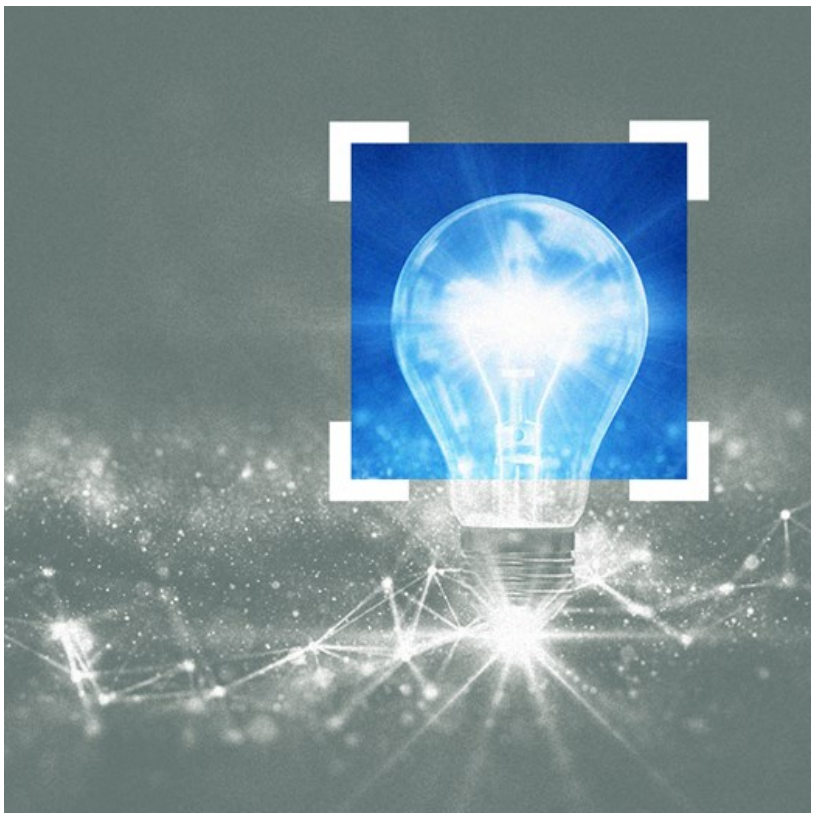

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ARTICLE

Biodiversity in the boardroom: a guide to nature-related data for companies, investors, and their legal advisors

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Introduction

Nature in crisis

Nature is in crisis. Over one million species are at risk of extinction,[1] driven to the brink by unsustainable human activity. Since 1950, 50 per cent of the world's forests have been degraded or completely cleared[2]—and some of these forests have been around for over 100 million years. We're on track to lose up to 50 per cent of global biodiversity by 2050 if current trends continue.[3]

The consequences of nature loss extend far beyond the environmental realm, and affect economies, public health, and social stability. More than 50 per cent of global GDP—or US$58 trillion—is estimated to be moderately or highly dependent on nature and the services it provides.[4]

Sectors such as agriculture, fisheries, and forestry are already experiencing the effects of nature and biodiversity loss in the form of reduced productivity and increased volatility.[5] These shocks travel up the value chain in the form of disrupted supply chains and increased costs of raw materials.

Public health is also at risk: the destruction of natural habitats has been shown to have played a key role in the spread of COVID-19, which has had devastating global impacts.[6]

There is a reinforcing link between nature, climate, and social justice: losing biodiversity undermines resilience to climate change, and worsens the impacts of natural disasters such as floods, droughts, and storms, which disproportionately affect vulnerable communities.[7]

And climate change is and will continue to be among the biggest drivers of biodiversity loss, with up to 37 per cent of species made vulnerable to extinction by 2050 if temperatures rise by 2°C.[8] The most vulnerable communities will have not contributed substantially to this 2°C rise, and yet they will bear a disproportionate burden of impacts and adaptation.[9]

Corporate disclosure as a mode of intervention

It is an unfortunate but unavoidable fact that the vast majority of companies, large and small, have a negative impact on nature. From deforestation for agricultural expansion to pollution from industrial processes, corporate activities, both directly and indirectly, are driving habitat destruction, resource depletion, and species extinction.

To change this trajectory, data on the state of nature and the pressures that affect it are urgently needed. Without reliable and accurate data, it is impossible to understand the scale of the problem or to implement effective solutions. As the well-known business adage goes, 'you can't manage what you don't measure'. A robust, standardized system of metrics and data collected and disclosed systematically by companies is essential for redirecting corporate and investor decision-making, whether that is via market mechanisms creating incentives and disincentives for companies, or via policy and regulation requiring corporate accountability and enforcing penalties.

As nature and biodiversity become embedded into corporate parlance and planning, companies and investors will pursue product development (e.g. constructing investment funds or designing nature-positive materials) based on nature and biodiversity data. And the role of biodiversity credits and markets is becoming clearer, with an emphasis on positive contributions rather than negative offsets.[10] These trends generally mirror the evolution of the climate space. As the practice of data disclosures moves from being voluntary to being regulated, companies and investors may face legal action for non-compliance or misleading claims.[11]

Understanding how nature-related data are used—and the associated legal implications—therefore becomes increasingly important. This overview will help readers place nature and biodiversity data into context as and when they encounter them, enabling readers to guide companies and investors accordingly. It is recommended to always reference the latest guidance on nature-related disclosure standards and regulations from official sources, as this landscape is evolving rapidly.

The main types of nature and biodiversity metrics

To introduce nature and biodiversity metrics, let us start with the simpler case of climate. There are two climate metrics that most people are familiar with: the amount of greenhouse gas (GHG) emissions, measured in tonnes of carbon dioxide equivalent; and change in global average temperature, measured in degrees Celsius. We know that GHG emissions cause higher temperatures, which is to say they are a pressure on (or driver of) changes to the climate. While there are many varied consequences of higher temperatures, the impact is summarized in terms of the average global temperature change. This relationship between *pressures* (e.g. GHG emissions) and *state* (e.g. global average temperature) establishes a precedent within which to consider nature and biodiversity metrics.

Pressure metrics are particularly relevant to companies because they are tangible, actionable, and predictive. They are tangible in that they can be measured by companies, such as volumes of water, hectares of land, or tonnes of emissions. They are actionable in that they can be managed and optimized via company operations. And they are predictive in that the effects on nature can be robustly modelled to anticipate impacts.

State metrics may be more familiar to many readers, as the predominant need for data has historically been to convince policymakers and the general public that nature is being lost at an unsustainable rate, and that action must be taken to halt and reverse nature loss. State of nature data are particularly relevant in cases where information on the health of ecosystems and species is required (e.g. for policymaking, or decisions on site selection for assets).

The subsequent sections will provide an overview of these key categories of metrics: how they are defined, how they are gathered, how they are combined with other data types, how they are used by companies and investors, and their strengths and limitations.

Understanding pressures on nature and biodiversity

Definition of pressures

Pressure metrics look to answer the question: ‘how do company activities impact nature, and by how much?’

Pressures are defined as human activities that directly or indirectly change the state of the environment or ecosystem.[12] These include emission-type activities, such as GHG emissions, waste generation, and pollution; consumption-type activities such as water use, fishing, and timber use; and other activities a company might engage in, like converting land or sea from its original state, or introducing invasive alien species. All these pressures lead to impacts on nature and are therefore also known as ‘impact drivers’.

The two main categories of pressures are direct pressures, where human activity results in an impact on nature via a direct causal link, e.g. cutting down a forest or catching fish; and indirect pressures, where an activity is indirectly linked to an impact on nature, e.g. the company releases GHG emissions, contributing to climate change, which disrupts species migration, and causes forest dieback.

This distinction becomes especially important when examining the nature-related impacts of companies who don’t directly use or manage land. For context, only 2.1 per cent of the market capitalization of the S&P 500 is attributable to sectors with direct operations associated with high intensity land use, such as agriculture, forestry, mining, and real estate.[13] For the rest, most of their operational impacts on nature are indirect.

How pressures data are collected, combined, and analysed

Pressures data will be recognizable to those familiar with corporate environmental practices. The gathering of these data is typically standardized for companies engaging in annual sustainability reporting, through on-site monitoring and integrated Enterprise Resource Planning systems that track operational data and resource flows.

Pressures data can be tied to impacts on nature and biodiversity through so-called 'pressure-impact pathways'. This not necessarily a one-for-one match: one pressure can lead to multiple impacts, and the same impact can be caused by multiple pressures. For example, agricultural companies causing land-use change (pressure) may result in habitat loss (impact), water cycle disruption (impact), and soil erosion (impact). Similarly, industrial run-off (pressure), plastic waste (pressure), and invasive species (pressure) may all result in water quality degradation (impact).

The aim of a pressure-impact pathway is to establish what human activities lead to what changes in the environment or ecosystem. Moving further downstream on that pathway enters 'state of nature' territory—focusing on how changes to the environment or ecosystem result in shifts in the health and resilience of nature and biodiversity, i.e. the functioning of ecosystems and survival of species. But with pressures, what happens upstream is critically important: pressures data concern themselves with the causes of nature and biodiversity loss, and halting and reversing those causes.

A key step is to establish a scientifically robust link between a certain quantity of a pressure (e.g. gallons of water consumed), and the corresponding level of impact (e.g. increased likelihood of species extinction). Pressures data can then be used to ensure that companies are tracking and managing their pressures in proportion to how impactful they are—their 'materiality'.

There are well-established scientific models that convert pressures into impacts. The most powerful approaches account for location-specific impacts, which may occur at different timescales, across a broad variety of pressures. These so-called 'footprinting' methods provide a common, standardized metric that allow one to size the relative impacts of different pressures, and compare between pressures. The most frequently used metric these models deploy is 'potentially disappeared fraction of species (PDF)', which represents the increased likelihood of species going extinct as a result of a company's activities.[14] Based on a given company's pressures data, one can then use PDF to assess, for example what percentage of a company's impact on species comes from GHG emissions, water pollution, water consumption, and land use, respectively.[15]

It's worth noting that there are other metrics that can be used to evaluate and size pressures—calculating impacts in monetary terms, for example, estimates the negative externalities (or costs to society) resulting from pressures. Increased water pollution, for example, would lead to increased human health costs, and increased GHG emissions would damage infrastructure and lower agricultural yield. This provides another, more anthropocentric lens through which to look at how pressures drive impacts.

How and why pressures data may be used by companies and investors

When companies and investors are evaluating which data to use to start to assess their impacts on nature and biodiversity, pressures data are a sound place to start. There are a few key reasons for this:

- *Pressures data are readily accessible and available.* In many cases, pressures data are operational data, such as pollution, water consumption, and land use. Companies that have been voluntarily disclosing these data in their sustainability reports will have such data on hand, and can immediately start to derive biodiversity-related insight from it. Investors looking at a listed equity portfolio of thousands of

companies will also be able to gather and use pressures data to model impact at scale and into the future, which they can use to then make stock selection, portfolio composition, and stewardship decisions.

- *Pressures data can be used to assess materiality across the value chain.* For many companies, a substantial proportion of impacts will occur in their value chains (e.g. through suppliers, rather than in their direct operations). In these instances, applying a pressures lens can help focus in on material intervention areas (e.g. a technology firm engaging with its suppliers on air pollution and waste generation after noting these to be their greatest impact areas, dwarfing the GHG emissions and water consumption from their own operations).

- *Pressures data are widely applicable to all companies in all sectors.* The dominant form of impacts on nature and biodiversity for most companies occur indirectly—via pressures like GHG emissions, water consumption, and pollution—rather than directly via land- and sea-use change. If a company does not have land intensive operations (as previously established, only 2.1% of global corporates do) their indirect impacts on nature become important. For example, an IT company may not use or convert much land, but find that its impacts are dominated by the emissions of its electricity suppliers, or by water consumed in its data centres, depending where its operations are located. The picture changes when one looks only at primary sectors—agriculture, mining, forestry, and infrastructure—and for these it is worth closely examining direct impacts as well as understanding the resulting change in state of nature that results.

Current limitations and future potential of pressures data

Using pressures data in the form of pressure-impact models has significant advantages as highlighted above, especially in building a picture of materiality that companies and investors can start to prioritize mitigation action around. There are two key limitations: one that is inherent, and one that is surmountable.

The inherent limitation is that pressure-impact models, while based on peer-reviewed science, are, at the end of the day, modelled impacts rather than measured impacts.[16] However, this is not unique to biodiversity data. Just as with climate models that explain how GHG emissions impact global temperature, the underlying science of biodiversity pressure-impact models is well established and actionable, with active research driving rapid improvements in model accuracy.

The surmountable limitation is to do with pressure data reported by companies: a common criticism of using pressure-impact models is that pressure data reported by the company itself are limited, and estimates are widely used for company pressure data as well as its supply chain.[17] This is rapidly changing, as disclosure increases due to regulations such as the Corporate Sustainability Reporting Directive (CSRD) in Europe, and as machine learning models are proving able to accurately estimate unreported pressure data (with R^2 over 0.9 for many metrics) based on known company information and geography.[18] Tracing data across supply chains remains a challenge, but innovation is occurring in this space as well, including the use of blockchain-based tracing of commodities.[19]

Understanding state of nature and biodiversity

Definition of state of nature

State of nature metrics look to answer the question: ‘how is the health of nature and biodiversity, now and over time?’ In the context of companies and investors, it’s often appended with ‘and how does corporate activity affect that change?’

Understanding the state of nature requires understanding the health and functionality of nature and biodiversity at multiple scales. Like the taxonomical hierarchy, nature and biodiversity data exist at different levels of organization: these span from realms (e.g. land, freshwater, and marine environments), biomes (e.g. tropical rainforests, deserts, and tundra), and ecosystems (e.g. coral reefs, wetlands, and forests) to species (e.g. specific plant or animal species) and, at the finest level, genes.

State of nature metrics focus on two of these levels—ecosystems and species—as they are specific enough to be distinctly measured and broad enough to be widely relevant.

Within ecosystems, state metrics typically cover *ecosystem condition*—an indicator of health—and *ecosystem extent*—an indicator of spatial coverage. Similarly with species, state metrics will cover *species extinction risk*—an indicator of species vulnerability—and *species abundance*—an indicator of population size.

How state of nature data are collected, combined, and analysed

State of nature data are gathered through a range of methods, from remote sensing (satellite imagery or drones) to bioacoustic monitoring (capturing sounds to monitor species populations), to field sampling, whether that's eDNA (using genetic material to trace species present) or traditional field sampling and camera traps to record the presence and abundance of species.

With state of nature data, the rule of thumb is the more granular the data the better (spatial resolution for these data can be as low as 1 m^2),[20] the more real time the better (as it is crucial to monitor rapid changes like sudden species declines and deforestation activities),[21] and the more varieties of data the better (as the objective is to get as accurate a picture of the health of nature from as many angles as possible).[22] Some methods for data collection will outweigh others for specific ecosystems and species: real-time satellite imagery can be used to effectively map habitat loss at the ecosystem level, while bioacoustics and eDNA can better track the presence or absence of elusive species, helping gauge species abundance and extinction risk.

As with pressures, various models have been developed to convert raw data on the state of nature and biodiversity (e.g. presence of a species in an area, or degradation of a specific habitat) into more decision-useful metrics that can convey information in a comparable way. One such metric is the Biodiversity Intactness Index (BII),[23] which quantifies how much biodiversity has been lost in an area, serving as an indicator of ecosystem health and resilience. The BII is based on a comparison between the current state of nature and biodiversity versus a baseline of conditions from before human intervention. It is expressed as a percentage, where 100 per cent represents no biodiversity loss and lower percentages indicate varying degrees of degradation. The index is calculated using a combination of satellite imagery, field sampling, and algorithmic modelling to assess ecosystem condition and extent, as well as species populations.

How and why state of nature data may be used by companies and investors

State of nature data offers a layer of insight into the mid- and long-term outcomes of the activities of a company where that company is interfacing with nature at specific locations. The users of state of nature data are more frequently going to be governments at the national, regional, and local levels to set policies and monitor change, but there are specific corporate use cases as well.

- *For governments, state of nature data inform policy, regulation, and land management decisions.* Governments are often the primary collectors of state of nature data through various satellite and on-site monitoring initiatives, and are also the primary users of these data: they rely on them to guide land-use planning, determine conservation priorities, and shape policies and regulations. For example, state of nature data are used in determining boundaries for protected areas and implementing restoration plans in degraded

ecosystems, and in setting baselines and tracking the effectiveness of conservation and restoration initiatives.

- *For companies and investors with land assets and direct impacts, state of nature data provide a detailed view of ecosystem health.* Unlike pressures data, which predominantly track factors like pollution or resource consumption, state data provide a snapshot of the actual condition in the quality of soil, water, and biodiversity at a specific site. This is relevant to companies managing land or natural assets directly: a water utility protecting a catchment area will need state of nature data to monitor the health of the watershed to ensure consistent water quality and availability. Similarly, mining or forestry companies that control large tracts of land may use state of nature data to assess the impacts of their operations on biodiversity and ecosystem services, and consider these data while planning expansion of their operational footprints to ensure they are not contributing to habitat loss or species decline. Natural capital investors who own landscape-based funds or assets may also want to monitor state of nature, as the health of the land will determine its value (e.g. through the provision of ecosystem services).

Current limitations and future potential of state of nature data

State of nature data are complex: ecosystem extent and condition, and species abundance and extinction risk, are all multidimensional and challenging to measure in real time, so these data are subject to missing short-term dynamics and localized disturbances.

Another key challenge in state of nature data is the lack of metrics standardization: databases on the state of nature often exist in different places, collected by very different groups (governments, NGOs, and researchers) and often applying inconsistent methodologies. There have been great efforts to address this: alliances like the Integrated Biodiversity Assessment Tool bringing together relevant data from major NGOs for ease of use (e.g. data on threatened species, and locations of key biodiversity areas and protected areas), and methodologies like BII taking significant steps forward to convert raw data to meaningful and actionable metrics while ensuring scientific rigour.

A final challenge is a common misconception that all companies need to be engaging separately with state of nature data. Companies often cite a lack of data or complexity around gathering data as a reason not to get started on measuring their impacts on nature and biodiversity. But, in ignoring their own corporate pressures, they fail to consider biodiversity impacts they are already tracking and measuring. ‘The real gap is nature intelligence – not nature-related data’, David Craig, the Co-Chair of the Taskforce for Nature-Related Financial Disclosures (TNFD), has said.[24]

The emerging landscape of nature-related standards and regulations: CSRD case study

From standards to regulations: a brief history

To apply the above understanding of pressures on nature and state of nature data to the world of nature-related disclosure standards and regulations, a short review of recent developments will help provide context.

Since 2020, we have seen a marked shift from voluntary sustainability reporting, from one key standard—the Global Reporting Initiative[25]—to guide this disclosure, towards a rigorous set of disclosure regulations, inspired by financial disclosures and applied to new types of material data: first climate, and now nature and biodiversity. For climate, a dedicated taskforce, the ‘Taskforce for Climate-Related Financial Disclosures (TCFD)’ was created, with the express purpose of designing a standard that built on the most rigorous research

(e.g. Intergovernmental Panel on Climate Change guidelines and the GHG Protocol[26]) to guide global legislation and regulation. It identified four categories of information around which companies must report: governance, strategy, risk management, and (most notably for this article) metrics and targets. It standardized reporting requirements by mandating consistent quantitative measures for assessing climate-related performance, with these defined metrics and targets feeding into the other categories (e.g. metrics to inform risk management and targets to govern strategy and action plans). Based on the TCFD's recommendations, several countries have implemented climate-related disclosure regulations, including the UK, Japan, and Canada.

In 2022, the UN adopted the Kunming-Montreal Global Biodiversity Framework,[27] marking a pivotal moment that put nature and biodiversity on the world's radar. The Global Biodiversity Framework also laid the grounds for systematic collection and reporting of nature and biodiversity data by setting a clear global mandate for companies to disclose their biodiversity-related impacts, dependencies, and risks.[28]

Based on the model established by TCFD, the TNFD was set up to support the development of nature and biodiversity-related disclosure regulation, with the final recommendations published in 2023. The TNFD also brought together well-established research and standards (e.g. the Natural Capital Protocol and the Partnership for Biodiversity Accounting Financials Standard) to provide once again a globally consistent guide for disclosure regulation.

There are now several regulatory frameworks in existence that require companies and investors to disclose nature and biodiversity-related data in a specific way, including the Sustainable Finance Disclosure Regulation[29] targeted at investors, Article 29 in France,[30] and the most comprehensive and broadly applicable: the European Union's CSRD.[31]

Deconstructing a nature-related disclosure requirement—CSRD's 'E4'

All disclosure regulations for companies and investors draw from a common foundational set of data—pressures on nature, and state of nature—in order to then set out specific requirements, including deriving further decision-useful insight from these data.

The European Sustainability Reporting Standard's (ESRS) topic on Biodiversity and Ecosystems (E4) makes up the disclosure requirement for companies eligible to report under the CSRD. This final section will go through the E4 requirements and map the requirements to pressures and state of nature metrics. The reader may choose to keep the ESRS Delegated Act[32] open to review alongside this article.

At first glance of ESRS E4, there are some overarching components that resemble the TCFD and TNFD: governance, strategy, risk management (though here it's combined with 'impact, risk and opportunity management'), and metrics and targets.

Within the 'impact, risks and opportunity management' section, the Act requires a company to first look at the issues most material to its operations through three lenses:

(1) Its contributions to 'impact drivers on biodiversity loss', listing all the pressures covered in this article: GHG emissions, pollution, resource consumption, land- and sea-use change, invasive alien species, and so on.

(2) Whether and how it is *impacting species* (specifically referencing 'population size and global extinction risk') and **ecosystems** (specifically referencing ecosystem 'extent and condition').

(3) What its key *dependencies* are on ecosystem services.

The first two make a direct link to pressures and state of nature metrics. Dependencies are a derived metric: they are a form of financial risk that the state of nature poses to a company's operations: they are defined as

'the reliance of a company on natural systems or services to function, create value, and deliver goods or services … these are required for the company's operations and long-term viability'.[33]

Therefore, in the case of biodiversity, companies must be able to use state of nature data to evaluate how they're affected by, for example, changes in water flow and water quality (e.g. energy companies), or pollinator services (e.g. agricultural companies). Where data are available on ecosystem extent and condition, these influence the ecosystem's ability to provide services (e.g. water purification), as do the presence of specific species (e.g. species required for pest control on farmland).[34]

A broader note on *risks*: throughout E4, there is mention of nature-related risks, such as physical risks (e.g. droughts and floods) and transition risks (e.g. policies that regulate water consumption or fishing). Insights around these risks can be derived based on pressures and state of nature metrics (as is the case with dependencies), but they will typically incorporate several other data dimensions (e.g. the company's capital expenditure and operating expenditure, and its asset locations and activities). The key point to take away is pressure and state data are the starting point, and dependencies and risks are derived metrics and insights based on these.

Moving to the section on metrics and targets, ESRS E4 again states the requirement to disclose all material impact drivers (i.e. pressures), and also requires identifying any sites operating in biodiversity-sensitive areas, which can be drawn from databases on Protected Areas and Key Biodiversity Areas.[35] It goes on to specify that where relevant, the company should then disclose information on ecosystem extent and condition, and species extinction at these sites. It also provides guidance on the distinction between in situ data (e.g. field samples) that can give an indication on the population of key species, geospatial data that can additionally provide insight into ecosystem extent and condition, and modelled data that link pressures to impacts, and impacts to state of nature.[36]

The remainder of the E4 requirement draws on these core metrics as a starting point: whether that's setting targets around nature and biodiversity data, building a risk picture using these data ('evaluate the actual or potential impacts and dependencies on biodiversity and ecosystems … including size, scale and frequency of occurrence') and incorporating that into a transition plan, strategy, and set of actions.

Nature and biodiversity data as a legal frontier

The development of regulatory mandates for disclosure represents a significant progression in addressing nature and biodiversity loss. It is imperative that legal professionals deepen their understanding of these data-driven requirements alongside companies and investors to effectively navigate compliance and provide informed guidance. The aim of this article has been to equip readers with the foundational knowledge necessary to engage meaningfully and confidently with this evolving topic. As companies and investors progress in integrating nature and biodiversity considerations into their decision-making, the expertise of legal professionals will be essential in guiding them through compliance with new disclosure requirements, and preparing them to effectively manage nature-related risks.

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