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Bringing sustainability to life: A framework to guide biodiversity indicator development for business performance management

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Abstract

Biodiversity loss is a critical sustainability issue, and companies are beginning to seek ways to assess their biodiversity performance. Initiatives to date have developed biodiversity indicators for specific business contexts (e.g., spatial scales—from site, to product, to regional, or corporate scales); however, many are not widely translatable across different contexts making it challenging for businesses seeking indicators to manage their biodiversity performance. By synthesising the steps of common conservation and business decision-making systems, we propose a framework to support more comprehensive development of quantitative biodiversity indicators, for a range of business contexts. The framework integrates experience from existing tried-and-tested conservation frameworks. We illustrate how our framework offers a pathway for businesses to assess their biodiversity performance and demonstrate responsible management by mitigating and reversing their biodiversity impacts and sustaining their dependencies, enabling them to demonstrate their contribution to emerging global biodiversity targets (e.g., Convention on Biological Diversity post-2020 targets).

KEYWORDS

impact mitigation, management system, metric, risk management, sustainability

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1 | INTRODUCTION

In 2020, biodiversity loss was recognised as one of the top five global risks to society (WEF, 2020). Businesses are critical actors in supporting international efforts to halt biodiversity loss, because the private sector accounts for a large proportion of both global impacts on biodiversity and the global capacity to halt and reverse biodiversity loss (Dempsey, 2013; Mace et al., 2018; Smith et al., 2020).

From site-level operations to the corporate level, some businesses recognise the material risk that biodiversity loss poses to their operations and account for biodiversity as an important aspect of organizational stewardship and legitimacy (Boiral, 2016; Boiral & Heras-Saizarbitoria, 2017; Jones & Solomon, 2013). Across multiple sectors (e.g., extractives, food, financial services and technology), businesses are beginning to make public commitments with associated disclosure of biodiversity performance in sustainability or non-financial annual reports (Adler, Mansi, Pandey, & Stringer, 2017; Boiral & Heras-Saizarbitoria, 2017; de Silva, Regan, Pollard, & Addison, 2019).

The corporate narrative provided by businesses is often based on reporting activity-based indicators, such as the Global Reporting Initiative's (GRI) biodiversity indicators (GRI, 2016). Whilst the GRI indicators paint a picture of the amount of activity that a business is implementing to minimise their biodiversity impacts, they miss capturing the critical picture of whether the business is achieving positive biodiversity outcomes (the state, or abundance and diversity of species; Boiral & Heras-Saizarbitoria, 2017; Addison, Bull, & Milner-Gulland, 2018).

Whilst the GRI biodiversity indicators provide a consistent way to communicate corporate-level biodiversity activities externally, they are not designed to guide businesses internal decision-making to understand and manage their biodiversity performance resulting from multiple activities (Adler et al., 2017; de Silva et al., 2019; Fonseca, McAllister, & Fitzpatrick, 2014). To support businesses to do this, a variety of initiatives have been dedicated to the development of biodiversity indicators for businesses across multiple sectors, such as finance (Berger et al., 2018; IUCN, 2019), extractives (UNEP-WCMC,-2017) and agriculture (CISL, 2017). The indicators developed through these initiatives are often context-specific, and their use is limited to the intended application and position in the value chain of the business (Lammerant et al., 2019). For example, indicators are designed to address specific business objectives, communicate to specific audiences, make assessments for specific scales of application (e.g., operational versus corporate scales) and temporal frequencies (e.g., one-off versus annual assessment). Therefore, these indicators are not easily translatable to other business contexts or sectors without considerable work.

Current initiatives have often focused on indicators alone, and many have not emphasised how indicator development fits within broader business sustainability and management processes (Lammerant et al., 2019; Smith et al., 2020). Thus, no overarching processes exist in the public domain to guide biodiversity indicator development and use across the multiple scales of business applications, to reflect business management systems, and help businesses make informed decisions to manage biodiversity performance (Addison, Bull, & Milner-Gulland, 2018; Lammerant et al., 2019).

Corporate biodiversity measurement remains a complex issue, making it challenging for businesses to know what indicators to use to understand and manage their biodiversity performance (Boiral, 2016; de Silva et al., 2019; Fonseca et al., 2014; Jones & Solomon, 2013). An additional theoretical challenge in biodiversity accounting is the questionable link between corporation-centred biodiversity measurement and the extent to which businesses are genuinely address biodiversity loss (Cuckston, 2018). Thus, biodiversity accounting should be guided by approaches from natural sciences (Feger et al., 2019; Russell, Milne, & Dey, 2017), and conservation scientists are well placed to help improve the practice of biodiversity accounting (Cuckston, 2018).

The commencing decade will be critical for biodiversity, with a new deal for nature being negotiated at international levels (e.g., the Convention on Biological Diversity [CBD]), and public advocacy groups loudly advocating for a shift in business accountability for biodiversity (e.g., B4N, 2019; SBTN, 2019). We are at a critical point in time where translational research is required to bring together the business, sustainability and the conservation sector to help advance corporate biodiversity measurement and accountability (Addison, Bull, & Milner-Gulland, 2018; Elliot, 2013).

This paper aims to support those working in the environment and sustainability departments of businesses who want to progress biodiversity performance management from within, by introducing approaches from the field of conservation science and management. This will help business decision-makers to advance the development and use of biodiversity indicators in business decision-making. We synthesise key literature, which integrates experience from existing tried-and-tested conservation frameworks to (i) introduce a framework to guide the development and use of biodiversity indicators by businesses and (ii) show how the framework can support the deployment of robust and relevant biodiversity indicators for business seeking to measure and understand their corporate-level biodiversity performance.

2 | A FRAMEWORK TO GUIDE BUSINESSES IN DEVELOPMENT AND USE OF BIODIVERSITY INDICATORS

Conservation organisations and government agencies measure and manage biodiversity for its intrinsic value (e.g., genetic diversity,

species abundance and diversity and ecological function), to ensure that both people and nature can thrive alongside each other (CBD, 2011). In conservation, biodiversity indicators include both qualitative and quantitative proxy measures, helping decision-makers monitor, manage and communicate biodiversity status or change over time (BIP, 2011; Butchart et al., 2010; CMP, 2020).

Given the complexity of biodiversity and the sheer number of different environmental variables that can be measured, a number of conservation monitoring and management frameworks exist to help guide the development of biodiversity indicators to ensure these are efficient and fit-for-purpose (see Table 1 for examples). Many of these frameworks have their theoretical underpinnings in decision science, aimed to guide robust and transparent decision-making (e.g., structured decision-making and adaptive management; Gregory et al., 2012). The steps within these frameworks will be familiar to business audiences, offering a structured and iterative

TABLE 1 Examples of prominent decision-support processes that guide the development and use of biodiversity indicators in conservation

Process and description	Examples of features related to indicator development
Structured decision-making A decision-making process used by natural resource and conservation managers to guide the entire decision-making process; from setting conservation objectives, developing indicators, undertaking monitoring, informing and adapting management (Gregory et al., 2012).	Draws upon a toolbox of qualitative and quantitative models, and participatory approaches to work with stakeholders to explore ecosystem dynamics, select relevant indicators for the decision context and evaluate patterns displayed by indicators to inform ongoing management of natural systems.
Open standards for the practice of conservation A systematic approach used by conservation managers for planning, implementing, and monitoring conservation initiatives (CMP, 2020).	Guides the implementation of management plans, supports the development of pressure–state–response indicators for monitoring and has a strong focus on development of monitoring, evaluation and reporting systems that encourages consideration of the spatial and temporal monitoring frequency. Includes reporting approaches to communicate the evaluation of indicator patterns for non-science audiences, like condition assessments and report cards.
Biodiversity indicator development framework A framework that guides national governments through 10 steps to develop biodiversity indicators (BIP, 2011).	Emphasises the importance of initial stages of indicator development, such as setting clear objectives, and using conceptual models to help explore local systems and assess the relevance of indicators. Also includes distinct steps dedicated to testing and refining indicators with stakeholders and developing fit-for-purpose monitoring and reporting systems.
Theory of change for ecosystem-based adaptation A process based on identifying causal links and testing assumptions of what activities lead to positive outcomes for nature, to support conservation project planning and monitoring (CI, 2013).	Theory of change is particularly useful in guiding the initial stages of setting objectives, identifying threats, exploring assumptions and estimating the intended outcomes to support the selection of management interventions. Supports the development of pressure–state–response indicators for monitoring and helps identify critical gaps in data, capacity and knowledge to inform monitoring.
Protected areas management effectiveness evaluation A framework and steps to guide adaptive monitoring and evaluation of protected areas (Hockings et al., 2006).	This is a standardised framework that supports the evaluation of full management cycle—from inputs, to outputs, and outcomes. Supports the development of pressure–state–response indicators for monitoring outcomes of protected areas. This has been standardised in several tools to support the rapid evaluation of protected areas (e.g., Management Effectiveness Tracking Tool [METT] and Rapid Assessment and Prioritization of Protected Area Management [RAPPAM]).
Vital signs monitoring A series of steps used guide the long-term ecological monitoring and adaptive management of United States National Parks (Fancy et al., 2009).	Emphasises the importance of initial stages of indicator development, such as setting clear objectives, and using conceptual models to help explore local systems and assess the relevance of indicators. Supports the selection of a 'core set of indicators' that are assessed across all National Parks in the country, in conjunction with Park specific indicators (useful for assessing ecosystem health from site- to national-level spatial scales). Has a strong focus on development of monitoring, evaluation and reporting systems (e.g., condition assessment and report cards) that encourages consideration of spatial and temporal monitoring frequency.
Global portfolio monitoring and management system A global system implemented by WWF that assesses their global conservation network to guide the monitoring and management of priority geographic areas (ecoregions), flagship species, ecological footprint and drivers (Stephenson et al., 2015; Stephenson & Reidhead, 2018).	Designed to assess programme performance by measuring impacts and outcomes through common indicators that are linked to the CBD Aichi target indicators. Indicators are designed to assess short-, medium-, and long-term conservation results, to inform conservation-efficient allocation of resources into programs. Has a strong focus on communication of indicators using dashboards to facilitate data interpretation and adaptive management.

approach to management, whereby goals are defined, stakeholders are consulted, indicators are developed and monitoring and management actions are implemented. These frameworks have been used to inform the protection and restoration of biodiversity in national parks, to manage threatened species to halt biodiversity loss and to control invasive species which exacerbate biodiversity loss across Australia, Africa and Northern America, among many other countries (BIP, 2011; Fancy, Gross, & Carter, 2009; Hockings, Stolton, Leverington, Dudley, & Courrau, 2006; Stephenson & Reidhead, 2018).

Business models for sustainability help guide companies through a logical process exploring purpose and environmental goals, performance measurement, the need to consider stakeholders and the role of organisations in driving both firm-level and systems-level changes (Schaltegger, Hansen, & Lüdeke-Freund, 2016; Stubbs & Cocklin, 2008). Such models include the Natural Capital Protocol (NCP; a framework designed to support businesses in being responsible environmental stewards) and the UN System of Environmental and Economic Accounting (UN SEEA; the international standard for public sector accounting for the environment, SEEA, 2014). Similarly, management frameworks, such as the Plan-Do-Check-Act (PDCA) process, help guide process control and continual operational improvement (ISO, 2015a), and environmental management systems help ensure environmental impacts are minimised by business operations (ISO, 2015b).

Drawing on the logic of business management and sustainability processes, such as the PDCA process, and synthesising the common steps used in many conservation frameworks (Table 1), we present a framework that can guide businesses through the development and use of biodiversity indicators for internal decision-making (Figure 1). This framework is designed to be used in conjunction with appropriate business management frameworks to support improved biodiversity indicator development to support business performance management (e.g., with environmental impact management systems for site-level biodiversity management or the NCP for corporate-level assessment of biodiversity impacts). We illustrate the steps of our framework alongside the steps of the PDCA process, as this logic will be familiar to business audiences, and some conservation frameworks already draw on the logic of these steps (e.g., the Open Standards for the Practice of Conservation, hereafter the Conservation Standards; CMP, 2020).

We discuss relevant tools and examples from conservation, sustainability and business to highlight how these steps could support the development of fit-for-purpose indicators for businesses. Whilst biodiversity performance management can include both qualitative narratives and quantitative measures of biodiversity, here, we focus on how quantitative biodiversity indicators can be developed to support internal business decision-making.

1. Define the business context for biodiversity

The planning phase is important for all business management processes and is equally so for the development of biodiversity indicators (Steps 1–4; Figure 1). Step 1 of the framework involves articulating the decision context and asking questions to ensure the indicators will meet a business's decision-making needs (Addison, Carbone, & McCormick, 2018) such as does the business want to assess the state of biodiversity, how often and how detailed will the assessment be, who will the audience be for communicating the state of business-relevant biodiversity, is it important to attribute biodiversity change to the actions of the business (i.e., to understand biodiversity performance) or also to understand dependencies and the broader biodiversity context and what business decisions will be influenced by a better understanding of biodiversity performance?

In conservation, spatial context (e.g., to assess local, site-level changes in biodiversity, versus regional or national) has a great influence on the type of indicators used to monitor the state of

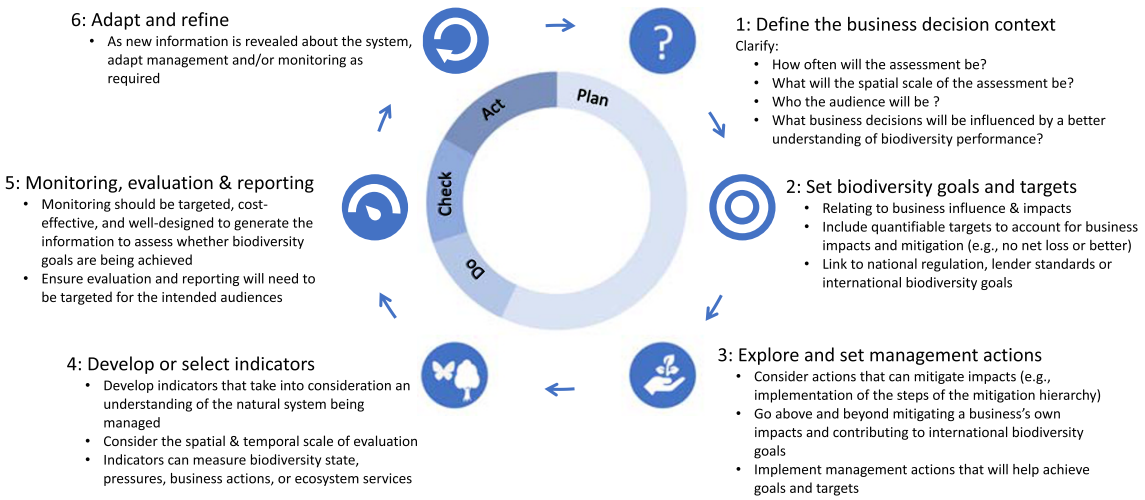

FIGURE 1 A framework to guide the development and use of biodiversity indicators by business, framing indicators (Step 4) within a broader management process (steps adapted from conservation decision-support processes outlined in Table 1). The inner circle of the figure shows how the Plan-Do-Check-Act business process stages align with the six steps [Colour figure can be viewed at wileyonlinelibrary.com]

biodiversity. Thus, consideration of the spatial context is critical, as this informs how biodiversity will be measured and influences how information is communicated (e.g., site-level assessment of the effectiveness of mitigation measures on biodiversity for internal decision-making, landscape-level or commodity-level assessment of biodiversity dependencies for internal decision-making and corporate-level holistic overview of a company's biodiversity performance for external disclosure; Lammerant et al., 2019). This is very different to greenhouse gas emissions, where the spatial context does not influence what is measured (tonnes of CO_2).

This framework is flexible enough to guide indicator development at different business scales (e.g., site-level or corporate-level), but the most important factor is that this context is clearly articulated in Step 1. For example, some businesses focus their attention on operations-level management of biodiversity performance (e.g., Rio Tinto, which applies the mitigation hierarchy to minimise their impacts on biodiversity), while others focus on gaining a corporate-level picture of biodiversity performance (e.g., ASN Bank, which aims to avoid investing in activities that have a major adverse impact on biodiversity, such as fossil fuels, mining, unsustainable fisheries and agriculture; see summary in de Silva et al., 2019).

2. Set biodiversity goals and targets

The second step of the framework is to develop biodiversity goals, which represent the vision for what a business wants to achieve for biodiversity. Most companies will also then want to develop quantifiable targets as stepping stones towards reaching their goals. Subdividing goals into objectives may also help define how they will be delivered. Goal-setting is an essential prerequisite for measuring performance, as indicators need to be linked to biodiversity goal. Historically, companies who make biodiversity goals have failed to define the scope of impacts, the type of biodiversity, a reference condition or time frame that they wish to account for (Adler et al., 2017; Boiral, 2016; de Silva et al., 2019). Some conservation tools are particularly useful in helping to set goals and targets, including theory of change process modelling (CI, 2013), objectives hierarchies and the mean-ends diagrams used in structured decision-making (Gregory et al., 2012; Table 1).

Often biodiversity goals and targets will respond to site-level regulatory or financial lender requirements (e.g., International Finance Corporation Performance Standard 6—to achieve net gain for critical habitats; IFC, 2012). They may also align with international biodiversity goals, like those included in the SDGs (e.g., reduce impacts, improve biodiversity status through protection and restoration, enhance benefits to society, support and engage in biodiversity knowledge-sharing; Smith et al., 2020). Such goals and targets should be specific to the business's influence and impacts, be quantified to account for business objectives (e.g., no net loss of biodiversity or better; de Silva et al., 2019) and use meaningful spatial and temporal frames of reference (e.g., compared with an appropriate baseline for biodiversity; Addison, Bull, & Milner-Gulland, 2018). In other words, these goals and targets should be SMART (Doran, 1981), such as Walmart's commitment to 'To conserve one acre of wildlife habitat for every acre of land occupied by Walmart U.S. through 2015' and Hewlett Packard's aim 'to achieve zero deforestation associated with HP brand paper and paper-based product packaging by 2020' (see summary in Addison, Bull, & Milner-Gulland, 2018). By setting clear goals with targets, businesses will be well placed to join progressive international business initiatives, such as Science-Based Targets (SBTN, 2019), signalling private sector environmental leadership.

3. Explore and implement management actions

Continuing to work through the initial planning phase of the process, Step 3 of the framework involves exploring potential actions that can manage or mitigate impacts on biodiversity (e.g., through impact mitigation and compensation) and support the achievement of biodiversity goals and targets. Business can take several actions to mitigate their impacts (e.g., implementation of the steps of the mitigation hierarchy; BBOP, 2018) or go beyond mitigating their own impacts and contribute to international goals such as the Sustainable Development Goals (SDGs; e.g., Smith et al., 2020). The management actions that will help achieve goals and targets should be implemented to ensure this framework is used not only for planning but also in active biodiversity management. For example, Yorkshire Water invests in U.K. peatland restoration in their catchments to deliver clean water for their customers, and Rabobank invested globally in financing sustainable agriculture, helping generate positive outcomes for farmers and nature (see summary in Smith et al., 2020).

4. Develop and select biodiversity indicators

Only after having set goals, targets and actions should indicators be developed in Step 4 (Figure 1). In this step, an assessment is made as to whether the company can use any of the numerous indicators that already exist or whether new indicators might need to be developed. A good starting point is to consider indicators being used to monitor global biodiversity goals, as many are applicable across temporal and spatial scales (e.g., BIP, 2011; Stephenson et al., 2015), or the biodiversity indicators developed for business (Lammerant et al., 2019). Some examples of the latter include the biodiversity footprint score being developed for the finance sector, scalable biodiversity indicators for the extractives sector and Biological Diversity Protocol accounts for cross-sector applications (Berger et al., 2018; Lammerant et al., 2019; UNEP-WCMC, 2017).

While a large number of indicators exist, as Rabaud, Coreau and Mermet (2018) point out, indicators can be developed for different organizational and social realities. The framework proposed here does not recommend specific indicators but instead highlights the need to clarify when an indicator will be fit-for-purpose in business decision-making; business decision-makers need to establish this based on the information available.

Some companies may find they want to make adjustments to existing indicators to make them relevant for measuring their own goals. Lessons from the conservation literature to support the development of fit-for-purpose indicators include ensuring that the underlying biodiversity data used in the indicator(s) matches the spatial scale and temporal frequency of assessment and reporting (e.g., as emphasised in the Conservation Standards; CMP, 2020). In addition, for indicator(s) to be useful in business applications, practitioners need to understand the natural system, have an idea of how the system will respond to management (so that the indicator will provide a signal that can be attributed to a business) and establish a preference for the type of measurement to be reported (e.g., one or a combination of biodiversity state, pressure, management response or benefit; CMP, 2020).

5. Monitoring, evaluation and reporting

Once indicators have been selected, the final steps include monitoring (i.e., data collection), evaluation and reporting (Step 5; Figure 1). Irrespective of the scale of concern (e.g., from operations, through supply chains or at the corporate level), monitoring should be targeted (i.e., using an indicator with a clearly defined relationship to the system or biodiversity feature of interest), cost-effective and well-designed (e.g., the data collected is sufficiently sensitive to detect change at the appropriate spatial and temporal scales), to generate the information needed to make decisions (e.g., following criteria used to guide targeted monitoring programmes for French Marine Protected Areas- testing indicator relevance and effectiveness; Beliaeff & Pelletier, 2011).

Given the local to global contexts of biodiversity indicators for business, it is likely that monitoring of biodiversity will range from site-level data collection (e.g., as is done for site-level biodiversity performance assessment in the extractives sector; UNEP-WCMC, 2017), through to use of globally modelled biodiversity data (e.g., as is done for corporate-level biodiversity performance for the agriculture sector; CISL, 2017). Evaluation of data to interpret spatial and temporal patterns in indicators will enable understanding of outcomes and how they could be improved (e.g. using quantitative models or ecological condition assessment against baselines to interpret indicator changes; Fancy et al., 2009; BIP, 2011; Gregory et al., 2012; Hayes et al., 2015; Table 1).

Reporting needs to be designed for the intended audiences. Conservation dashboards have been useful for internal decision-making and guiding adaptive management (e.g., Han et al., 2014; Stephenson et al., 2015), whereas report card formats are considered useful for external reporting targeted at non-scientific audiences (e.g., CMP, 2020; Hockings et al., 2006). Report card formats are similar to the Environmental Profit and Loss system used by Kering, with the main difference being that it may be unlikely that biodiversity can be presented in the monetary terms, as is done for other environmental impacts (e.g., CISL, 2017; Kering, 2017). When data aggregation is required to synthesise biodiversity information from site to national or corporate scales, businesses could consider the aggregation techniques used by the U.S. National Parks Service. This includes both site-level monitoring and management and a national scale assessment of biodiversity information in a standardised format using a core set of national indicators (e.g., by using a hierarchical organizational tool, indicators are categorised into functional groups and aggregated through data synthesis and modelling to produce higher order ecological summaries; Fancy et al., 2009; NPS, 2012). Indicators need to be measured regularly over time, so having an information system to support the collection, analysis and storage of biodiversity information has also been important for national governments (e.g., conservation information management systems; UNEP-WCMC, 2016).

6. Apply, adapt and refine

Similar to the 'Act' stage of the PDCA cycle, information collected through monitoring can be used to adapt and improve performance. It is vital that biodiversity indicator systems adapt over time to take account of emerging issues and changing circumstances (CMP, 2020; Likens & Lindenmayer, 2018; Stephenson, 2019). Step 6 in the framework involves reviewing progress to date and adapting as necessary the indicators and data collection methods and sometimes even the biodiversity goals (e.g., adaptive management used within the vital signs monitoring of U.S. National Parks; Fancy et al., 2009; Gregory et al., 2012).

Whilst the framework includes six core steps, working through these steps can be flexible and iterative. Moving through the process will often involve moving back and forth between steps as more information is revealed or learnt (as mentioned previously in relation to the planning Steps 1–4). Also, the framework should be used to draw in existing management and monitoring processes; therefore, some steps could potentially be worked through quite quickly. It will usually be beneficial to include stakeholders throughout the framework (e.g., staff, shareholders and external stakeholders), as this will promote buy-in to the process (e.g., participatory processes used in ecosystem-based adaptation and structured decision-making; Gregory et al., 2012; CI, 2013).

3 | USING THE FRAMEWORK FOR CORPORATE-LEVEL BIODIVERSITY PERFORMANCE ASSESSMENT

Given the growing interest in measuring corporate-level biodiversity performance (e.g., to report against company commitments or international biodiversity goals; CBD, 2018; SBTN, 2019), we provide two case studies that illustrate how businesses could use the framework to guide corporate-level biodiversity performance management (Box 1). These examples are based on work being carried out with real companies by the authors, but specific details have been generalised to anonymise the companies.

Business 1 is a multi-national energy company wishing to conduct site- and corporate-level biodiversity performance assessments

BOX 1 How two hypothetical businesses could use the framework for corporate-level biodiversity indicator development

Hypothetical Business 1: Multi-national energy company wishing to conduct site-level and corporate-level biodiversity performance assessments for annual corporate-level internal decision-making

1: Decision context: Business 1 wishes to aggregate site-level and corporate-level biodiversity performance assessments for annual corporate-level internal decision-making.

2: Biodiversity goals and targets: Goals are clarified at the site-level (e.g., against national regulatory requirements, financial lending requirements, and locally important biodiversity features), and at the corporate-level (e.g., against international biodiversity goals (e.g., the SDGs and CBD strategic goals). These are then harmonised into an integrated set of goals and objectives at multiple levels. Examples include Global Goal - Priority species around the businesses power plants are stable or increasing; National Goal - Priority species around the businesses plants in Country A are stable or increasing; Site Goal - Priority species around Plant A, Country A are stable or increasing.

3: Management actions: Business 1 defines biodiversity actions (many of which may already be taking place) that mitigate their biodiversity impacts and contribute to local needs and corporate goals. These include conserving areas of natural habitat identified as important (as no-go areas or offsets); reducing biodiversity impacts from construction, pollution and emissions; eliminating invasive species and supporting local community conservation work.

4: Biodiversity indicators: Indicators are required to assess biodiversity performance, which in this instance relates to the outcomes of business impacts and mitigation measures on biodiversity. Site-level indicators should relate to trends in state (e.g., the population levels of key species), pressures (e.g., activities contributing to habitat loss and levels of pollution), responses (e.g., area of land managed for protection or sustainable management of biodiversity), and benefits (e.g., non-timber forest products available to local people). In order to aggregate data from site to corporate levels and allow a comparison of biodiversity information across operations, at least some of the indicators need to be common across sites. These core indicators will support a corporate-level performance assessment against the business' corporate biodiversity goals. For example, trends in the populations of key species at each site will allow the creation of an index of species abundance at national and corporate level, as well as identification of which sites are showing the most or least success in conserving species.

5: Monitoring, assessment and reporting: Site sustainability managers in each country of operation will need to collect relevant data on all site-level indicators and to produce regular updates to management so as to facilitate decision-making. In addition, they will need to share with headquarters the data on common, core indicators allowing the global sustainability team the opportunity to create aggregate scores and thereby provide a global assessment of corporate-level biodiversity performance. Data may be collated in dashboards to facilitate ease of interpretation and published in annual sustainability reports.

6: Adapt and refine: Business 1 will review data regularly and adapt indicators or data collection methods where relevant (e.g., if corporate global goals are changed for practical or political reasons; of the data are not robust enough to determine change; if the methods prove inappropriate for the local habitat or staff capacity).

Hypothetical Business 2: A multi-national apparel company with long supply chains, wishing to undertake corporate-level biodiversity performance assessment for external disclosure in non-financial accounts and sustainability reporting

1: Decision context: Business 2 wishes to go beyond reducing their own direct operational biodiversity impacts and contribute towards broader efforts to halt global biodiversity loss both through their supply chain and in the sector more widely. Part of this would involve demonstrating performance against international biodiversity goals (e.g., SDGs and the CBD strategic goals), as a means of providing thought leadership on corporate sustainability. Corporate-level biodiversity performance assessment is desired by the board for external disclosure in non-financial accounts and sustainability reporting and to present externally what best practice in corporate biodiversity conservation looks like.

2: Biodiversity goals and targets: Business 2 has a broad goal to substantially reduce its environmental impacts, including those on biodiversity. Biodiversity-specific goals relate to habitats (e.g., forests) and species (e.g., threatened vertebrate species) being no worse off due to the business' activities. These goals align with the current CBD strategic goals and SDGs: to reduce biodiversity loss and promote the sustainable use of biodiversity and to improve the status of biodiversity (as per the translation of CBD goals to corporate biodiversity goals in Smith et al., 2020).

3: Management actions: Business 2 uses a proactive form of the mitigation hierarchy (the conservation hierarchy; Bull et al., 2019) to structure and prioritise its business' management actions to help avoid, minimise, restore and offset their impacts. The business' production of apparel (e.g., clothes and fashion accessories) means that impacts and dependencies on biodiversity are primarily upstream in the supply chain (e.g., raw material and manufacturing) and include (but are not limited to) habitat clearance, water pollution and direct exploitation of species. The management actions it wishes to implement in the four stages of the mitigation hierarchy include avoid (do not source from suppliers that convert natural habitats [e.g., through deforestation] to agricultural land for raw material production), minimise (work with suppliers to reduce the amount of agricultural pollutant run-off), restore (source from suppliers that are certified as 'wildlife-friendly', creating sustainable populations of wild species that are used for raw materials [e.g., snakes for skins]), and offset (invest in nature-based solutions to restore habitats and slow or prevent water pollution).

Beyond addressing their own impacts, the business also aims to undertake additional conservation actions, which help tackle local and global biodiversity loss (i.e., at the local scale the business invests in nature-based solutions with neighbouring businesses and NGOs to reduce water pollution threatening freshwater fish and birds in heavily farmed water catchments), and at the global scale, they join coalitions of businesses that aim to fund habitat restoration programmes throughout their supply chains.

4: Biodiversity indicators: Business 2 wishes to have a corporate picture of their biodiversity performance and also to provide an external blueprint for what best practice looks like. Following current practice, they report on their activities to reduce impacts on biodiversity such as ensuring the sustainability credentials of their suppliers (e.g., % of suppliers certified as adhering to wildlife friendly farming practices). For the additional conservation actions that they are involved in, the business can report on pressure reduction (e.g., reduced water pollution in catchments resulting from nature-based solutions) and improved biodiversity state (e.g., improvements in forest condition and extent). Over the coming decade, the business aims to strive towards best practice, moving away from tracking their actions, towards tracking outcomes for biodiversity, and thus is investigating relevant regional, national and global biodiversity datasets that may be informative to assess their supply chains.

5: Monitoring, assessment and reporting: Since the key biodiversity impacts within the sphere of influence of Business 2 are in raw material supply chains, which the business does not directly control or manage, monitoring requires the business to engage with and survey suppliers. The process could either be implemented through regional business managers or through those responsible for specific material supply chains—either way, suppliers could be requested to provide evidence of minimised impacts on biodiversity (e.g., through certification). Failing the capacity to do so, the

(Continues)

BOX 1 (Continued)

business can either carry out visits to sample supplier performance (if agreed with suppliers) or use other techniques to infer performance (e.g., remote sensing). In all cases, the emphasis is upon two-way engagement between the business and the suppliers that benefits the latter wherever possible (e.g., through capacity building and skills development). Results are aggregated by raw material type, which in turn is summed to corporate scale for disclosure as part of annual sustainability reporting.

6: Adapt and refine: The entire process of measuring, monitoring and reporting on biodiversity impacts in the supply chain is made open access by Business 2 and interrogated regularly through conversations with academic and NGO partners. In this way, options for adapting and refining methods are sought and acted upon on an ongoing basis. Equally, by providing information on corporate outcomes that feeds into global policy discussions on how best to manage business and biodiversity issues (e.g., through the CBD and the Natural Capital Coalition), Business 2 is part of the discussion in terms of how best to refine approaches and incorporates the outcomes of those discussions into business practice.

for annual corporate-level internal decision-making. They have a clear understanding of their biodiversity impacts and dependencies, through their site-specific operational footprints. Business 2 is a multi-national apparel company wishing to undertake corporate-level biodiversity performance assessment for external disclosure in non-financial accounts and sustainability reporting. Their biodiversity impacts and dependencies are less obvious and more disparate, occurring throughout their long supply chains. By following the framework (Figure 1), we illustrate how these companies can establish a set of fit-for purpose biodiversity indicators by working through a logical process to measure their biodiversity performance.

The different supply chains of Businesses 1 and 2 influence the type of biodiversity indicators that can be used to measure the effectiveness of their actions at the corporate level. In Step 4, Businesses 1 and 2 have determined what aspect of biodiversity should be measured, relating to the type of indicator: Business 1 identified a suite of state and pressure indicators, of which a core set of indicators can be aggregated from site to corporate levels to support assessment against the business' corporate biodiversity goals, while Business 2 can only report action to reduce impacts on biodiversity, through ensuring the sustainability credentials of their suppliers.

This difference is linked to the different level of control that Businesses 1 and 2 have on their impacts and the measures they can put in place to mitigate these: as highlighted in Step 3, Business 1 is contributing to local needs and corporate goals by mitigating biodiversity impacts from construction, pollution and emissions and taking steps to protect biodiversity through conserving areas of natural habitat. In contrast, Business 2 does not directly act on the sites but works through other systems such as suppliers' codes of conduct, contractual clauses and certification schemes. Business 1 can aim at using pressure and eventually state indicators at the corporate level, while Business 2, unless there is a strong traceability system in place, can probably only use response or activity indicators.

The actors engaged during the steps towards developing the indicators are different between Businesses 1 and 2, particularly because of their spheres of influence: Business 1 is focussed much more on responsible management of its own sites, and Business 2 is focussed on its supply chain. Thus, Business 1 will probably include site-level actors such as operations and environmental managers and local stakeholders such regulators, local conservation groups and other landowners. Business 2 will probably need to consult a much more disparate group of stakeholders at a range of scales, such as supply chain and sustainability managers, suppliers and key stakeholders associated with important supply chains (e.g., those with high biodiversity impact/dependency). Both will benefit from consulting conservation practitioners at the corporate level (Businesses 1 and 2) and operations level (Business 1) to ensure biodiversity goals, targets and indicators are feasible and align with national and global commitments to halt biodiversity loss.

In the monitoring and management phase of the framework, the businesses undertake indicator data collection, assessment and reporting (Step 5). This can involve the collection and aggregation of information from site- up to corporate-level. Business 1 develops aggregate scores to provide a global assessment of corporate-level biodiversity performance in a dashboard for internal decision-makers. Business 2 assesses the sustainability credentials of their suppliers, which are aggregated by raw material type, which in turn is summed to the corporate scale for disclosure as part of annual sustainability reporting.

Finally, in Step 6, the businesses include provisions for adaptation and refinement, as new information accumulates about their site- to corporate-level biodiversity performances. Business 1 reviews data regularly and adapts indicators or data collection methods where relevant, such as if corporate-level goals are changed for practical or political reasons. Business 2 regularly explores options for adapting and refining their corporate biodiversity performance through open dialogue with academic and NGO partners. Whether any change in indicators can be attributed to the business's own activities will always need to be considered, as some changes are likely to be driven by larger processes outside the control of the business (e.g., the impacts of neighbouring businesses on local biodiversity or the effects of climate change on biodiversity). This is not to say that the business should do nothing if changes are outside their direct control, but consideration of attribution will help inform the type of management response required (e.g., working with other businesses within a landscape to collectively reduce impacts on biodiversity or working at national and international levels to reduce the business's contribution to climate change such as through reduction of carbon emissions).

4 | CONCLUSION

This translational research is designed to contribute to the growing literature about practical ways to cut through environmental complexity and help advance corporate biodiversity accountability and sustainability (Addison, Bull, & Milner-Gulland, 2018; Boiral, Heras-Saizarbitoria, & Brotherton, 2018; Elliot, 2013). Many existing frameworks associated with conservation monitoring and management are transferable to the relatively new context of business sustainability and biodiversity accountability. They have accumulated over decades and are in use already for setting goals, designing indicators, aggregating data and testing assumptions. By working through the framework presented here (which integrates which integrates experience from existing tried-and-tested conservation frameworks), businesses will be in a better position to clarify exactly what they need from biodiversity indicators and thereby identify indicators that are fit-for-purpose and sensitive to a given business's requirements.

The driver for this work was to clarify how businesses can develop and use biodiversity indicators to assess their own performance from site to corporate levels. However, indicators are only a 'means to an end'. Indicators should inform proactive and responsible environmental management, designed to abate threats to, and restore, biodiversity. We believe that leading businesses can and should take on the role of responsible environmental stewards seeking to create public benefit beyond their organisational boundaries (Bocken, Short, Rana, & Evans, 2014; Schaltegger et al., 2016; Stubbs & Cocklin, 2008) and to contribute to global efforts to 'bend the curve' of biodiversity loss (Mace et al., 2018). By framing indicator development within the context of the entire management cycle, we offer businesses a way to align their actions and performance assessment to the wider international context aiming to halt and reverse biodiversity loss (e.g., CBD, SDGs; CBD, 2011; UN, 2016).

Business engagement with the biodiversity agenda will be increasingly important this decade, with the CBD's new deal for nature being negotiated, and public advocacy groups advocating for a shift in business accountability for biodiversity. During this period, there will be a window of opportunity for businesses to begin to use more structured processes, such as this framework, to assess their biodiversity performance. If companies are able to demonstrate responsible management by mitigating and reversing their environmental impacts and sustaining their dependencies, they will also be able to demonstrate their contribution to global goals for biodiversity.

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