FTSE 100 equity index are associated with production processes with high or very high material dependence on nature. Biodiversity and nature are essential to the global economy and to the livelihoods that it enables.

However, humanity's unsustainable interactions with nature are causing a dangerous and unprecedented decline of biodiversity. The scientific evidence is clear. Through land and sea use change, overexploitation, pollution, climate change and invasive alien species – the five direct drivers of biodiversity loss – humanity's impacts on nature are overwhelmingly negative (IPBES, 2022b). Around 75 per cent of the land surface area has been dramatically altered by human activity, 66 per cent of the world's oceans are significantly impacted and 85 per cent of wetlands have been lost due to human intervention (WWF, 2022b; IPBES, 2019a). According to WWF's latest *Living Planet Report*, monitored vertebrate wildlife populations have decreased by an average of 69 per cent between 1970 and 2018 (WWF, 2022b). IPBES (2019a) estimates that up to one million species are at risk of extinction by the end of this century, if business-as-usual continues.

Global actors are waking up to the risks biodiversity loss poses to the global economy and human wellbeing. Since 2009, when the issue was first cited as a global risk in WEF's annual *Global Risk Report*, its perceived significance has been steadily increasing (WEF, 2009-2022). Biodiversity loss has ranked among the top 10 long-term global risks since 2016, with potential adverse implications for financial stability (WEF, 2016-2022). Several institutions, such as the Network of Central Banks and Supervisors for Greening the Financial System (NGFS, 2022), the UN-backed Principles for Responsible Investment (UN PRI, 2020) and Finance Watch (2019), describe biodiversity loss as a systemic risk to the global economy. They recommend that central banks integrate biodiversity into risk management, assess the financial risks associated with biodiversity loss and explore actions to halt the destruction of biodiversity (NGFS, 2022). One measure of the risk suggests that, if we continue with business as usual, the continued degradation of biodiversity would result in economic losses of at least US\$479 billion each year until 2050 (Roxburgh, et al., 2020).²

Biodiversity loss is becoming an increasingly important issue on the national and international policy agenda. There is a growing consensus among global leaders that there is not only a need to halt the ongoing destruction of biodiversity, but also to shift our economy towards one that halts and reverses biodiversity loss. UN CBD Kunming-Montreal Global Biodiversity Framework (GBF) targets the reduction of threats to biodiversity, meeting people's needs through sustainable use and benefit-sharing and the implementation of tools and solutions for implementation and mainstreaming of biodiversity. It emphasises the role of the private sector in implementing and mainstreaming global biodiversity conservation by "regularly monitoring, assessing and transparently disclosing their risks, dependencies and impacts on biodiversity including with requirements for all large as well as transnational companies and financial institutions along their operations, supply and value chains and portfolios". Additionally, it stresses the progressive alignment of all financial flows with the goals and targets of the GBF (CBD, 2022b). These goals will raise the profile of biodiversity as an issue, and likely lead to binding commitments and regulations at the national level (e.g., as outlined in the Biodiversity and Farm to Fork strategies of the EU Green Deal, which, for example, plan stricter limits to pesticide use (European Commission, 2020b)). Ultimately, this might further increase regulatory pressure on companies and financial institutions operating in the signatory countries.

1.2 BIODIVERSITY AS A MATERIAL ECONOMIC AND FINANCIAL RISK

Macroeconomic and systemic risks from biodiversity loss emerge from the bottom up: there is an increasing recognition that biodiversity loss poses direct risks to individual companies. Companies depend on and impact nature through their operational activities and supply chains. All companies depend on nature, be it for direct inputs to produce goods (e.g., water or fibres), for business-enabling ecosystem services such as pollination, water regulation or soil fertility, or indirectly through the dependencies along their supply chains (Banque de France, 2021). Conversely, companies also impact nature in places where they operate through direct or indirect overexploitation, pollution, land and sea use change (including the conversion, degradation and modification of ecosystems) etc., as well as through the upstream and downstream activities in their supply chains. The impacts of biodiversity loss can be extensive and often go unnoticed for long periods of time, causing disruptions to supply chains, increasing regulatory compliance costs and potentially eroding companies' social license to operate. For example, 78 per cent of humanity's major food crops, accounting for around 35 per cent of global food production, depends on animal pollination (Klein, et al., 2007). Soil degradation, which affects 61-73 per cent of agricultural soils in the EU, is also having a negative impact on food production. Erosion alone already causes losses of almost 3 million tonnes of wheat and 0.6 million tonnes of maize per year in the EU (IEEP, 2022). Research by IPBES (2019a) also shows that of the 18 ecosystem services studied, more than three-quarters have deteriorated significantly in the last 50 years. The loss of biodiversity is not only a potential future risk but is already impacting business today. In Germany, the floods during summer of 2021 were even more devastating partially because natural protection mechanisms like trees have been widely removed to make way for agriculture. This has impacted businesses throughout the area (Euractiv, 2021).

Financial institutions are also exposed to biodiversity-related risks through their investments, financing and underwriting. Any loss of biodiversity, and therefore reduction in nature's capacity to provide ecosystem services, may have negative financial implications for financial institutions, whether in the form of insurance claims, investment losses or an inability to recoup loans. A landmark study by De Nederlandsche Bank, the Dutch central bank, and PBL Netherlands Environmental Assessment Agency (2020) found that the Dutch financial sector has an exposure of €510 billion to companies with high or very high dependence on one or more ecosystem services, equal to 36 per cent of the value of the portfolios examined. Similar conclusions were drawn by the French central bank (Banque de France, 2021) and the Malaysian central bank (Bank Negara Malaysia, 2022). They concluded that 42 per cent and 54 per cent respectively of the value of securities held by French and Malaysian financial institutions were issued by companies that are highly or very highly dependent on one or more ecosystem services.

Global financial institutions acknowledge the importance of limiting the negative impacts of their investments, financing and underwriting business and to proactively manage biodiversity-related risks. For example, 111 financial institutions with €16.3 trillion of assets under management have signed the Finance for Biodiversity Pledge, which commits the signatories to protect and restore biodiversity through their investment and financing activities (Finance for Biodiversity Pledge, 2022). Numerous financial institutions from around the world have joined the Taskforce on Nature-related Financial Disclosures (TNFD), which is working to develop and deliver a nature-related risk management and disclosure framework for companies and financial institutions.

The increasing awareness among governments, regulators, central banks, consumers and sector peers that biodiversity loss poses a direct threat to individual companies, financial institutions and financial stability, along with the global target of transitioning toward an economy that halts and reverses biodiversity loss, is pushing companies and financial institutions to integrate biodiversity-related risks into mainstream risk management and financial decision making.

1.3 THE AIM AND MAIN OUTPUTS OF THE WWF BIODIVERSITY RISK FILTER

Understanding and addressing biodiversity-related risks and opportunities is vital for companies and financial institutions. However, it is challenging, as location-specific data is necessary. As the importance and state of biodiversity integrity can vary across the location of company sites, the assessment of biodiversity-related risks, response options and progress need to be location-specific as well (SBTN, 2022b; TNFD, 2022d). Without location-specific biodiversity information (i.e., data on the importance and integrity of biodiversity) and company data (i.e., coordinates of a company’s operational sites), it is difficult for companies and financial institutions to fully understand their biodiversity-related risks and prioritise where they should be acting to reduce their greatest risks and to provide benefits to biodiversity and nature. Such an analysis requires a tool that can process relevant and available spatially explicit biodiversity data and link it to the company locations.

Responding to this need, WWF has launched the Biodiversity Risk Filter (BRF). The WWF BRF is a free-of charge, web-based, spatially explicit corporate- and portfolio-level screening and prioritisation tool for biodiversity-related risks. It comes with a methodological guidance to support companies and financial institutions in tackling the first steps on their biodiversity stewardship journey.

The development of the WWF BRF tool builds heavily on WWF’s experience with the Water Risk Filter (WRF), launched in 2012 (see Box 2). In essence, both tools are designed to be used by companies and financial institutions for company- and portfolio-level screening and prioritisation, to identify risk hotspots across companies’ operational locations and supply chain locations. By using spatially explicit data on biodiversity and freshwater at global scale, the tools provide location-specific and industry-specific assessments of biodiversity and water-related physical, regulatory³ and reputational risks. The tools aim to help companies and financial institutions to better prioritise where and on what to focus contextual responses as well as inform their biodiversity and water-related stewardship strategies and target setting.

The current version of the WWF BRF tool consists of three key modules: the Inform Module, which provides an overview of the industry-specific dependencies and impacts on biodiversity; the Explore Module, which is a collection of spatially explicit maps of the importance and local integrity of biodiversity; and the Assess Module, which contains a tailored physical and reputational risk assessment for which users need to input location-specific company and/or supply chain data.⁴ A fourth module, the Respond Module, is currently under development. This will support users in identifying suitable actions to respond to the identified risks. In addition, it will include guidance on where to get more specific information on biodiversity values in a particular identified high-risk site, via complementary tools such as the Integrated Biodiversity Assessment Tool (IBAT)⁵ (see Figure 1).

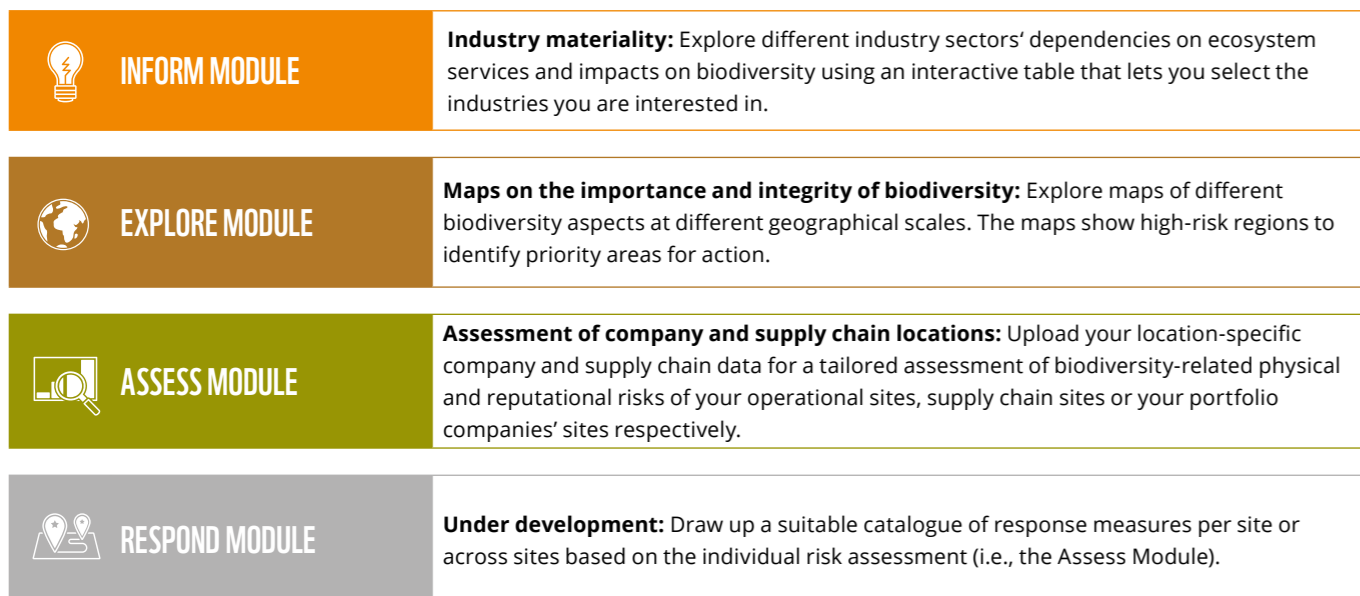


Figure 1: The four modules of the WWF BRF tool

The WWF BRF and WRF are distinct but complementary tools. The WWF BRF tool covers broad aspects of biodiversity (e.g., freshwater, marine, forest, grasslands, wetlands) and includes some specific indicators from the WWF WRF (e.g., water scarcity, water quality, fragmentation status of rivers). While the WWF BRF tool provides general high-level assessment of biodiversity-related risks, the WWF WRF provides a more in-depth assessment of water-related risks (including operational risk assessment, higher resolution datasets and scenario risk assessment) as well as water stewardship-focused recommendations (WWF Water Risk Filter, 2021). The tools are intended to be complementary and offer unique features for assessing and responding to biodiversity- and water-related risks and opportunities.

Both tools are available through the WWF Risk Filter Suite.⁶ This integrated platform has a common user database. That means that users only need to enter the required location-specific company data once and can manage both tools in one central location.

The WWF BRF Methodology Documentation describes the underlying methodology of the Inform, Explore and Assess Modules that have already been integrated in the WWF BRF tool, including a description of the risk assessment framework, underlying structure, data and limitations. In addition, it includes three guidance chapters developed by WWF and Climate & Company that have not been included in the WWF BRF tool at this point: Guidance A, B and C. Guidance A and B provide support for companies and financial institutions on collecting the required input data for the WWF BRF and WRF Assess Modules. Guidance A supports financial institutions with collecting location-specific proxy data on companies’ operational sites. Guidance B supports companies and financial institutions with collecting location-specific proxy data on supply chains. Guidance C, on the other hand, provides support for financial institutions on how the location-specific output data from the WWF BRF and WRF Assess Modules can be further processed and aggregated to the company and portfolio level (see Figure 2).

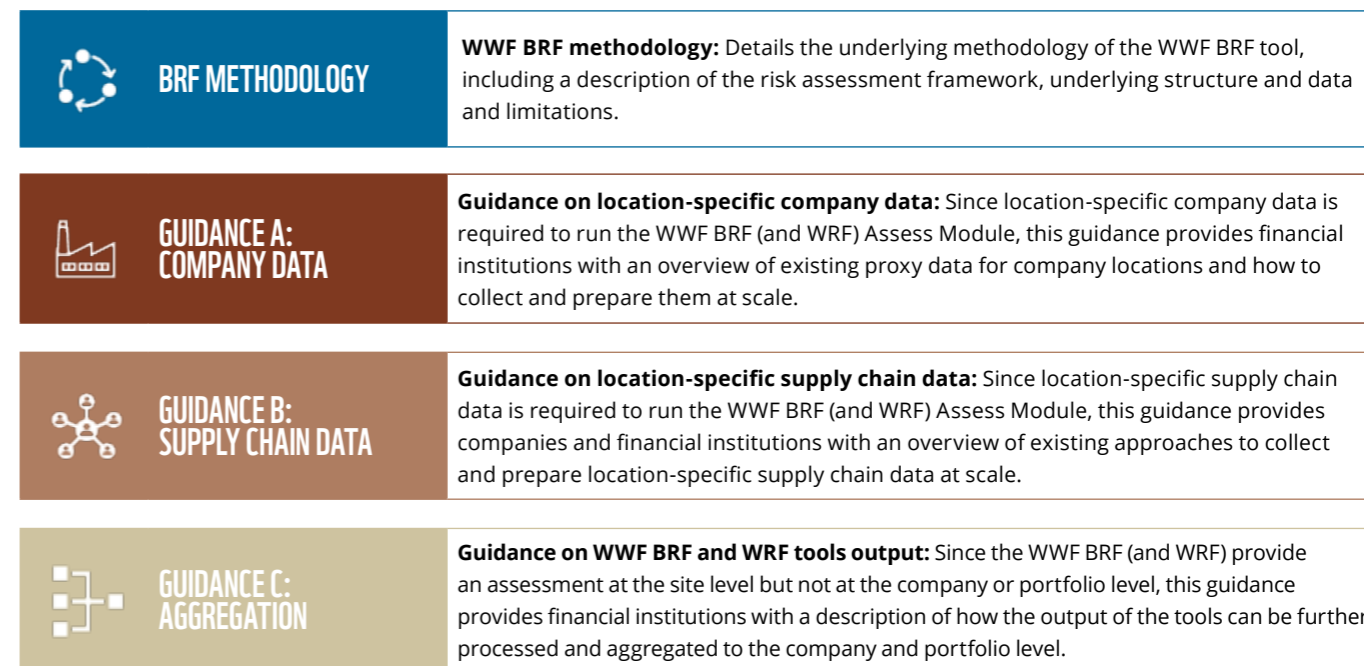


Figure 2: Overview of the components of the WWF BRF Methodology Documentation

BOX 2: THE WWF WATER RISK FILTER

The **WWF Water Risk Filter (WRF)** is a freely available, web-based, spatially explicit corporate- and portfolio-level screening and prioritisation tool for companies and financial institutions to assess and respond to water-related risks.

Launched in 2012, in partnership with the German Development Finance Institution DEG, the WWF WRF was one of the first online water risk assessment tools for companies and investors. It has become a leading water risk tool, with more than 500,000 sites (i.e., company site locations) assessed by over 4,000 active users from a broad range of industries, including food and beverages, textiles, retail, mining and finance.

While the WWF BRF tool provides general high-level assessment of biodiversity-related risks, the WWF WRF tool provides a more in-depth assessment of water-related risks. It covers:

- **Basin water risks:** Risks related to a company’s geographic location are assessed using 32 state-of-the-art basin risk indicators, covering different aspects of physical, regulatory and reputational water-related risks.
- **Operational water risks:** Risks related to how a company’s activities depend on and impact water resources are assessed using either a short (10-questions) or a more detailed (45-questions) site-level questionnaire covering different aspects of physical, regulatory and reputational water-related risks.

With the support of the UK Development Finance Institution, British International Investment (BII), the WWF WRF was enhanced to provide climate and socio-economic water risk scenarios (Optimistic, Current trend and Pessimistic pathways) for 2030 and 2050. This tool enhancement enables companies and investors to better understand future water risks, to inform business strategy and investment decisions as recommended by the Task Force on Climate-related Financial Disclosures (TCFD) and the TNFD. The enhanced WWF WRF, in partnership with BII, won the **Principles for Responsible Investment (PRI) Award for ESG Research Innovation of the Year**.

1.4 CURRENT BIODIVERSITY MANAGEMENT, DISCLOSURE AND ASSESSMENT FRAMEWORKS

Several initiatives and organisations are developing frameworks and tools for biodiversity-related risk, opportunity and impact accounting, assessment and management for the private sector. In particular, there is strong momentum around the TNFD⁷ and the Science-based Targets Network (SBTN)⁸. Many private sector actors consider that these broader frameworks will support their efforts to better assess biodiversity-related risks, opportunities and impacts (Credit Suisse, 2021).

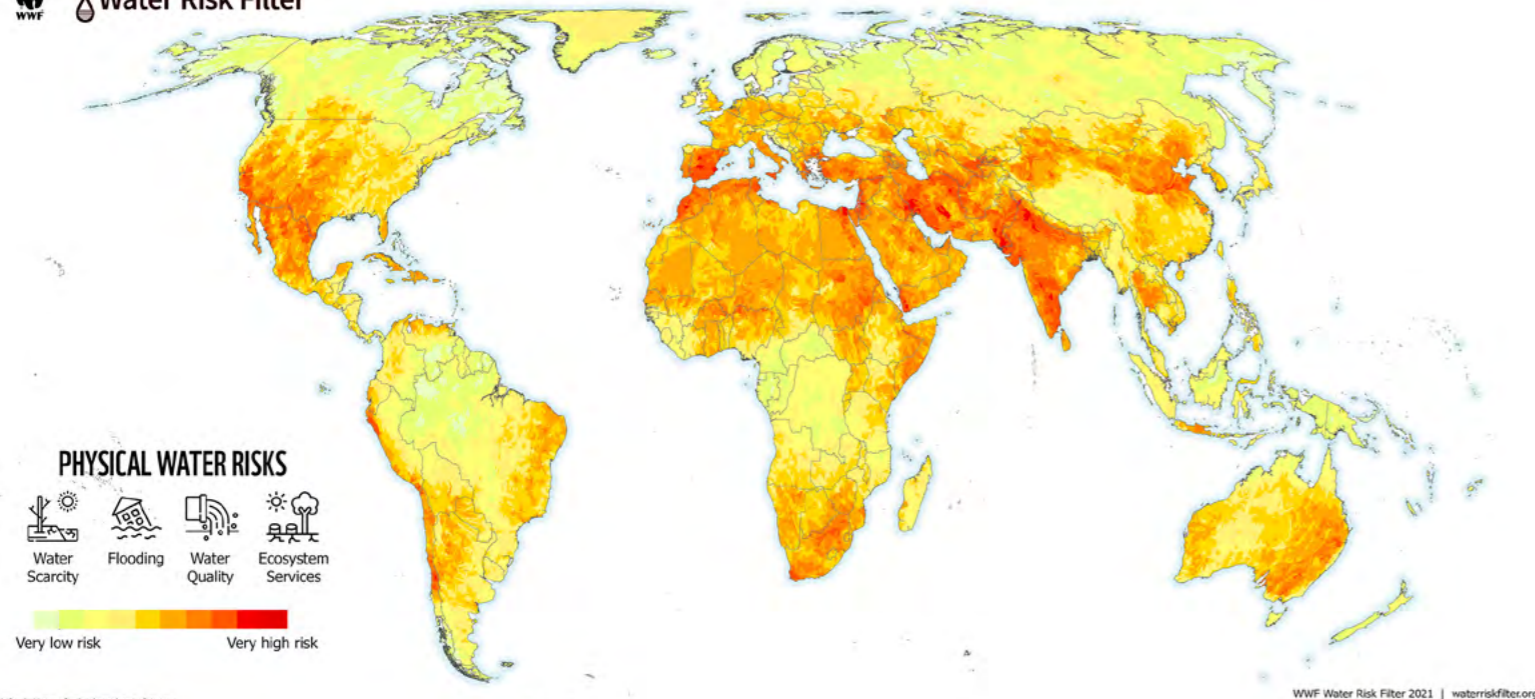
TNFD is a global, market-led initiative established in 2021 with the mission to develop a risk management and disclosure framework for companies and financial institutions to report and act on nature-related risks and opportunities. TNFD follows the conventions of its climate-focused predecessor, TCFD, by dividing nature-related risks into two primary categories: physical and transition risks. TNFD draws significant parallels from TCFD, providing companies and financial institutions with an effective platform to frame their thinking on biodiversity, and to support a shift in global financial flows towards outcomes that halt and reverse biodiversity and nature loss (TNFD, 2022b). In addition to the management and disclosure framework, TNFD is also developing an integrated assessment approach for nature-related risk and opportunity management for companies and financial institutions, called the LEAP (Locate, Evaluate, Assess, Prepare) approach (see Box 3). The LEAP approach provides guidance to support internal, nature-related risk and opportunity assessments within companies and financial institutions to inform strategy, governance, capital allocation and risk management decisions, including disclosure decisions consistent with TNFD’s draft disclosure recommendations (TNFD, 2022d). The final version of the framework is intended to be published in September 2023.

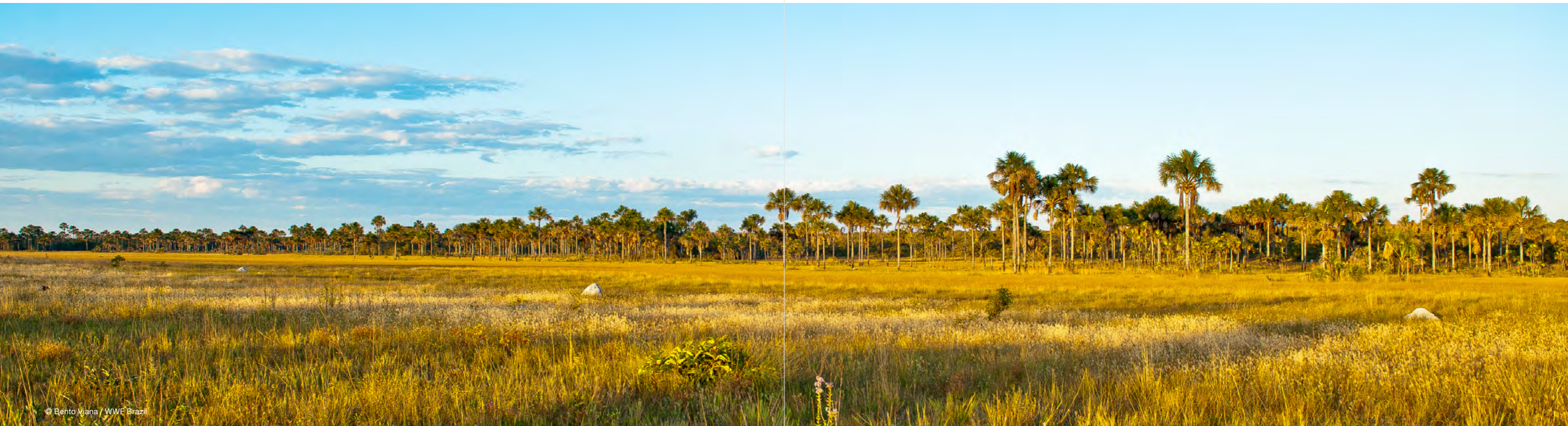
SBTN is a collaboration of over 60 leading global environmental non-profit and mission-driven organisations. Alongside the Science-based Targets initiative (SBTi), SBTN will equip companies and cities with the guidance, tools and methods needed to set science-based targets for climate and nature. Its goal is to encourage companies and cities to set science-based targets to reduce impacts on freshwater, land, biodiversity and oceans (SBTN, 2020a). In its initial guidance for businesses, the SBTN presented a five-step process for companies to proactively address their impacts on nature.

In short, the initial guidance, the technical guidance on Step 1 and Step 2 and SBTs for Nature v1 will enable companies to:

- **Assess** (Step 1) and identify a company’s most material impacts and dependencies on nature and where they occur in its value chain;
- **Prioritise** (Step 2) different places across a company’s spheres of influence where it can start acting and target setting today;
- **Set targets** (Step 3) on specific material environmental issues with timelines, baselines, and plans to achieve the targets;
- **Act** (Step 4) in priority places and use the AR3T Framework for best implementation practices to deliver on your nature targets on the ground; and
- **Track** (Step 5) progress towards the set targets, report publicly on the progress, and adapt the strategy if necessary (SBTN, 2022a, 2022b).

Mandatory disclosure requirements are also emerging across the globe. Mandatory disclosure regimes tend to be more effective than voluntary initiatives (Bingler, Kraus, & Leippold, 2021). Although there is a trend towards mandatory environmental, social and governance (ESG) disclosure requirements, the landscape is still very diverse. There is considerable variation between jurisdictions on the comparability, accessibility and assurance of the information disclosed. Also, disclosure is often focused on climate rather than on the broader biodiversity and nature context (Climate & Company, University of Hamburg, IPSF, 2021). One example of mandatory biodiversity-related disclosure is the European Union’s Corporate Sustainability Reporting Directive (CSRD). The directive⁹ targets around 50,000 companies that operate in the EU,¹⁰ and requires that companies report against the European Sustainability Reporting Standards “Water and marine resources” (ESRS E3) and “Biodiversity and ecosystems” (ESRS E4) modules (European Commission, 2021). The ESRS E3 requires disclosure of impacts of activities on water and marine resources, the results of mitigation actions, the material risks to water and marine resources and the financial effects of activities (EFRAG, 2022b). ESRS E4 contains disclosure requirements on potential financial implications of biodiversity and ecosystem-related impacts, risks and opportunities, transition plans in line with the targets of no net biodiversity loss by 2030, net biodiversity gain from 2030 and full biodiversity recovery by 2050, and measurable biodiversity and ecosystem targets (EFRAG, 2022a). Another example is Indonesia which includes the disclosure of biodiversity-related impacts and conservation activities in its reporting obligations (Indonesia Financial Services Authority, 2017).





Several entities are also developing biodiversity-related risk, opportunity and impact assessment tools to support companies and financial institutions on their biodiversity journey. Among these are: the Exploring Natural Capital Opportunities, Risks, and Exposure (ENCORE) tool; the Integrated Biodiversity Assessment Tool (IBAT); the Corporate Biodiversity Footprint (CBF); the Global Biodiversity Score (GBS); the Biodiversity Impact Analytics (BIA); the Biodiversity Impact Assessment Tool (BIAT); and Biodiversity Footprint Financial Institutions (BFFI), to name a few (see Appendix I for a description of the tools). Apart from ENCORE, most of these tools focus on the assessment of companies' (negative) impacts on biodiversity, but do not cover target setting or risk assessment.

1.5 WHY A BIODIVERSITY RISK FILTER?

These frameworks and tools provide a good entry point for companies and financial institutions to understand, assess and respond to biodiversity-related issues. However, key gaps exist in the current landscape of biodiversity solutions that handicap companies and financial institutions that are looking to assess and manage biodiversity-related issues. Key gaps exist with regards to:

- Spatially explicit assessment of risks, opportunities and impacts;
- Holistic coverage of local and global biodiversity integrity;
- The quantification of risk stemming from the dependencies and impacts of companies;
- Broad coverage of industry sectors for cross-industry application;
- Alignment with emerging biodiversity frameworks; and
- Assessment of supply chains.¹¹

In addition, many companies and financial institutions are still in the early stages of integrating biodiversity-related issues into their business practices. Most existing tools are highly technical and time intensive, deterring companies and financial institutions from using them (Credit Suisse, 2021).

The WWF BRF was therefore developed to address these gaps and provide companies and financial institutions with a spatially explicit risk assessment framework that builds on existing and, where possible, open-source data and tools, and which is aligned with emerging assessment frameworks and regulatory standards, including the following:

- **Science-based Targets Network:** SBTN is primarily aimed at helping companies to set and act on science-based targets for managing their impacts on nature. The WWF BRF and WRF, meanwhile, are designed to facilitate this process and help companies get a sense of where the highest priority areas are with regards to biodiversity and water. The WWF BRF and WRF thus complement the SBTN five-step process by helping companies understand their location-specific risks and prioritise where to act. The WWF BRF and WRF provide support especially for Step 1 Assess and Step 2 Prioritise.
- **Taskforce on Nature-related Financial Disclosures:** The WWF BRF and WRF are particularly aligned with the TNFD's proposed LEAP approach and its underlying principles for companies and financial institutions (e.g., its recommendation for spatially explicit assessment of a company's dependencies and impacts on nature). While the LEAP approach is data- and tool-agnostic, the WWF BRF and WRF provides a concrete and automated approach for identifying and prioritising biodiversity and water-related risks based on available data and can hence serve as a tool to implement parts of the LEAP approach (see Box 3). In addition, the WWF BRF and WRF adopted the TNFD's fundamental concepts and definitions of nature-related risks and opportunities to promote a consistent nature terminology.
- **European Sustainability Reporting Standards:** The WWF BRF and WRF help companies and financial institutions to comply with the planned European Sustainability Reporting Standards on "Water and marine resources" (ESRS E3) and "Biodiversity and ecosystems" (ESRS E4). In the absence of an authoritative methodology, the WWF BRF and WRF provide a starting point to identify and assess material biodiversity- water-related risks.¹² As reporting against biodiversity- water-related risks is also a learning process, requiring company-specific information as well as decisions at management level, the WWF BRF and WRF are not "off-the-shelf" solutions to comply with mandated disclosure. However, both tools provide guidance and can facilitate the disclosure process (see Figure 3). For a more detailed analysis see Appendix II.

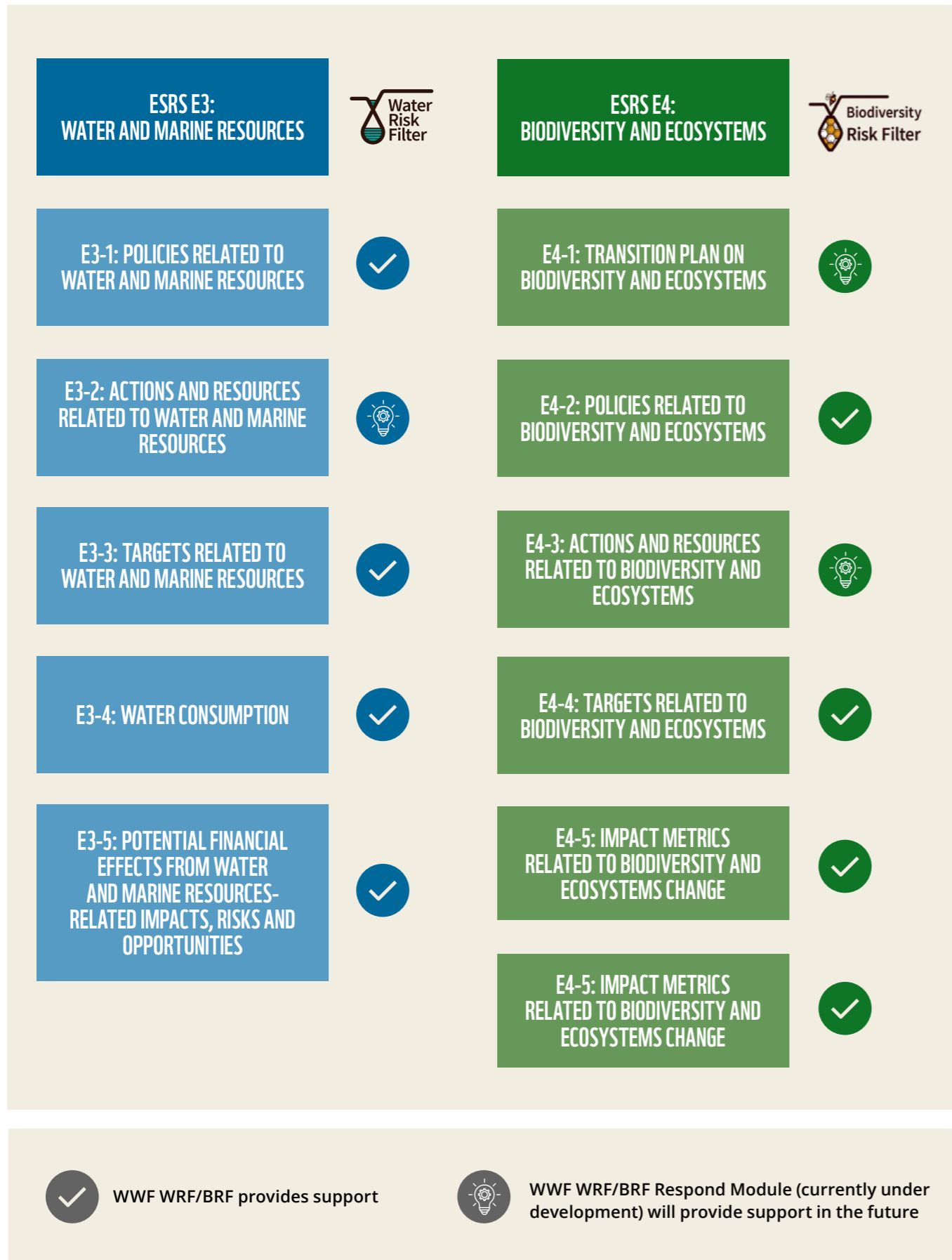


Figure 3: Alignment of WWF BRF and WRF with ESRS E3 and E4

The WWF BRF and WRF tools also build on, complement and collaborate with existing tools and data providers. In particular, the WWF BRF integrates data from ENCORE, IBAT and RepRisk. Each of these tools supports companies and financial institutions in understanding and assessing different aspects of biodiversity and biodiversity-related risks.

- **ENCORE** provides users with insights into the dependencies and impacts of different sectors and production processes on natural assets. It also offers new functionalities that provide an overview of portfolio alignment for the agriculture/mining sector and geographic hotspots of natural capital depletion. ENCORE's sector-level dependency and impact ratings were used as a basis for the industry materiality ratings of the WWF BRF and were adjusted slightly following peer reviews with WWF internal experts, financial institutions and companies. In combining industry-level impact and dependency ratings with assessments of local biodiversity aspects, the WWF BRF allows companies and financial institutions to run tailored assessments across industries and locations to provide insights into their exposure to biodiversity-related risks.
- **IBAT** mainly provides detailed site-level data on local biodiversity values (e.g., data on Key Biodiversity Areas, Protected Areas and threatened species, via the IUCN Red List of Threatened Species), that can be leveraged by users to understand site-level issues and support them in managing those issues effectively. The WWF BRF integrates and makes use of the IBAT data sets to evaluate local biodiversity aspects feeding into the assessment of physical and reputational risk.
- **RepRisk** maintains the world's largest database of ESG risks, combining AI and advanced machine learning with human intelligence to identify material ESG risks to companies, real assets and countries. The WWF BRF and WRF integrate and make use of the RepRisk datasets to assess the indicator 'Media Scrutiny' in the reputational risk assessment.

BOX 3: WWF BRF AND WRF ALIGNMENT WITH TNFD LEAP

TNFD has developed an integrated assessment process for nature-related risks and opportunity management to support companies and financial institutions in understanding and responding to nature-related risks and opportunities. The approach is called LEAP:

- **Locate** your interface with nature;
- **Evaluate** your dependencies and impacts;
- **Assess** your risks and opportunities; and
- **Prepare** to respond to nature-related risks and opportunities and report.

The TNFD also provides guidance on scoping the assessment before starting with the four phases of the LEAP approach (see Figure 4). The WWF BRF and WRF tools' Inform and Explore Modules can help focus the scope of the assessment on priority industries and geographic areas as recommended by TNFD. Further, the WWF BRF Inform Module can support the Evaluate phase, WWF BRF and WRF Explore Modules the Locate phase and the WWF BRF and WRF Assess Modules can support the Assess phase of the TNFD LEAP approach.

SCOPE THE ASSESSMENT

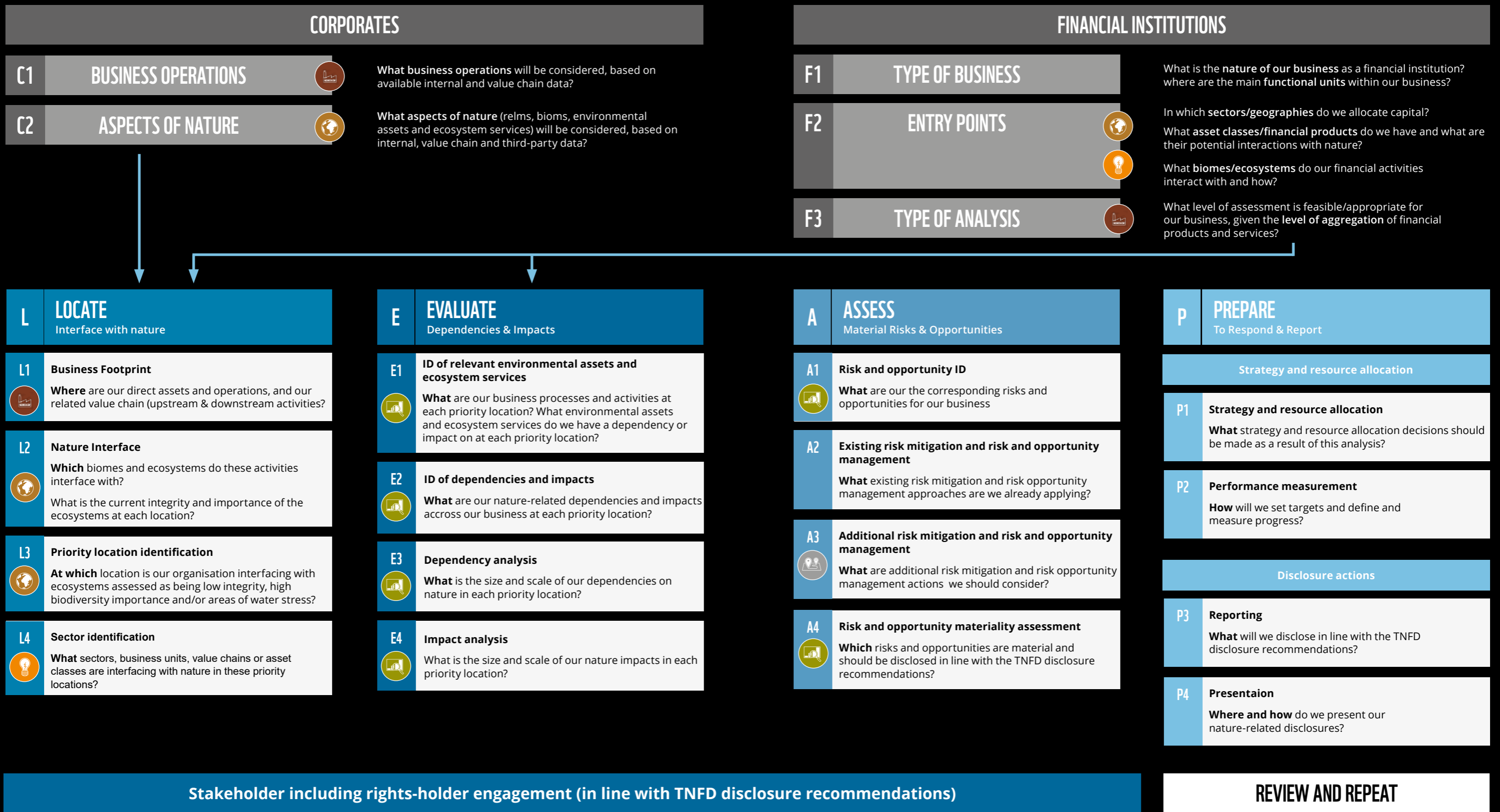


Figure 4: WWF BRF and WRF alignment with TNFD LEAP approach

An aerial photograph of a lush forested valley. A river flows through the center of the valley, surrounded by dense trees with vibrant autumn foliage in shades of yellow, orange, and green. In the background, rolling hills and mountains are visible under a dramatic, cloudy sky with a rainbow arching over the landscape.

2 THE WWF BIODIVERSITY RISK FILTER METHODOLOGY

This section provides a high-level overview of the WWF BRF Methodology. It lays out a step-by-step framework to identify, assess and link biodiversity-related risks to specific company locations. In addition to describing the underlying methodology of the WWF BRF tool, it illustrates how financial institutions, in particular, can make use of available proxy data to collect and prepare the required input data to run the WWF BRF or WRF Assess Modules (i.e., Guidance A and B). Furthermore, it shows financial institutions how the output data generated by the WWF BRF or WRF Assess Modules can be further processed and aggregated, to create portfolio-wide overviews of biodiversity-related (or water-related) risks and to identify potential high-risk companies within a portfolio for further investigation and engagement (i.e., Guidance C). The following sections first describe the general risk hierarchy that was employed to assess the aspects of biodiversity-related risks, followed by a description of the four-step methodological framework. For a detailed description, see the *WWF Biodiversity Risk Filter Methodology Documentation (WWF Biodiversity Risk Filter, 2023)*.

2.1 THE WWF BIODIVERSITY RISK HIERARCHY

The current version of the WWF BRF covers biodiversity-related physical and reputational risks that affect company locations:

- **Physical risks** are driven by the ways in which a business and its supply chains depend on and can be affected by both natural and human-induced conditions of land- and seascapes, and how pressures might deteriorate ecosystem services in the future. The global decline of ecosystem services, for example, could lead to reduced productivity (e.g., lack of fertile soils and pollination) or increased costs of inputs (e.g., scarcity of natural fibres or harvest losses).
- **Reputational risks** can result from a company’s actual or perceived negative impacts on biodiversity and people. Reputational risk represents stakeholders’ and local communities’ perceptions of whether companies conduct business sustainably or responsibly with respect to biodiversity and can ultimately affect brand value and market share, among other factors. Adverse effects on business could emerge from, for example, damages to the corporate brand and thus declining sales, or greater investor scrutiny and thus declining share price.

To assess these risks, the WWF BRF follows a four-level risk hierarchy. It breaks down physical and reputational risk to 33 different indicators, which cover aspects of biodiversity that may be (or may become) material risks from a financial or environmental and social perspective. The risk hierarchy consists of the following four levels (see also Figure 5):

- **LEVEL 4, Metrics**, comprises the raw global data sets that measure different aspects of biodiversity in a specific location that may lead to biodiversity-related risks for companies and financial institutions. Currently, the WWF BRF tool contains 56 global biodiversity data sets;¹³
- **LEVEL 3, Indicators**, comprises information on the importance and local integrity of biodiversity aspects, not as raw data but spatially (dis-)aggregated to an assessment unit and translated to a risk score ranging from 1 to 5. The 56 metrics currently integrated in the WWF BRF are grouped into 33 Indicators (20 physical risk and 13 reputational risk indicators);
- **LEVEL 2, Risk categories**, groups the indicators into higher-level risk clusters with more direct relevance to companies and financial institutions. The 33 indicators have been grouped into eight different risk categories (five physical risk categories and three reputational risk categories); and
- **LEVEL 1, Risk types**, combines the risk categories into the broader risk types (physical risk and reputational risk).

It should be noted that risk types, risk categories and indicators are visible in the WWF BRF tool, but metrics (i.e., the raw data sets) are not.

The structure was, on the one hand, put in place to construct a hierarchical framework that consists of not only broad risk types, but more specific risk categories, as they provide more insights on the aspects the risks are comprised of. For example, biodiversity-related physical risks comprise very different aspects of biodiversity, ecosystems and their services. In this case, the availability of “Provisioning Services” (such as wood or fibre) can be investigated separately from the availability of “Regulating and Supporting Services” (such as pollination or soil condition). On the other hand, these broad risk types (i.e., physical and reputational risk) and the general structure of the WWF BRF risk hierarchy have already been successfully used in the WWF WRF. This ensures consistency between water-related and biodiversity-related risk assessments and offers users a familiar approach that is still specific to the topics of water and biodiversity.

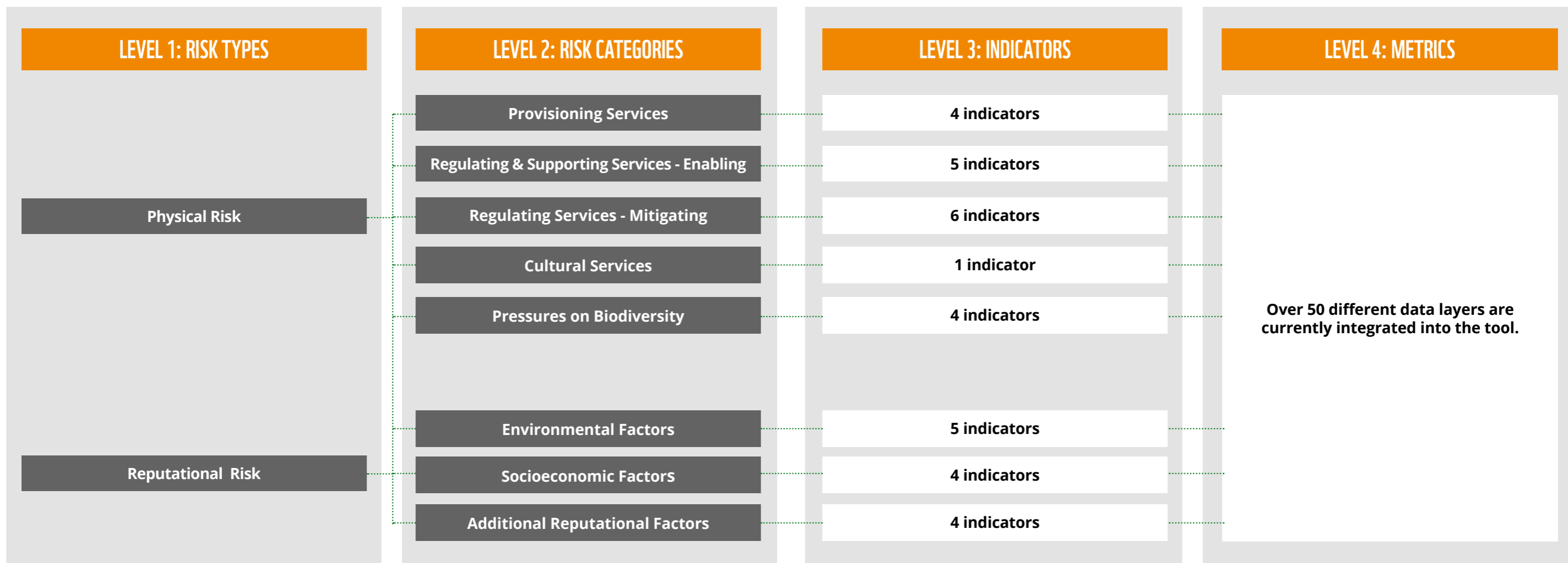


Figure 5: WWF BRF risk hierarchy

2.2 METHODOLOGY AT A GLANCE

To begin the process of assessing biodiversity- or water-related risks, companies and financial institutions should define the scope that can and should be considered (Step 0), as well as collect and prepare the necessary location-specific company and supply chain input data to run the WWF BRF and WRF Assess Modules (Step 1). For Step 0, the tools provide support: The WWF BRF Inform Module provides information about the level of dependencies and impacts on biodiversity for a total of 25 industry sectors (see Appendix III or an overview of industry sectors covered), which help to identify the industry sectors with the highest impact and/or dependency to focus on (Step 0A); and the WWF BRF and WRF Explore Modules provides a set of maps on the importance and local integrity of biodiversity and water respectively, which can help to identify priority geographical locations (Step 0B). Step 1 describes the required input data to run the WWF BRF or WRF Assess Modules. Guidance A and Guidance B explain, in particular for financial institutions, how the required location-specific company and supply chain input data (i.e., the location of company and supply chain sites, the industry sector and business importance of the site) can be approximated at scale using existing data products, if company-reported data is missing.

After the scope is defined and the needed input data collected and prepared, the risk scores at the company site-level are calculated (Step 2). The risk hierarchy builds the foundation of this assessment. The risk scores, ranging from 1 to 5 (where 1 indicates a very low risk, and 5 a very high risk), are first built for each indicator (LEVEL 3): the resulting score is called the scape risk score. Following the definition of risk, for each company location, l , the scape risk score per indicator, i , is the combination of the industry sector-specific impact or dependency rating (i.e., the industry materiality, $IM_{i,s}$) and the location-specific biodiversity importance or integrity rating of the indicator (biodiversity importance/integrity assessment, $IA_{i,l}$):

$$Scape\ risk_s^i = \frac{IM_{i,s} + IA_{i,l}}{2}$$

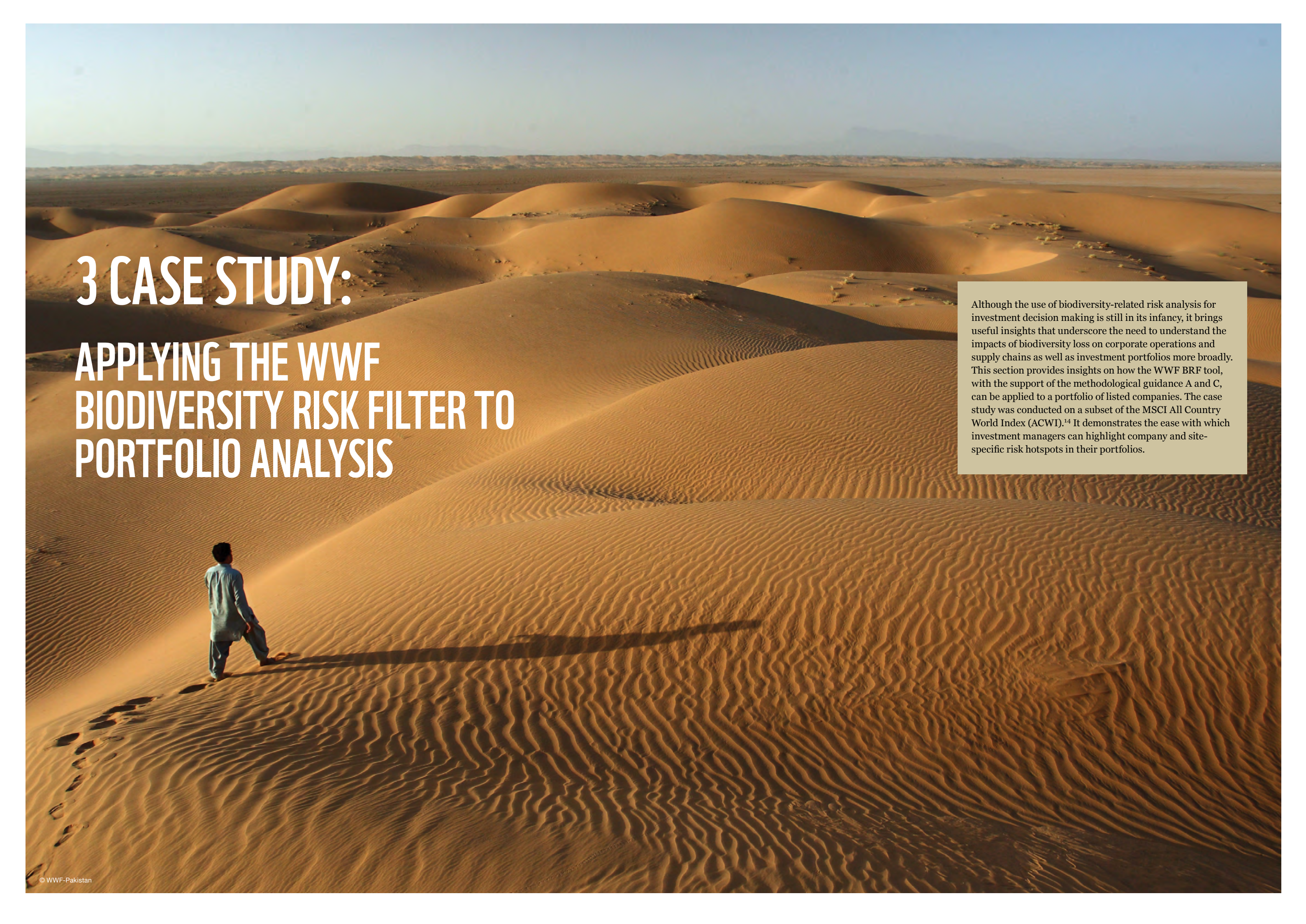
From the indicator level, the scape risk scores are then aggregated to the risk category level per company site (LEVEL 2) using the 75th percentile of all indicators forming the respective risk category. Finally, using again the 75th percentile, the scores of the risk categories are aggregated to the risk type level (physical risk and reputational risk; LEVEL 1).

Step 3 of the methodology provides guidance on how the WWF BRF and WRF output data from the Assess Modules, which provide risk scores at the company site-level, can be aggregated toward the company and portfolio level (Guidance C). Risk at the company and portfolio level is determined by upward aggregation, considering company or portfolio assets, their locations and the importance and local integrity of biodiversity or water.

Figure 6 provides an overview of the WWF BRF Methodology step-by-step framework, including the preceding scoping assessment. In addition, it also highlights how Guidance A-C can be of use to run the WWF BRF and WRF Assess Modules.



Figure 6: Structure of the WWF BRF Methodology Documentation



3 CASE STUDY: APPLYING THE WWF BIODIVERSITY RISK FILTER TO PORTFOLIO ANALYSIS

Although the use of biodiversity-related risk analysis for investment decision making is still in its infancy, it brings useful insights that underscore the need to understand the impacts of biodiversity loss on corporate operations and supply chains as well as investment portfolios more broadly. This section provides insights on how the WWF BRF tool, with the support of the methodological guidance A and C, can be applied to a portfolio of listed companies. The case study was conducted on a subset of the MSCI All Country World Index (ACWI).¹⁴ It demonstrates the ease with which investment managers can highlight company and site-specific risk hotspots in their portfolios.

3.1 PARAMETERS AND METHODOLOGICAL APPROACH

3.1.1 Parameters

The case study was carried out on a portfolio constructed from a random sample of 605 equally weighted companies included in the MSCI ACWI, covering 24 out of the 25 WWF Risk Filter industry sectors (see Table 2 and Table 8) and 11.89 per cent of the MSCI ACWI in terms of the constituents' weight. In total, 7,629 globally distributed operational sites of the portfolio companies were identified. The sample does not comprise of any upstream or downstream supply chain operations and hence does not consider supply chain effects.

3.1.2 Methodological approach

The case study was constructed following the step-by-step approach presented in the *WWF BRF Methodology Documentation* (WWF Biodiversity Risk Filter, 2023):

Step 1: Collecting location-specific company data

- First, georeferenced company data (i.e., the locations of company sites) was collected for the sample of the 605 listed companies following Guidance A: Collecting location-specific proxy data on portfolio companies own operations. Data from FactSet's corporate structure data¹⁵ and from the Spatial Finance Initiative (SFI)¹⁶ was used as the proxy data set, resulting in 7,629 operational company locations (latitude/longitude). The SFI database provided asset-level data for the cement sector which is a part of the industry sector 'construction materials' within the WWF Risk Filter industry sector classification. The rest of the data points used in the analysis came from FactSet's corporate structure data.¹⁷
- Each operational company location was then assigned to a WWF Risk Filter industry sector classification so that industry-specific dependencies and impacts on the biodiversity aspects could be incorporated in the analysis (i.e., the industry materiality).
- Lastly, the business importance of a specific company location to the overall company performance was determined. This helps to better understand organisation-wide implications and serves as a weighting factor to aggregate risk scores in later steps (see Step 3). Three types of weighting factors were used based on data availability: production capacity, conditional weighing on reported disaggregated revenue and equal weighting. As production capacity is included with the SFI database this was used as the weighing factor for companies operating in the cement sector. Disaggregated revenue per site was available for a portion of the corporate structure data and was used as a weighting factor when available. When either production capacity or disaggregated revenue per site were not available for a company, equal weighting was given to the business importance of each site.

Step 2: Assessing location-specific biodiversity-related risks

- The list of 7,629 location-industry pairs was fed into the WWF BRF tool¹⁸ to obtain site-level physical and reputational risk scores (LEVEL 1 of the risk hierarchy), site-level risk scores per risk category (LEVEL 2) and per indicator (LEVEL 3).
- The outputs of the WWF BRF Assess Module were then downloaded using the integrated Excel function.

Step 3: Aggregating location-specific risks to the company and portfolio level

- Each location-specific risk indicator is weighted by the business importance of the location and summed over the company to create a company specific risk rating (physical and reputational)
- Company-specific risk is then weighted by its value in the total portfolio composition (in this case study, each company is given equal weighting) and summed to give a physical and reputational portfolio risk score.

3.2 CASE STUDY RESULTS

3.2.1 Portfolio-level analysis

Biodiversity-related risks are material risks and will affect the performance of investment portfolios. The case study shows that the vast majority of the portfolio companies have a medium or high exposure towards biodiversity-related risks. For physical risks, 66.3 per cent of the total number of companies assessed have medium and 33.4 per cent a high to very high exposure. For reputational risk, the figures are 74.4 per cent and 24.8 per cent, respectively. Table 1 provides an overview of the distribution of physical risk and reputational risk scores across the sample portfolio.

Risk score		Physical risk		Reputational risk	
		Nr. of companies	% of companies	Nr. of companies	% of companies
1.0 - 1.4	very low risk	0	0.00%	0	0.00%
1.4 - 1.8		0	0.00%	0	0.00%
1.8 - 2.2	low risk	0	0.00%	0	0.00%
2.2 - 2.6		2	0.33%	5	0.83%
2.6 - 3.0	medium risk	151	24.96%	137	22.64%
3.0 - 3.4		250	41.32%	313	51.74%
3.4 - 3.8	high risk	141	23.31%	99	16.36%
3.8 - 4.2		34	5.62%	30	4.96%
4.2 - 4.6	very high risk	16	2.64%	19	3.14%
4.6 - 5.0		11	1.82%	2	0.33%

Table 1: Number and percentage of total companies in the sample portfolio by physical and reputational risk score

Deeper insights into the impacts of biodiversity loss on the sample portfolio are presented below by breaking down the analysis further to the industry, company and company site level.

3.2.2 Industry-level analysis

Most industry sectors are exposed to biodiversity-related risks. Table 2 provides a breakdown of physical and reputational risk per WWF Risk Filter industry sector.¹⁹ Fishing and aquaculture, and Agriculture topped the industry distribution of biodiversity-related physical risk. Both these industries are intrinsically linked to the health of biodiversity integrity on many fronts and companies within these industries are understandably highly exposed to the physical degeneration of ecosystem services. These industries are also highly exposed to biodiversity-related reputational risks. This is understandable as many reputational factors such as environmental and socioeconomic factors are correlated to the health of biodiversity. The other end of the spectrum also provides plausible results: renewable energy production, office and professional services and construction industries are all less directly dependent on ecosystem services when looking only at their own operations but not supply chain operations. With the inclusion of supply chain, a relatively insulate industry such as renewable energy production might face increased risk. For example, pollution might be associated less with renewable energy production, but is still associated with the manufacturing of components integral to the operation of a windmill or solar panel.

Industry-level risk assessment of a portfolio acts as a high-level identifier of potential biodiversity hotspots. An industry with a high aggregated biodiversity risk score within a portfolio could warrant a deeper dive into the drivers of risk on either a company- or industry-level. Performing the portfolio analysis first on an industry-level can help investors integrate biodiversity-related risk into overarching strategic industry investments decisions.

Industry (WWF Risk Filter industry sector classification)	Physical risk score	Reputational risk score	Percentage of total sample portfolio (%)
Fishing and aquaculture	4.40	3.66	4.24
Agriculture (plant products)	4.37	3.97	24.80
Agriculture (animal products)	4.29	4.03	7.82
Electric energy production (geothermal or combustion)	3.81	3.46	3.58
Transportation services	3.75	3.58	3.05
Paper and forest product production	3.64	3.43	1.19
Health care, pharmaceuticals and biotechnology	3.62	3.17	2.79
Water utilities / Water service providers	3.61	3.29	0.53
Metals and mining	3.57	3.59	0.93
Oil, gas and consumable fuels	3.54	3.71	2.25
Food and beverage production	3.51	3.40	1.46
Hospitality services	3.50	3.26	1.46
Construction materials	3.48	3.47	1.19
Textiles, apparel and luxury good production	3.45	3.29	1.86
Automotive, electrical equipment and machinery production	3.43	3.19	0.27
Chemicals and other materials production	3.42	3.43	2.52
Food retailing	3.35	3.32	0.93
Appliances and general goods manufacturing	3.26	3.28	4.11
Telecommunication services (including wireless)	3.25	3.16	8.36
General or speciality retailing	3.25	3.20	4.11
Land development and construction	3.24	3.17	0.27
Electronics and semiconductor manufacturing	3.22	3.19	6.10
Electric energy production (solar, wind)	3.21	3.34	1.72
Offices and professional services	3.19	3.18	14.46

Table 2: Average industry risk score (physical and reputational) and percentage of total portfolio per industry
 Note: Industries descending in order of physical risk scores.

3.2.3 Company-level analysis

Using the WWF’s BRF tool, it is possible to have a broad overview of company-specific biodiversity-related risks within a portfolio and to identify high-risk companies that might require engagement. Figure 7 shows the physical and reputational risk scores of all companies analysed in the portfolio. By ordering the companies by risk scores, it becomes easy to identify high risk companies that could pose problems for the portfolio performance. As the analysis in part uses industry-specific data for ecosystem dependency and impacts on biodiversity, an overall company risk score is not sufficient for direct action. However, it gives an indication of what companies should be further investigated with more in-depth analysis. In this case, one could either: reach out directly to the company to evaluate its resilience capacity and biodiversity strategy or to ask for the precise locations of the company’s operations; commission a deep dive into a company’s potential biodiversity-related risk; or use the site-specific granular data to further contextualise the potential risk (such as the identification of LEVEL 3 risks on a per-site basis).

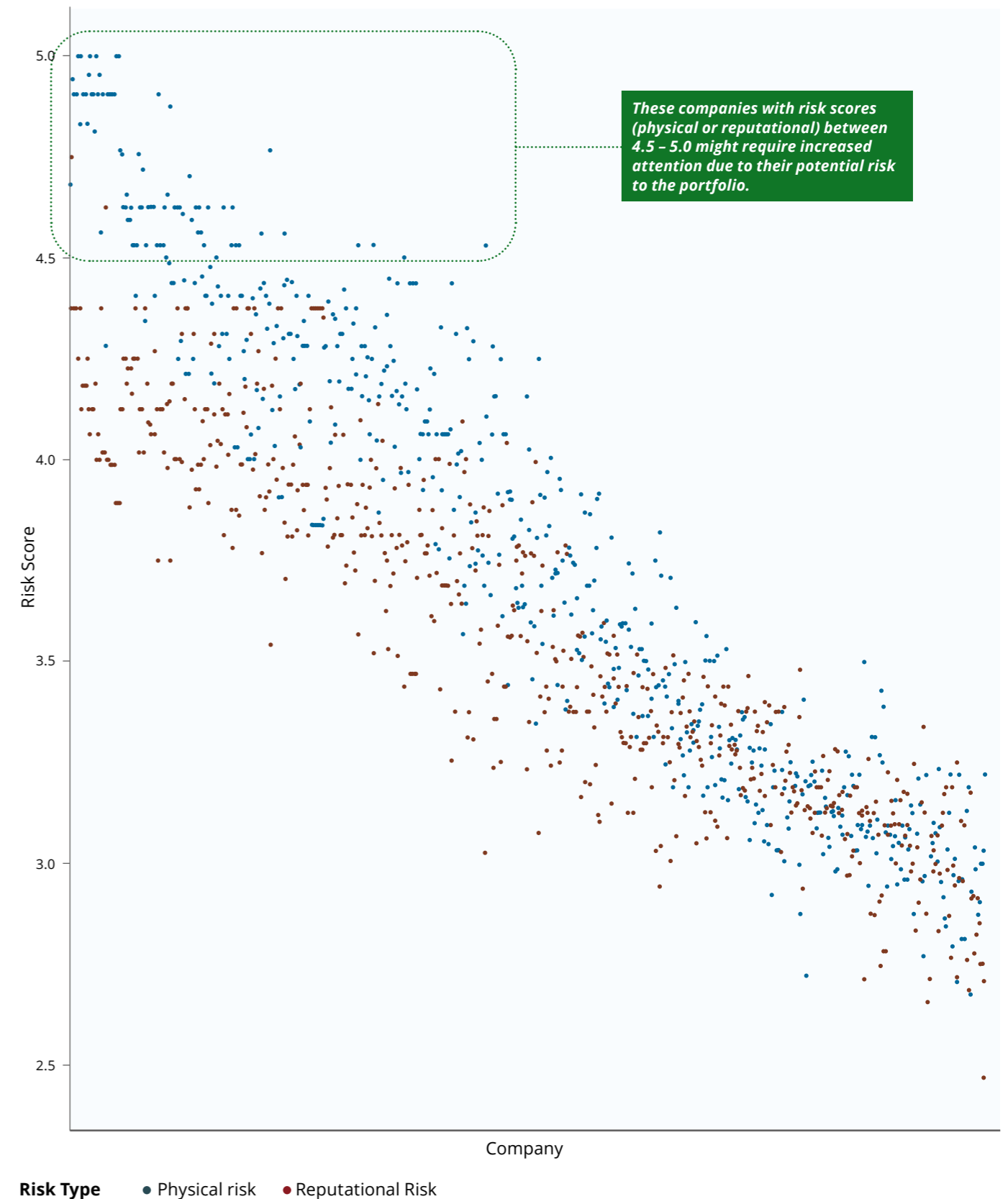


Figure 7: Physical and reputational risk scores per company for the sample portfolio
 Note: Companies are represented on the x-axis while biodiversity risk scores are displayed on the y-axis. Colours differentiate between physical (red) and reputational (blue) risks per company.

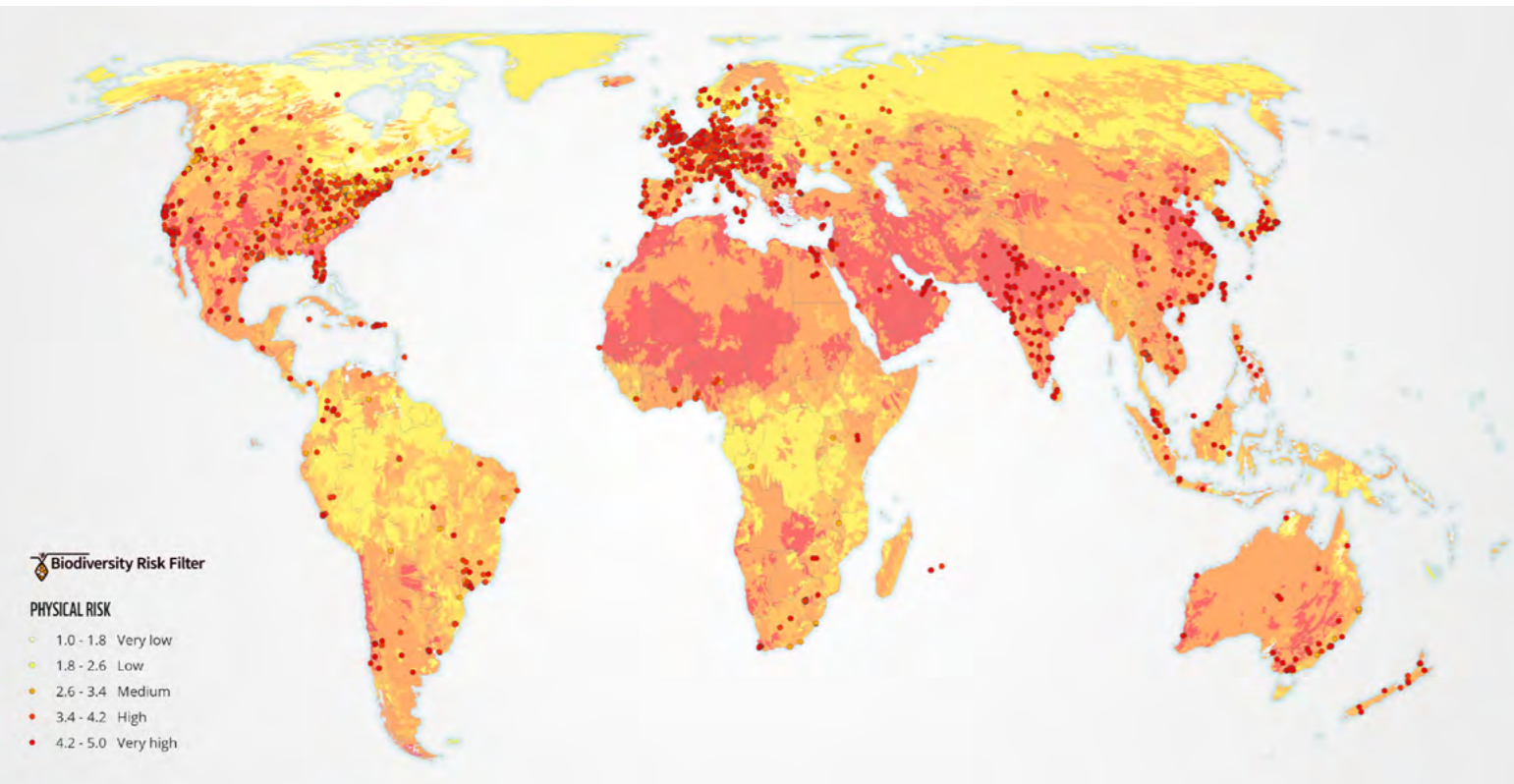


Figure 8: Global mapping of physical risk scores of all sites of the sample portfolio analysed
 Note: Each dot represents one site. Red represents scape risk scores from 4-5, orange from 3-4, yellow from 2-3 and green risk from 0-2.

As the WWF BRF uses site-level data to compute physical and reputational risks, the analysis can provide a visual depiction of the global distribution of a company’s risks within a portfolio. With this global outlook, investors can layer biodiversity-related risk on top of other types of country-specific risk (such as economic or political risk) to further inform global investment strategies. Figure 8 is a direct output from the WWF BRF tool that helps to visualise a portfolio of companies’ site-specific risks across the globe.

3.2.4 Site-level analysis

Although industry- and company-level analysis are useful for a general understanding of a portfolio’s risk, investment managers require a detailed overview of asset-specific risk if they are to take effective action. Herein lies the strength of the WWF BRF approach, as each company site is analysed separately to form the basis of the total risk score. The tool provides an overview of all sites within a company. This overview enables investment managers to easily identify high-risk assets and to dive deeper into the site-level analysis, e.g., of high-risk ranking companies. Although the WWF BRF tool does not aggregate the site-level analysis to the company or portfolio level, the Excel export file provides granular data that can be used by third parties for further processing and analysis (see Guidance C of the WWF BRF Methodology Documentation (WWF Biodiversity Risk Filter, 2023)).

By visualising all individual sites within a company, one can obtain insights about the distribution of risk within a company’s operational sites. This information is useful when approaching a company about its sustainability processes, as it provides an initial picture of where the potential risk might lie. Figure 9 displays site-specific physical risks of three anonymised companies taken from the Agriculture (Company A), Construction materials (Company B) and Office and professional services (Company C) sectors.²⁰ The site-level disaggregation of physical risk reveals that some companies, such as Company A, have consistently high physical risk exposure across all sites. Others, such as Company B, have a large distribution of physical risk across sites, with some being extremely exposed and others with negligible risk. In the case of Company B, this site-specific information can enable investment managers to approach the company in a more targeted manner and ask about these specific high-risk sites to gather more information.

In the case of Company A, an investigation of the entire company would be needed to decide on how to act on it. Given that almost all of Company C’s sites are of low risk compared with the two other companies, attention would be better focused on understanding the potential physical risks of companies A and B and their individual sites. Though it seems obvious to not focus on Company C’s site in this limited example. When analysing a portfolio of hundreds of companies there will be several grey zone situations where a low-risk company will have a few high-risk sites that might require investigation. Risk from sites of companies in the same or similar industries is highly correlated, since the industry materiality ratings comprise 50 per cent of the risk score at the indicator level. Despite this effect being driven by the underlying methodology, it helps to illustrate that companies and sites within similar industries are likely to be exposed to similar risks which, when combined, could become systemic. This systemic risk to an industry could be further amplified if the majority of sites are located in close proximity to one another, as is sometimes the case for particular production processes such as with semiconductors (Attinasi et al. 2021; Leibovici & Dunn 2021). Through understanding this industry exposure from the site level, investment managers can formulate strategies to avoid large-scale risk concentrations. It is also worth noting that, given a high correlation of site-level risk within industries, one large-scale event might not only be felt industry wide but might also have severe implications up and down the supply chain. The use of granular rather than aggregate risk data can help investors more accurately identify the elements of site-specific risk. Integrating this with knowledge of company operations can help to identify and prevent knock-on effects and operational tipping points.

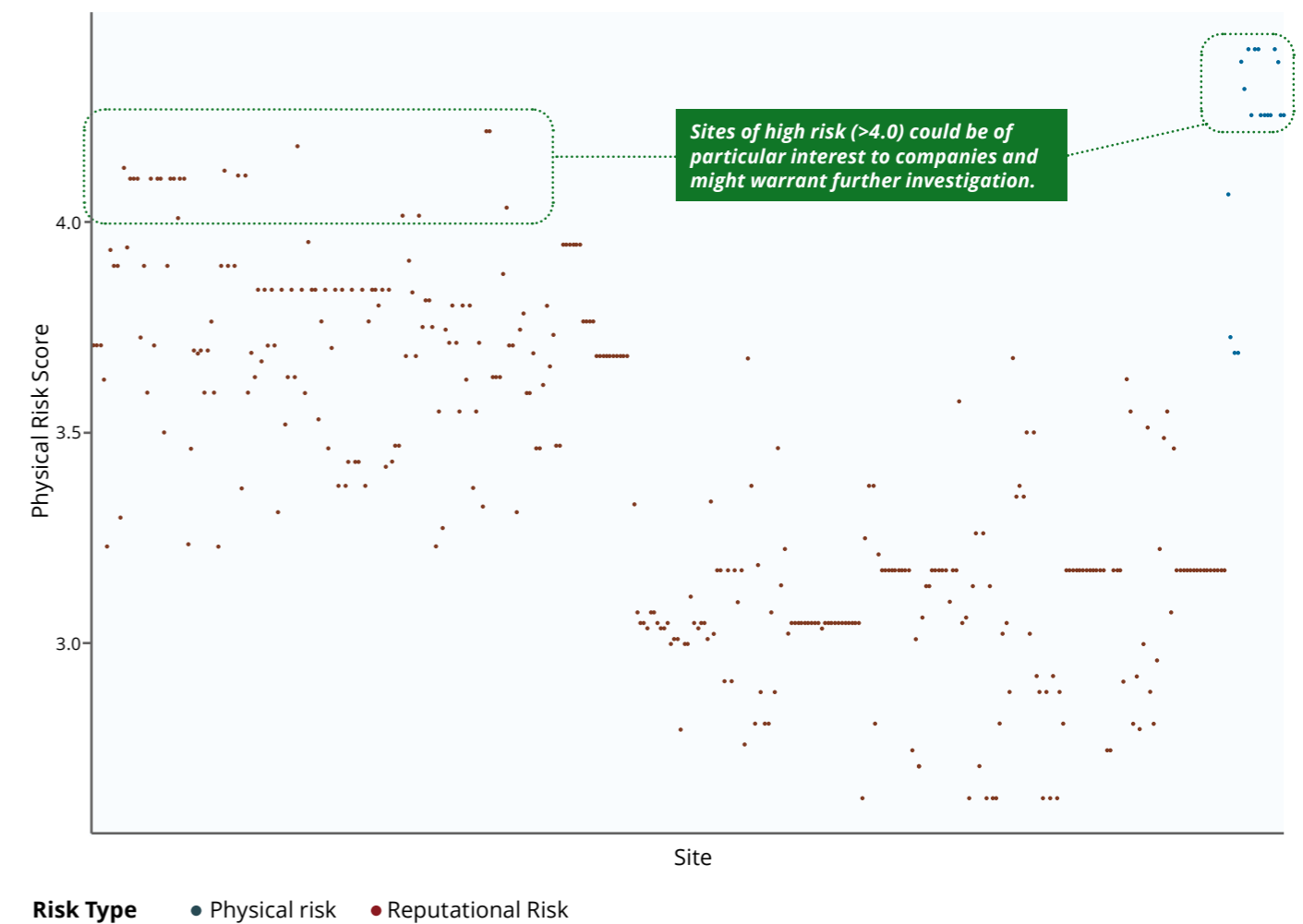


Figure 9: Site specific physical risk for three companies
 Note: The x-axis represents different sites for each company while the y-axis displays the physical risk scores. Colours differentiate between each company.

The WWF BRF tool also provides highly granular analysis of the 20 physical and 13 reputational biodiversity indicators at the site-level to help further inform investment decisions. This granular risk data can help to address specific concerns when interacting with a company. Table 3 shows a breakdown of the physical risks faced by five of Company A's sites. This breakdown enables users to identify specific ecosystem service dependencies of concern which they can raise with investee companies. For example, the Regulating Services - Mitigating and Pressures on Biodiversity risk categories

show the highest scores, suggesting that an investor could inquire with the companies whether they plan to increase fire hazard mitigation and storm protection (both high ranking indicator for Regulating Services - Mitigating across all sites), or whether the company plans to deal with challenges around land-use (high ranking indicator in Pressures on Biodiversity). The granular aspect of the WWF BRF tool allows for specific enquiries without the need for costly and large-scale deep dives into specific sites.

Location	Physical Risk	Physical risk categories and indicators													
		1. Provisioning Services	1.1 Water Scarcity	1.2 Limited Timber Availability	1.3 Limited Wild Flora & Fauna Availability	Regulating & Supporting Services - Enabling	2.1 Soil Condition	Regulating Services	4. Cultural Services	5. Pressures on Biodiversity					
Canada (ON)	4.5	3.23	3.3	2.5	3.0	...	4.0	3.5	...	4.25	...	0	...	4.75	...
U.S. (Illinois)	4.75	3.33	3.45	2.5	3	...	4.75	3.5	...	4.62	...	0	...	4.75	...
U.S. (Montana)	4.69	3.9	4.2	2.5	3	...	4.0	4.0	...	4.62	...	0	...	4.75	...
Canada (B.C.)	4.32	3.85	3.4	2	4	...	3.5	3.0	...	3.88	...	0	...	4.75	...
...
U.S. (Florida)	4.88	3.9	3.65	2.0	4.0	...	3.75	3.5	...	5.0	...	0	...	4.75	...

Table 3: Disaggregated physical risk classes and indicators for five of Company A's sites

In the final section of this case study, we take a deep dive into Company D, a very large global corporation operating within the Oil, gas and consumable fuels industry. The company operates across 76 different countries from 590 sites (see Figure 10) and has physical and reputation risk scores of 3.8 and 3.4 respectively. Although this risk is not low (oil industry average risk is 3.5 and 3.7), it nonetheless understates the right-hand tail risk as approximately 10% of its sites have a risk level above 4.0 (see Figure 11).

loss in the region is pollution, which is likely a direct result of the oil and gas operations in the area. Other important factors appear to be air condition (related to pollution) and increased wildfire hazard. An investment manager could, for example, take this information and engage with the company on its exposure within these areas to better understand if the company has any response actions in place (e.g., biodiversity strategy, targets and transition plans related to biodiversity, more sustainable practices than the sectoral average, etc.). Using the WWF BRF tool, investors can identify these large global companies' risk hotspots and either attempt to influence companies to address them to become more sustainable and resilient, or avoid the risks altogether through divestment.

Table 4 shows a breakdown of the most important physical risk indicators for Company D's two highest risk sites. This granular analysis reveals that a major driver of biodiversity

Location	Arabian Peninsula	Godavari	
Physical Risk	4.58	4.5	
Physical risk categories and indicators	1. Provisioning Services	4.15	3.75

	2. Regulating and Supporting Services - Enabling	3.5	4

	2.2 Air Condition	2.5	4

	3. Regulating Services - Mitigating	3.25	4.38

	3.2 Wildfire Hazard	1.5	4.5

	4. Cultural Services	0	0
...	
5. Pressures on Biodiversity	5	4.62	
...	
5.4 Pollution	5	5	

Table 4: Disaggregated physical risk classes and indicators for the two riskiest sites in the Arabian Peninsula, and Godavari for Company D

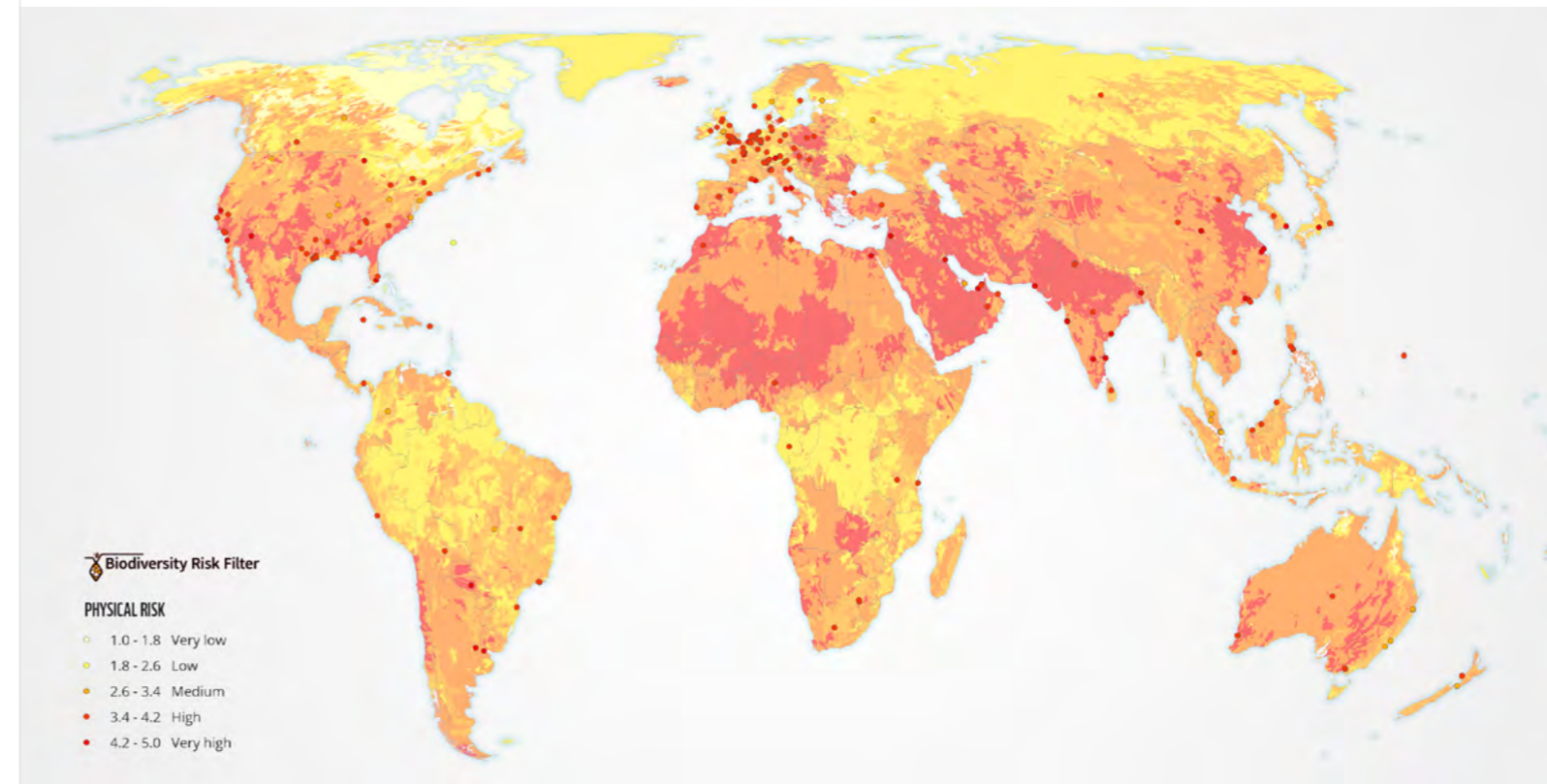


Figure 10: Distribution of Company D's global operations and their physical risk
Note: Red represents scape risk scores from 4-5, orange from 3-4, yellow from 2-3 and green from 0-2

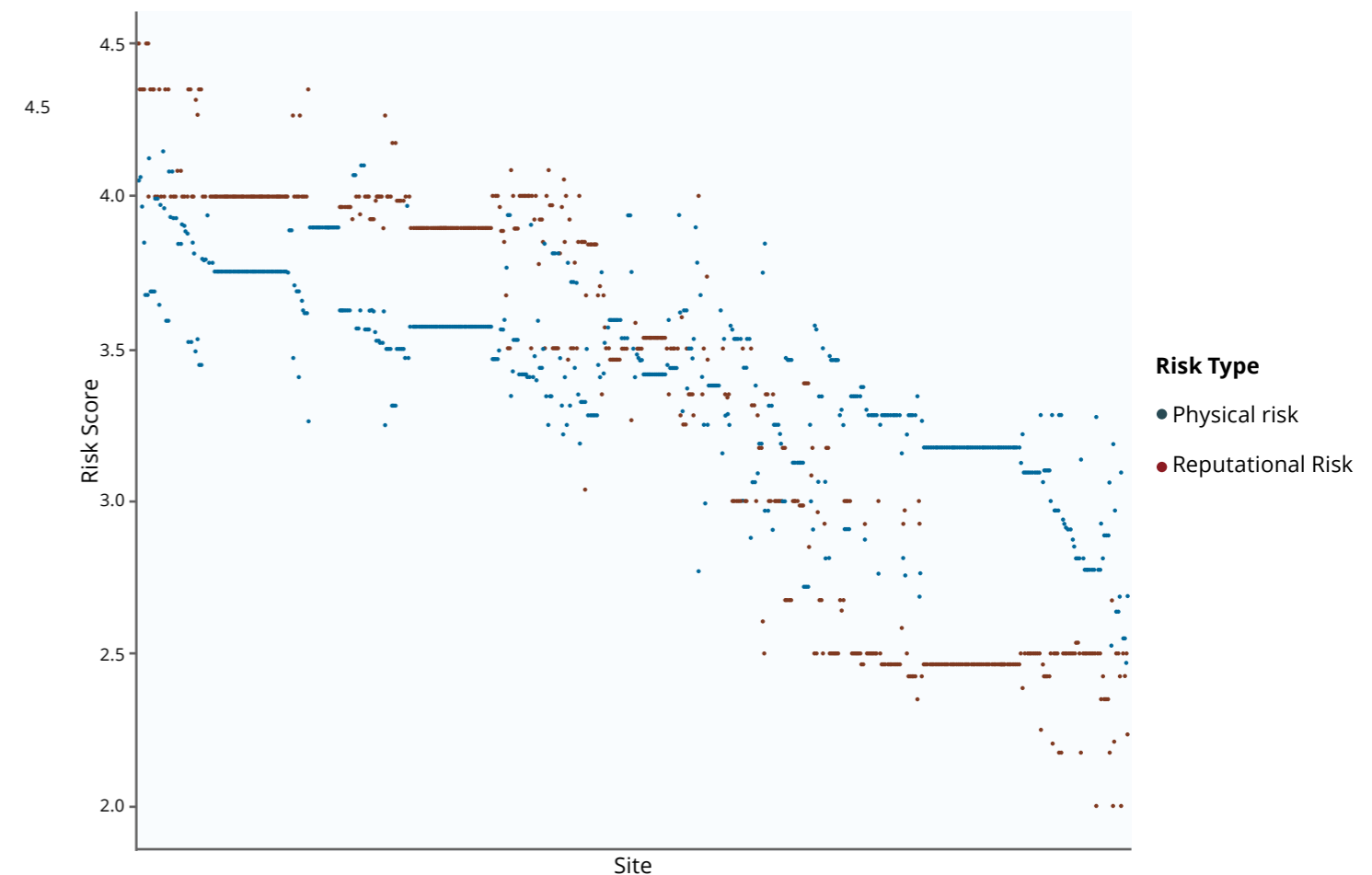


Figure 11: Physical and reputational risk scores of Company D's sites

4 CONCLUSIONS

Biodiversity loss represents a material risk to businesses, as shown in the case study. To stop biodiversity and nature loss, all economic stakeholders have a role to play. This section first reflects on the key results of the case study, followed by specific recommendations for companies, financial institutions, policymakers, regulators and authorities, data and tool providers and academia.

4.1 - REFLECTION ON THE CASE STUDY OUTCOMES

The analysis of the sample portfolio of 605 MSCI ACWI companies and their respective 7,629 sites using the WWF BRF tool and methodological guidance A and C, has provided two major insights in the narrative of biodiversity-related risk assessment.

First, the WWF BRF is able to provide companies and financial institutions with valuable insights into biodiversity-related risks and how they might affect company locations. Second, sufficient data exists for many aspects of biodiversity which enable location-specific and multi-factorial assessment of biodiversity-related risk:

- 1. The case study has shown that, with the help of the WWF BRF tool and methodological guidance, companies and financial institutions can start to analyse and identify potential biodiversity-related risk.** As the tool provides an overview of site- as well as company-level risk aspects, investment and risk managers can easily screen and prioritise companies and industry sectors as biodiversity hotspots and explore the underlying risk down to the site and indicator-level. This level of granular analysis is important when deciding how to spend resources on in-depth investigations and when engaging with companies on their impacts, dependencies and coping strategies. As shown in Figure 7 and Figure 9, the output given by the WWF BRF tool can be easily visualised to identify potentially high-risk companies within a portfolio, as well as potentially high-risk sites within companies. The tool requires further development before it can be fully integrated into financial risk management, for example with the inclusion of scenario analysis. Nonetheless, even in its current form, it provides a unique and effective platform which companies and financial institutions can use to begin to integrate biodiversity-related risk analysis into their operations.
- 2. The case study showed that there is sufficient data available to conduct a comprehensive biodiversity risk assessment.** A common obstacle cited to exploring biodiversity-related risk for companies and financial institutions is that there is insufficient data to enable accurate analysis. Through this case study and the creation of the WWF BRF, we have shown that this is not true. Sufficient location-specific company-level data and location-specific biodiversity data is available to start with the assessment. To conduct the case study analysis down to the site level for a large number of companies, two databases (FactSet and SFI) were used to identify the geographical locations of company operations. These and similar databases are available to financial institutions and could be used in their own biodiversity-related risk analysis. In addition, the WWF BRF provides 33 geo-specific individual indicators for biodiversity importance and integrity assessments. These indicators are being constantly updated and cover an extensive array of ecosystem services that are integral to the functioning of the global economy. By combining location-specific company data with location-specific biodiversity data, this case study has shown there is sufficient data available to start assessing biodiversity-related risk.

The methodology and data used in the case study provide a clear example to the financial industry of how to begin assessing biodiversity-related risk for a portfolio of companies. However, it is crucial to note again that the sample in this case study did not include spatial information on upstream or downstream supply chain sites. This remains a significant gap in risk assessment, particularly as many companies' greatest biodiversity-related risk will be in upstream operations. Although there is still much work to be done fine-tuning indicators and developing future functions, the WWF BRF tool and methodological guidance A-C offers the industry a much needed first start to biodiversity-related risk assessment.

4.2 - RECOMMENDATIONS

As we have seen, nature and biodiversity underpin the global economy and human wellbeing. If we are to secure a sustainable economy that lives in harmony with nature and people, we need to transition to a world that conserves and restores biodiversity. For this to happen, all the economy's stakeholders have a role to play. Companies and financial institutions can start their biodiversity journey now by assessing their dependencies and impacts and the resulting risks and opportunities, setting science-based targets and identifying actions. They should further contribute to defining standards on nature-related disclosure and ask for the disclosure of location-specific company data specifically, as these data is essential to perform biodiversity or nature-related risk assessments. Policymakers, regulators and supervisory authorities should contribute by ensuring a level playing field and enforcing conservation measures. Legislation, subsidy regimes, tax systems and reporting frameworks must specifically address the protection and restoration of nature and its biodiversity – creating protected areas, reducing deforestation and promoting circular economies and nature-based industrial practices. Finally, data and tool providers as well as academia can help by enhancing our understanding of biodiversity, for example, by making environmental as well as georeferenced company data more accessible or developing scenarios on how the integrity of biodiversity and ecosystems might change over time to identify appropriate measures.

COMPANIES

- **Assess baselines and set targets:** Identify biodiversity-related hotspots, assess own biodiversity-related risks and impacts and set ambitious science-based targets to contribute to an economy that halts and reverses biodiversity and nature loss.
- **Identify actions:** Define a set of appropriate actions to restore and conserve biodiversity.
- **Increase transparency:** Collect location-specific data about own operational sites and demand disclosure of location-specific company data from key suppliers, particularly upstream suppliers. Make this data public or at least accessible to lenders, investors and buyers.
- **Collaborate:** Collaborate with others, join international initiatives and adopt standards (e.g., TNFD).

FINANCIAL INSTITUTIONS

- **Assess baselines and set targets:** Identify biodiversity-related hotspots, assess biodiversity-related risks and impacts of investment, financing and underwriting activities and set ambitious science-based targets to contribute to an economy that halts and reverses biodiversity and nature loss.
- **Identify actions:** Engage with “hotspot” companies to get a better understanding of their actual risk exposure (i.e., whether the company has sustainable practices in place, a biodiversity strategy etc.) and to encourage them to identify appropriate actions to manage, restore and conserve biodiversity. Integrate biodiversity-related issues into mainstream risk assessment.
- **Demand transparency:** Engage with portfolio companies on the disclosure of location-specific company and, particularly upstream, supply chain data and biodiversity-related risks, opportunities and impacts.
- **Collaborate:** Collaborate with others, join international initiatives and adopt standards (e.g., TNFD).

POLICYMAKERS, REGULATORS AND AUTHORITIES

- **Adjust regulation:** Adopt legislation to conserve biodiversity and biodiversity targets in national legislation, implement international taxonomies and standards and enforce action towards an economy that halts and reverses biodiversity and nature loss.
- **Adapt monetary policy and prudential supervision to integrate biodiversity-related risks:** Central banks and financial supervisors should systematically assess the biodiversity-related risks in their own portfolios and ask financial institutions how they are dealing with biodiversity-related risks. They should also start defining minimum expectations towards management of biodiversity-related risks by financial institutions.
- **Increase transparency:** Require mandatory, globally comparable disclosures of location-specific company and supply chain data and biodiversity-related risks, opportunities and impacts in alignment with international standards (e.g., TNFD).

DATA AND TOOL PROVIDERS AND ACADEMIA

- **Expand asset-level data sets:** Gather and offer asset-level data on additional industry sectors of particular importance to biodiversity (e.g., agriculture).
- **Increase supply chain transparency:** Increase the level of transparency and trackability of upstream and downstream supply chains by developing tools and certifications.
- **Leverage existing frameworks:** Extend offerings and integrate biodiversity into your sustainability data sets. Make use of this and similar frameworks to ensure consistency.
- **Develop biodiversity scenarios:** Develop quantitative regional and global biodiversity scenarios to indicate how the integrity of biodiversity might change over time and how that might impact company performance.



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APPENDICES

APPENDIX I: OVERVIEW OF BIODIVERSITY ASSESSMENT TOOLS

Tool	Provider	Description
BFFI	CREM and PRé Sustainability, together with ASN Bank	The Biodiversity Footprint Financial Institutions (BFFI) provides a biodiversity footprint of the economic activities in which a financial institution invests. The methodology allows calculation of the environmental pressures and the biodiversity impact of investments within an investment portfolio, at the level of a portfolio, an asset class, a company or a project.
BIA-GBS	Carbon4Finance and CDC Biodiversité	Biodiversity Impact Analytics (BIA-GBS) measures the biodiversity impact of companies. Investors can identify biodiversity hotspots in their portfolios and use biodiversity impact data for decision-making and to engage with key stakeholders. By offering large-scale biodiversity data, BIA-GBS™ supports the transition of the financial sector to align with international targets and reduce the impact from multiple pressures on biodiversity.
BIAT	ISS ESG	The Biodiversity Impact Assessment Tool (BIAT) assesses the impacts of corporates on biodiversity by considering a set of environmental pressures on species and habitats, the entire value chain and the geographical location. It enables investors to better understand and assess biodiversity risk in their portfolios in alignment with two of the most widely accepted biodiversity assessment metrics: Potentially Disappeared Fraction of Species (PDF) and Mean Species Abundance (MSA).
CBF	Iceberg Data Lab and I Care Consult as scientific partner	The Corporate Biodiversity Footprint (CBF) is designed to assess the annual impact of activities of corporates, financial institutions, real assets and sovereign entities on global and local biodiversity. This appraisal is based on the impact generated from the products purchased or sold by companies calculated throughout their value chain.
ENCORE	UNEP-WCMC, UNEP FI and Global Canopy	Exploring Natural Capital Opportunities, Risks and Exposure (ENCORE) enables users to visualise how the economy potentially depends and impacts nature and how environmental change creates risks for businesses. ENCORE has two main parts: the first focuses on natural capital, the second focuses on biodiversity (a specific component of natural capital). For the first, starting from a business sector, ecosystem service, impact driver, or natural capital asset, ENCORE can be used to start exploring risks related to natural capital. These risks can be explored further to understand location-specific risks with maps of natural capital assets, drivers of environmental change, and impact drivers. For the second, ENCORE allows finance sector users to assess their portfolios' potential alignment with the vision of a nature positive future.
GBSFI (GBS)	CDC Biodiversité	The Global Biodiversity Score for Financial Institutions (GBSFI) is based on the GBS®, a tool which provides an overall and synthetic vision of the biodiversity footprint of economic activities. It is measured by the Mean Species Abundance (ratio between the observed biodiversity and the biodiversity in its pristine state). Calculation of the Mean Species Abundance is based on PBL Netherlands Environmental Assessment Agency's GLOBIO model of five terrestrial pressures (land use, nitrogen deposition, climate change, fragmentation, and infrastructure/ encroachment) and five aquatic pressures, and their impacts on biodiversity.
IBAT	BirdLife International, Conservation International, IUCN and UNEP-WCMC	Integrated Biodiversity Assessment Tool (IBAT) is a web-based biodiversity data provider and the single source of licenced commercial access to global biodiversity datasets based on the IUCN Red List of Threatened Species™, the World Database on Protected Areas (WDPA) and the World Database of Key Biodiversity Areas (WDKBA). Furthermore, IBAT provides access to the Species Threat Abatement and Restoration Metric (STAR) – a metric that allows quantification of the potential contributions that species threat abatement and restoration activities offer towards reducing extinction risk across the world.

Table 5: Non-exhaustive list of biodiversity assessment tools

APPENDIX II: ALIGNMENT WITH THE EUROPEAN SUSTAINABILITY REPORTING STANDARD (ESRS) E3 AND E4

Disclosure requirements of ESRS E4	Alignment analysis
E4-1: Transition plan on biodiversity and ecosystems	The planned integration of a Respond Module can be used to inform a transition plan in the future (to align with relevant biodiversity targets such as the Post-2020 Global Biodiversity Framework, or relevant targets as part of the EU's Biodiversity Strategy (European Commission, 2020a)).
E4-2: Policies related to biodiversity and ecosystems	E 4-2 asks each undertakings to disclose its "policies implemented to manage its material impacts, risks and opportunities related to biodiversity and ecosystems". While the WWF BRF tool cannot provide the policies itself, the assessment can inform and structure the design of such policies (which should be linked to material impacts and risks).
E4-3: Actions and resources related to biodiversity and ecosystems	The planned integration of the WWF BRF Respond Module can be used to inform action plans.
E4-4 (adopted): Targets related to biodiversity and ecosystems	Similarly to E 4-2, the WWF BRF tool does not yield a specific list of targets. However, the WWF BRF tool provides valuable support as targets should relate to the company's material impacts, dependencies and risks.
E4-5: Impact metrics related to biodiversity and ecosystems change	For E 4-5, the WWF BRF provides only partial support, as the tool covers only potential but not actual impacts. However, the current WWF BRF covers a few aspects, such as "disclosing number of sites owned, leased or managed in or near these protected areas". Other disclosures, e.g., whether the undertaking has concluded that it directly contributes to the impact drivers such as land-use change or the introduction of invasive species, require further analytical resources.
E4-6: Potential financial effects from biodiversity and ecosystem-related impacts, risks and opportunities	While the methodology does not provide specific guidance to estimate potential financial effects, the WWF BRF data output provides an excellent data foundation which contains the important linkages between each company location, its dependencies on ecosystem services, the local integrity of ecosystem services (physical risk) and its reputational risk. One could process this data further, which would require further assumptions to translate the risk exposure into (adverse) financial effects. One could, for example, derive potential adverse effects based on the dependency on functioning ecosystem services and their local integrity (which would require a damage function). ²¹

Table 6: Alignment of the WWF BRF with the ESRS E4

Disclosure requirements of ESRS E3	Alignment analysis
E3-1: Policies related to water and marine resources	E3-1 asks each undertaking to disclose its "policies implemented to manage its material impacts, risks and opportunities related to water and marine resources". While the WWF WRF tool cannot provide the policies itself, the assessment can inform and structure the design of such policies (which should be linked to material impacts and risks).
E3-2: Actions and resources related to water and marine resources	The planned integration of the Respond Module can be used to inform action plans.
E3-3: Targets related to water and marine resources	Similar to E3-1, the WWF WRF tool does not yield a specific list of targets. However, the tool provides valuable support, as targets should relate to the company's material impacts, dependencies and risks.
E3-4: Water consumption	The WWF WRF basin risk assessment provides valuable support as water consumption performance should relate to the company's material risks and opportunities. In addition, the WRF operational risk assessment provides valuable information on site-level water use (e.g., water withdrawal and discharge).
E3-5: Potential financial effects from water and marine resources-related impacts, risks and opportunities	While the methodology does not provide specific guidance to estimate potential financial effects, the WWF WRF data output provides an excellent data foundation which contains the important linkages between each company location, its dependencies on water, the local integrity of water resources (physical risk) and its reputational risk. WWF has explored developing a valuation tool to help understand how water risks may potentially affect financial value (see <i>Linking Water Risk and Financial Value Report III: New valuation tool and database</i> (WWF, 2019)).

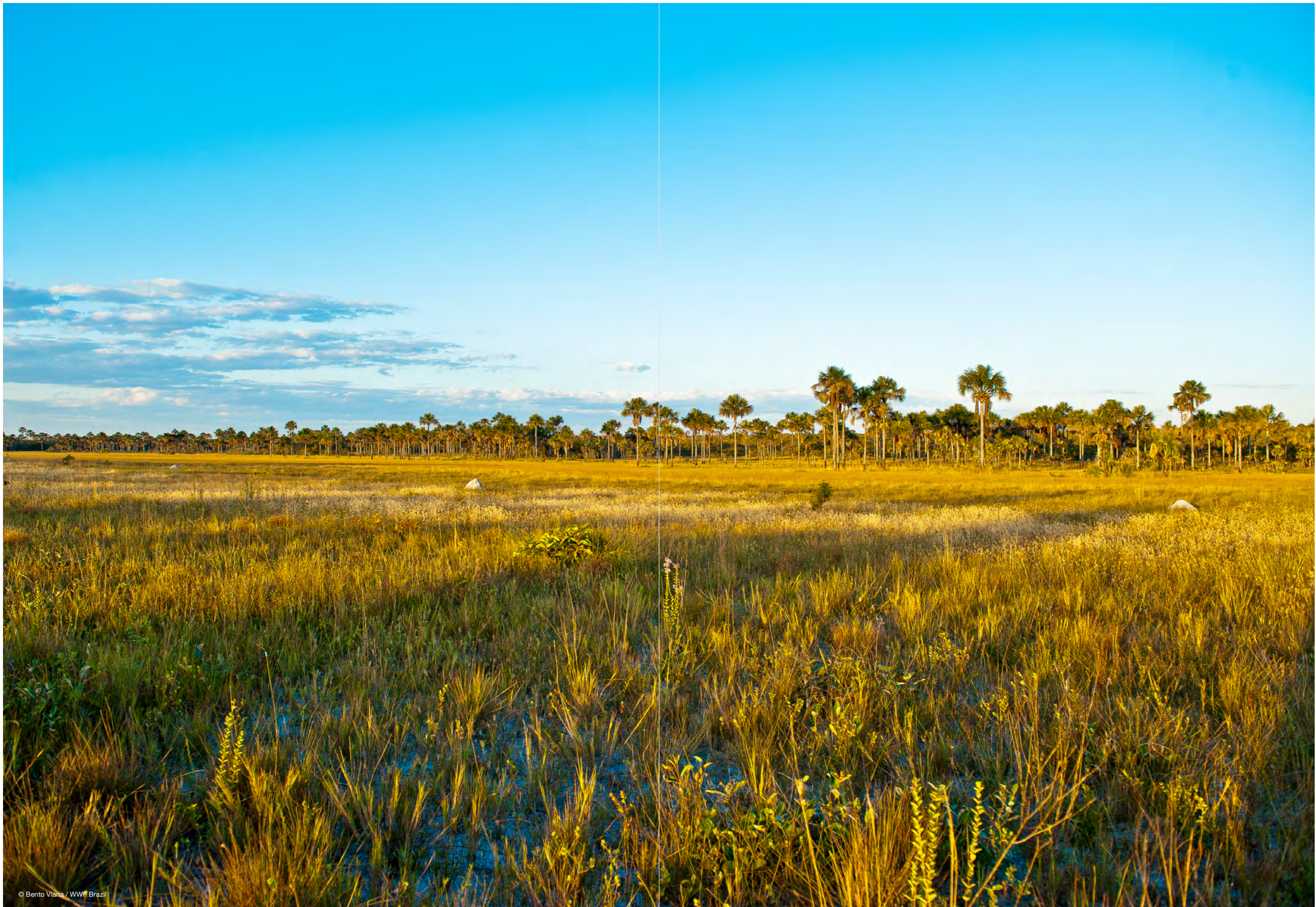
Table 7: Alignment of WWF WRF with ESRS E3

APPENDIX III: WWF RISK FILTER INDUSTRY SECTOR CLASSIFICATION

WWF Risk Filter Industry Sector	Associated Activity Guidelines
Agriculture (animal products)	Large-scale livestock (beef and dairy)
	Small-scale livestock (beef and dairy)
Agriculture (plant products)	Large-scale irrigated arable crops
	Large-scale rainfed arable crops
	Small-scale irrigated arable crops
	Small-scale rainfed arable crops
Appliances and general goods manufacturing	Manufacture of machinery, parts and equipment
	Houseware and specialities production
Automotive, electrical equipment and machinery production	Manufacture of machinery, parts and equipment
	Tyre and rubber production
Chemicals and other materials production	Catalytic cracking, fractional distillation and crystallization
	Incomplete combustion
	Polymerisation
	Vulcanisation
	Synthetic fertilizer production
	Cryogenic air separation
	Gas adsorption
	Membrane technology
	Natural gas combustion
	Recovery and separation of carbon dioxide
Construction materials	Glass making
	Construction materials production
Electric energy production – combustion (biomass, coal, gas, nuclear, oil), geothermal energy	Infrastructure holdings
	Electric/nuclear power transmission and distribution
	Nuclear and thermal power stations
	Biomass energy production
	Geothermal energy production
Electric energy production – hydropower	Infrastructure holdings
	Hydropower production
	Electric/nuclear power transmission and distribution
Electric energy production – solar, wind	Infrastructure holdings
	Solar energy provision
	Wind energy provision
	Electric/nuclear power transmission and distribution
Electronics and semiconductor manufacturing	Electronics and hardware production
	Manufacture of semiconductor equipment
Fishing and aquaculture	Aquaculture
	Freshwater wild-caught fish
	Saltwater wild-caught fish
Food and beverage production	Alcoholic fermentation and distilling
	Processed food and drink production
Food retailing	Infrastructure holdings
General or speciality retailing	Infrastructure holdings
Health care, pharmaceuticals and biotechnology	Infrastructure holdings
	Life science, pharma and biotech manufacture
	Life science, pharma and biotech tools and services
	Provision of health care
	Managed health care

Hospitality services	Cruise line provision
	Hotels and resorts provision
	Restaurant provision
Land development and construction	Construction
	Infrastructure builds
Metals and mining	Alumina refining
	Mining
	Iron extraction
	Iron metal production
	Metal processing
Offices and professional services	Steel production
	Infrastructure maintenance contracts
	Infrastructure holdings
	Financial services
	Leisure facility provision
Oil, gas and consumable fuels	Real estate activities
	Environmental and facilities services
	Mining
	Oil and gas drilling
	Manufacture of machinery, parts and equipment
	Oil and gas services
	Oil and gas exploration surveys
	Oil and gas refining
	Oil and gas storage
	Oil and gas transportation
Gas distribution	
Gas retail	
Paper and forest product production	Large-scale forestry
	Production of forest and wood-based products
	Small-scale forestry
	Paper packaging production
Telecommunication services (including wireless)	Production of paper products
	Cable and satellite installations on land
	Fibre-optic cable installation (marine)
Textiles, apparel and luxury good production	Telecommunication and wireless services
	Jewellery production
	Natural fibre production
	Synthetic fibre production
	Footwear production
Transportation services	Production of leisure or personal products
	Tobacco production
	Infrastructure maintenance contracts
	Distribution
	Airport services
	Marine transportation
	Marine ports and services
Railway transportation	
Water utilities and water service providers	Construction
	Water services (e.g. waste water, treatment and distribution)

Table 8: Overview of WWF Risk Filter industry sector classification



ENDNOTES

- 1 Based on SBTN working definition, unpublished.
- 2 This only includes losses from a decrease in the supply of six key ecosystem services (crop pollination, water supply, carbon storage, marine fisheries, production of timber, and coastal protection from flooding and erosion).
- 3 Please note that the January 2023 version of the WWF BRF tool does not yet include the regulatory risk assessment. The regulatory risk assessment is under development and will be available in due course.
- 4 By location-specific company data we refer to data on the locations of company operational and supply chain sites (coordinates, or address), the industry classification and business importance of the site to the overall company performance. For more information, refer to the WWF BRF Methodology documentation (WWF Biodiversity Risk Filter, 2023).
- 5 See <http://www.ibat-alliance.org>
- 6 See <https://riskfilter.org>
- 7 See <https://tnfd.global>
- 8 See <https://sciencebasedtargetsnetwork.org>
- 9 The final text of the CSRD was adopted by the European Parliament and the European Council in November 2022. It is expected that companies will start reporting in 2025 on their 2024 financial year (Council of the EU, 2022).
- 10 It targets all listed European companies as well large European companies that meet two of the following criteria: a) more than 250 employees; b) more than €40 million turnover; and c) over €20 million on the balance sheet. The directive will also cover non-European companies who generate a net turnover of €150 million in the EU and have at least one subsidiary or branch in the EU (European Commission, 2021).
- 11 The gap analysis is based on WWF's Assessing Portfolio Impacts report (WWF, 2021), an internal analysis of over 40 tools, frameworks, guides and initiatives and the SBTN Tool Stream assessment (in which WWF participated), which tested around 30 biodiversity-related tools.
- 12 A general requirement for both ESRS E3 and E4 is to describe the processes used to identify and assess material impacts, risks and opportunities related to water and marine resources, as well as biodiversity and ecosystems (EFRAG, 2022a; EFRAG, 2022b).
- 13 See Methodology Documentation for more information on the underlying data (WWF Biodiversity Risk Filter, 2023).
- 14 The MSCI ACWI comprises 2,933 companies from 23 developed and 23 emerging markets. For more information, see www.msci.com/our-solutions/indexes/acwi
- 15 <https://go.factset.com/marketplace/catalog/product/factset-data-management-solution>
- 16 <https://www.cgfi.ac.uk/spatial-finance-initiative/geoasset-project/geoasset-databases>
- 17 A hybrid solution was used to increase the quality of the data for the analysis. The inclusion of the SFI asset-level data gives slightly more granularity to the analysis and assist in providing more accurate results. For more information on the hybrid approach and data collection, see Guidance A of the WWF BRF Methodology Documentation (WWF Biodiversity Risk Filter, 2023).
- 18 The case study is based on WWF BRF data from November 2022. As the underlying data is continuously improved, changes may occur that are not reflected in the case study.
- 19 This industry average is found by taking the average of all industry specific sites.
- 20 While this exercise was conducted for physical risk the same principles apply to the analysis of reputational risk.
- 21 For helpful work on this topic, we recommend a list of case studies by CISL (Cambridge Institute for Sustainability Leadership, 2022).





**OUR MISSION IS TO CONSERVE
NATURE AND REDUCE THE MOST
PRESSING THREATS TO THE
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