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Biodiversity reporting by United Kingdom (UK)-listed companies: A review of extent, content and readability of disclosures

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Abstract

This study examines biodiversity reporting by UK-listed companies. An instrument is developed, based on earlier research, and used to analyse biodiversity-related disclosures as either policy considerations or actions taken to conserve biodiversity. A mixed design is employed. The extent of reporting, information content of disclosures and their readability are used to provide an overarching perspective on how firms internalise biodiversity. Outliers are identified and their reports are examined interpretively to identify how leading reporters understand biodiversity as a policy imperative and factor it into their operational and managerial performances. This qualitative analysis highlights best practices that can be used by other entities interested in developing the accounting and management infrastructure necessary for reporting comprehensively on biodiversity. Best practices are, however, isolated and stand in stark contrast with how organisations are dealing with biodiversity on average. At the policy level, there is little on how biodiversity is defined and the rationale for wanting to protect biodiversity. When it comes to performance, few organisations are setting detailed biodiversity-related targets linked clearly to operational plans, risk assessments and key performance indicators. Post-implementation reviews of conservation initiatives are seldom conducted and biodiversity is not being factored into valuations, cost assessments and project appraisals. Understanding these limitations is timely given the international community's recent efforts to develop standards for extra-financial reporting. The results will be relevant for regulators, scholars and practitioners interested in advancing the quality of biodiversity reporting and factoring biodiversity into mainstream business discourses.

KEYWORDS
biodiversity, disclosure quality, disclosure readability, sustainability reporting, United Kingdom

Abbreviations: CBD, Convention on Biological Diversity; CDSB, Climate Disclosure Standards Board; ESRS, European Sustainability Reporting Standards; EU, European Union; FSB, Financial Stability Board; GRI, Global Reporting Initiative; IIRC, International Integrated Reporting Committee; ISSB, International Sustainability Standards Board; IUCN, International Union for Conservation of Nature; NGOs, non-governmental organisations; SASB, Sustainability Accounting Standards Board; TCFD, Taskforce on Climate-Related Financial Disclosures; TNFD, Taskforce on Nature-Related Financial Disclosures; USD, US dollar; VRF, Value Reporting Foundation.

None of the authors have a conflict of interest to disclose.

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1 | INTRODUCTION

The urgent need to address environmental degradation has transitioned from a purely scientific issue (Ceballos et al., 2017, p. 8) to a focal point of supra-national policy development (United Nations, 2023). Issues such as climate change and biodiversity loss have become part of mainstream business discourse, with calls for environmental factors such as carbon emissions (e.g. Financial Stability Board, 2017, CDP, 2017), biodiversity (e.g. FSB, 2023; Houdet et al., 2021) and natural capital (e.g. IIRC, 2021a; Natural Capital Coalition, 2016) to be incorporated into organisations' strategies, risk mitigations and operating protocols. These changes reflect the fact that "conventional economic models do not account for the declining trends in nature's services and thus provide an overly optimistic scenario of economic growth" (The World Bank, 2021, p. 8). Left unchecked, a pre-occupation with pursuing short-term financial returns could result in long-term economic losses of up to USD 3 trillion per annum (The World Bank, 2021) while contributing to serious social and political unrest (United Nations, 2023) and the possible failure of critical ecosystem services (Ceballos et al., 2017).

Efforts to advance more sustainable business models go hand-in-hand with initiatives to drive expanded accounting and reporting models. Examples include corporate social responsibility (Bebbington et al., 1999; Gray et al., 1988), sustainability (Adams & Frost, 2008; Gray, 2006) and integrated reporting (De Villiers et al., 2020; Eccles & Serafeim, 2014). Each is predicated on the fact that accounting for and reporting on, only financial indicators does not provide a comprehensive assessment of an organisation's performance necessary for guiding more sustainable approaches to doing business (Adams et al., 2020; King & Atkins, 2016).

One area of extra-financial reporting attracting growing attention is biodiversity. In the European Union, the Corporate Sustainability Reporting Directive establishes mandatory reporting requirements effective from 2024, which include a biodiversity element.[1] The International Sustainability Standards Board (ISSB) has released two reporting standards "designed to enable companies to communicate to investors about the sustainability-related risks and opportunities they face over the short-, medium- and long-term".[2] The standards are not specific to biodiversity but they provide a framework for assessing and reporting on how ecosystems are being integrated into, for example, business models, risk governance and operational considerations. In addition to reporting requirements, the investor community is focusing on how companies identify and respond to environmental risks, including the risks arising from biodiversity loss (ACCA, 2016; Atkins & Macpherson, 2019; Maroun et al., 2018; WEF, 2019). Codes on corporate governance (Solomon, 2020) and jurisdiction-specific legal requirements (Sobkowiak, 2023) are starting to incorporate biodiversity protection and related considerations. That the world's most prominent organisations are paying more attention to issues such as climate change, habitat loss and the state of ecosystems (see KPMG, 2012, 2020, 2022) only adds to the growing emphasis on biodiversity reporting and provides the basis for the current research: to examine the nature of biodiversity-related disclosures of companies listed in the United Kingdom.

This is done by developing a detailed disclosure schematic based on the latest academic research and complemented by recent developments in environmental standard-setting. The schematic is used to score a sample of UK-listed firms according to the extent of their reporting, the information content of disclosure and the readability of those disclosures. To provide additional insights, the study differentiates between disclosures used to frame or understand biodiversity in a commercial context (policy-related disclosures) and those which explain how biodiversity is factored into operational and management practices (performance-related disclosures). A qualitative analysis of biodiversity reporting at the level of policy and performance is used to contextualise quantitative results.

The paper's findings make, at least, four important contributions. Firstly, earlier work on biodiversity (Jones & Solomon, 2013), ecological (Russell et al., 2017) and extinction (Atkins et al., 2019) accounting shows how the scope of conventional accounting systems can be widened to include different measures of the state of the environment and contribute to positive change. How elements of biodiversity, ecological and extinction accounts are being applied is less clear. Examining the extent to which large listed firms are engaging with, and reporting on, biodiversity-related issues provide empirical evidence on the operationalisation of biodiversity accounting and reporting in a practical, rather than theoretical, setting.

Secondly, the empirical work on biodiversity reporting prioritises select developing economies (e.g. Lanka et al., 2017; Mansoor & Maroun, 2016; Sun & Lange, 2023) and only certain developed nations like Australia (Hossain, 2017), Denmark (van Liempd & Busch, 2013), New Zealand (Schneider et al., 2014) and Sweden (Rimmel & Jonäll, 2013). Some papers cover biodiversity conservation by local government in the UK (Cuckston, 2017; Gaia & Jones, 2017), but the nature and extent of biodiversity reporting by the country's listed firms have not been considered in detail. The most recent surveys on the adoption of biodiversity reporting are either international (see Hassan, Elamer, et al., 2020, Adler et al., 2018, Boiral, 2016, Atkins et al., 2014, Grabsch et al., 2012) or limited to specific case studies (Sobkowiak, 2023).

Thirdly, the instrument outlined in this paper incorporates principles from earlier work on biodiversity reporting (e.g. Grabsch et al., 2012; Jones & Solomon, 2013; Rimmel & Jonäll, 2013) and accounting for natural inventories (e.g. Jones, 1996, 2003). The schematic has been updated based on the latest academic research to incorporate additional features and examples of different disclosure themes. Major international developments dealing with biodiversity reporting and, more generally, reporting on sustainability-related issues, are also taken into consideration. The result is a current and comprehensive assessment of "elements" of biodiversity reporting that can be readily adapted for different settings and is a useful means which environmental accounting researchers and users of corporate reports interested in evaluating biodiversity reporting by different entities can employ.

[1]See https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

[2]See https://www.ifrs.org/news-and-events/news/2023/06/issb-issues-ifrs-s1-ifrs-s2/

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Finally, an examination of current biodiversity reporting trends is relevant for policymakers interested in how UK firms report on biodiversity at a time when the EU is mandating environmental reporting and international standards are being issued to deal with different environmental concerns. The current paper fills a gap by covering biodiversity reporting by a key member of the G7 and a country committed to advancing sustainable development locally and internationally.

The remainder of the paper is structured as follows: Section 2 outlines the literature used to develop a conceptual model for reviewing biodiversity reporting. The method followed to collect and analyse data is explained in Section 3. Results are presented in Section 4, followed by a discussion and suggestions for future research in Section 5.

2 | LITERATURE AND FRAMEWORK

According to the GRI (2024, p. 146), "biodiversity" is

> "the variability among living organisms [which] includes diversity within species, between species and of ecosystems. Biodiversity not only has intrinsic value, but is also vital to human health, food security, economic prosperity, and mitigation of climate change and adaptation to its impacts."

There have been numerous experiments to account for and depict changes in biodiversity by both private (e.g. Gray, 1990; Russell et al., 2017) and public sector firms (Gaia & Jones, 2017; Samkin & Wingard, 2020; Weir, 2018) but numerous challenges remain. For example, the extent to which companies can be held accountable for the impact on habitats and ecosystems, not all of which are directly under their control, is debatable (Jones & Solomon, 2013). Not all organisations will have the accounting and management systems in place necessary for collecting and processing the data necessary for operationalising a biodiversity account (Rimmel & Jonäll, 2013; van Liempd & Busch, 2013; Wagner, 2023). That biodiversity reporting may be co-opted as part of an impression management strategy by companies that only claim to be conserving the environment cannot be precluded. Even if this is not the case, there is no guarantee that biodiversity reporting will promote changes in how organisations operate and are managed to advance real progress towards the achievement of sustainable development (Feger & Mermet, 2017; Gray & Milne, 2018; Maroun & Atkins, 2018; Milne et al., 2009).

Nevertheless, biodiversity reporting can make organisations aware of "stocks" of plant and animal species on which their business models are dependent (Jones & Solomon, 2013). It can complement existing forms of environmental, sustainability and integrated reporting leading to more extensive and informative extra-financial reporting (Atkins & Maroun, 2018). That biodiversity reporting is attracting attention from national and supra-national bodies keen on advancing the extra-financial reporting and sustainable development agenda (see, for example, GRI, 2024, ISSB, 2021, IIRC, 2021b, European Commission, 2024, Financial Stability Board, 2022, Financial Stability Board, 2017) affirms the need to study how companies are currently reporting on biodiversity in more detail. To do so, a type of conceptual framework is used to outline the core "elements", "indicators" and "themes" comprising a biodiversity report.

2.1 | A biodiversity reporting framework and schematic

Biodiversity reporting can play a key role in highlighting the importance of protecting flora and fauna from both an ecological and economic perspective (Jones & Solomon, 2013). It can be used to identify current and emerging challenges; shape an organisation's environmental agenda and inform how "natural capital" is understood and managed by the entity's governing body (Gray et al., 1995). When applied in conjunction with other types of environmental and social accounting, biodiversity reporting has the potential to contribute to material changes by making organisations aware of the importance of natural resources and the need for urgent interventions to prevent or reverse biodiversity loss (Atkins et al., 2015). This is in keeping with the argument that expanded forms of accounting can serve as catalysts for advancing long-term sustainable development by problematising issues, promoting engagement with stakeholders and widening the fields of organisational visibility beyond the narrow focus of traditional financial reporting (Gallhofer et al., 2013).

2.1.1 | Biodiversity as a policy consideration

At the level of idea or policy, biodiversity can be incorporated as part of over-arching business objectives, mission statements and policy agendas. These guide the type of actions the organisation ought to take and can be useful for setting strategic and operational boundaries according to which the entity must operate (Bui & De Villiers, 2018). At the policy level, biodiversity reporting also provides the parameters according to which a firm accounts for performances, differentiates between desired and unfavourable outcomes and justifies actions to stakeholders. Constituents are left with a clear understanding of the organisation's environmental stance and the extent to which these align with the norms or expectations according to which any claims to legitimacy are judged (Boedker, 2010; Corvellec, 2016b). Five policy-level "indicators" are identified by earlier research, namely: (1) scene-setting, (2) species-related, (3) external reporting, (4) accounting schematics and (5) legal considerations. Each is outlined below.

The reasons for wanting to conserve biodiversity should be clarified (Atkins & Maroun, 2018; Jones & Solomon, 2013; Russell et al., 2017). The aim is to "set the scene" by defining "biodiversity", explicating the motivations for protecting biodiversity and developing a clear mission statement to guide the organisation and enable it to be held accountable by its governing body and stakeholders (see also King et al., 2022; Rimmel & Jonäll, 2013; van Liempd & Busch, 2013).

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Details on species impacted by the organisation contextualise "scene-setting" information (van Liempd & Busch, 2013). They provide a sense of environmental impact by covering matters such as the number and type of species impacted by operations, the classification of those species in terms of generally accepted scientific standards, the size and location of habitats affected by operations, the ecological health of ecosystems and total area under conservation (Cuckston, 2017; Maroun & Atkins, 2018; Russell et al., 2017). Species and scene-setting disclosures can also be used to iterate the business case for biodiversity protection while explaining the "value" of biodiversity in ecological, social and commercial terms (Anthony & Morrison-Saunders, 2023; Atkins & Maroun, 2020; Jones & Solomon, 2013).

Scene-setting and species-related disclosures need to be supported by suitable accounting conventions, systems and processes (Alrazi et al., 2015). These will define the data that needs to be collected and how that data is organised to provide insights into the state of biodiversity per ecosystem, business unit and operation. The design of internal controls used to ensure the accuracy and completeness of the data used to prepare information for internal decision-making or reporting to stakeholders will also form part of the accounting system design (Bui & De Villiers, 2018; King et al., 2022). The same is true of the checks and balances put in place to ensure compliance with laws and regulations dealing with biodiversity, including mandatory monitoring or inspection requirements (Atupola & Gunarathne, 2023).

While industry-level regulations may deal with certain aspects of biodiversity impact and management, how firms account for, and report on, biodiversity remains largely voluntary. In the context of resulting uncertainty, firms draw on non-regulated reporting frameworks and other codes of best practice, which are already prominent in the broader environmental accounting and reporting space (see Atupola & Gunarathne, 2023; Wagner, 2023). The United Nations' Sustainable Development Goals (SDGs) are an example.

Dealing specifically with biodiversity, SDGs 14 and 15 focus on the conservation of oceans and terrestrial ecosystems to halt or reverse environmental degradation. They are complemented by SDG 13, which addresses climate change and its direct and indirect impact on plant and animal life (United Nations, 2019b). While developed as a supra-national framework, the SDGs are being adapted by organisations to inform both their understanding of biodiversity and associated policy-level considerations including the scope of reporting to stakeholders (e.g. Ahmed, 2023; Lodhia et al., 2022; Stefanescu, 2022). The SDGs do not, however, provide details on how organisations should incorporate biodiversity into their strategies, mission statements and operating policies. One of the most influential sources dealing more specifically with biodiversity is the Global Reporting Initiative (GRI).

The GRI's standards are intended to be readily understood by practitioners and applicable to a broad range of entities committed to reporting on environmental and other extra-financial considerations, including biodiversity (GRI, 2016). In early 2024, the GRI issued a revised standard on biodiversity. This provides additional guidance on biodiversity reporting for location-specific impacts and complex supply chains. The new standard also includes requirements dealing with the drivers of biodiversity loss and interactions between biodiversity and society including, for example, policies to remedy biodiversity losses by capitalising on community engagement and key partnerships (GRI, 2024).

The GRI's efforts are complemented by other well-established reporting frameworks. Although not dealing with biodiversity specifically, the International Integrated Reporting Council (IIRC, 2021a) stresses the importance of managing natural capital as part of a holistic approach to ensuring that organisations generate value for themselves and stakeholders in the short-, medium- and long-term (Adams, 2017; De Villiers et al., 2020). The *Natural Capital Protocol* provides further detail. It outlines the importance of defining clear objectives related to natural capital, evaluating performance against those objectives, assessing impacts, taking action and reporting transparently on natural capital (Natural Capital Coalition, 2016). A similar approach is followed by the *Biological Diversity Protocol* (Houdet et al., 2021), *Taskforce on Nature-Related Financial Disclosures* (Financial Stability Board, 2022) and *Taskforce on Climate-Related Financial Disclosures* (TCFD) (Financial Stability Board, 2017).[3] Recommended practices for evaluating risks, assessing impacts and informing policy are intended to contribute to more robust business models and credible reporting to investors and other key stakeholders (Chua et al., 2022; Endangered Wildlife Trust, 2020; UNEP-WCMC, 2015).

2.1.2 | Biodiversity at the level of performance

In addition to being a policy consideration, biodiversity can be framed in terms of the actions taken to conserve or restore it (Corvellec, 2016a, 2016b). Nine performance-level "indicators" were identified by earlier research namely (1) social engagement; (2) performance evaluation; (3) reviews; (4) valuation; (5) risk assessment; (6) inventory management and boundary setting; (7) systems and management; (8) internal management and (9) assurance. Each is outlined below.

How organisations engage with biodiversity-related challenges ensures that policy-level considerations have substance and are maintained by a coherent set of activities informed by minimising, avoiding or reversing biodiversity loss (Maroun & Atkins, 2018; Panwar et al., 2023). This entails, for example, partnerships with non-governmental organisations (NGOs), researchers and other specialists to integrate biodiversity into an organisation's strategy, risk management and core operations (Atkins et al., 2022; Sobkowiak, 2023). Companies will need to educate stakeholders on biodiversity impact and co-opt them in exploring solutions to biodiversity challenges and

[3]The IFRS Foundation Trustees created the International Sustainability Standards Board (ISSB) and have consolidated the IFRS Foundation, the Climate Disclosure Standards Board (CDSB) and the Value Reporting Foundation (VRF) (which consists of the IIRC and the Sustainability Accounting Standards Board (SASB)). The CDSB consolidation was completed in January 2022 and the VRF consolidation in August 2022. In addition, the ISSB has integrated the TCFD recommendations into its standards and is taking over the monitoring responsibilities and duties of the TCFD from 2024. See ifrs.org.

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implementing material changes to how the organisation is managed and operated (Atkins et al., 2022; Sobkowiak, 2023; van Liempd & Busch, 2013). Effective stakeholder engagement plays a key role in bolstering the organisation's credibility but also ensures that it relies on networks with constituents to develop an efficient and a context-specific approach to biodiversity conservations.

Formal performance evaluations and post-implementation reviews are needed to ensure that biodiversity reporting is not just symbolic (Lodhia et al., 2022; Sobkowiak, 2023; Wagner, 2023). Performance targets should be set for biodiversity-related matters. These should be carefully designed to promote the proactive management of biodiversity over the short-, medium- and long-term while also enabling accountability for biodiversity-related performance (King et al., 2022; Maroun & Atkins, 2018; van Liempd & Busch, 2013).

How biodiversity (as a "stock" of natural capital) is assessed or valued for performance evaluation and post-implementation review should consider economic and ecological factors. For example, the costs of biodiversity action plans can be evaluated in financial and environmental terms and reported to stakeholders using the latest valuation frameworks (e.g. The World Bank, 2021; United Nations, 2019a). Any fines incurred or liabilities assumed should be factored into cost assessments. Conversely, improvements in the size and quality of ecosystems under management should be reported as "gains" and compared to the financial and extra-financial costs of the applicable biodiversity management plans as part of modified productivity or efficiency ratios (Atkins & Macpherson, 2019; Buchling & Maroun, 2021; Cuckston, 2017). Favourable variances in inventories of natural capital should lead to the codification and replication of best practices. Unfavourable variances should prompt further analysis and remedial action as part of a process of continuous improvement (Adler et al., 2018; van Liempd & Busch, 2013).

Performance evaluation and review should be carefully integrated with risk assessments (Panwar et al., 2023; Sobkowiak, 2023). These should identify the risks that environmental factors pose to the organisation and, conversely, how the organisation's activities can lead to adverse environmental outcomes (GRI, 2016, 2024). Plans to mitigate risks and capitalise on the opportunities will be required. How these are implemented and the time-frames under review will form an integral part of how an organisation internalises sustainability (see, for example, Scarpellini, Marín-Vinuesa, et al., 2020, Scarpellini, Valero-Gil, et al., 2020, Sobkowiak, 2023).

How the organisation identifies, assesses and manages risk exposure can be contextualised further by reporting on adverse incidents categorised according to impact (Barone et al., 2024). Favourable events can also be reported when these point to a reduction in risk to avoid a biased account of biodiversity-related performance (Atkins & Maroun, 2018; van Liempd & Busch, 2013). The organisation should explicate how it gauges the materiality of risks linked to biodiversity and how materiality assessments are used to scale the actions taken in response to each class or category of risk (Atkins & Maroun, 2018, van Liempd & Busch, 2013). This will take the direct and indirect financial implications of biodiversity into consideration, as well as the impact that an entity has on society and the environment (GRI, 2024).

Experiences from post-implementation and review should inform revisions to the organisation's management of natural capital to ensure that biodiversity at the policy level is informed by successes and failures in different parts of the business (Atkins & Maroun, 2018). Given the complexity of business models and the difficulty of attributing biodiversity loss to specific firms, action plans need to focus on all material parts of the value chain (GRI, 2024). The applicable management systems should collect and process data on qualitative and quantitative indicators of the quality of biodiversity inventories from both economic and ecological perspectives (Cuckston, 2017; Panwar et al., 2023). In practical terms, this will necessitate a multi-period analysis of changes in biodiversity by multi-disciplinary teams of experts rather than the finance unit operating in isolation. A biodiversity officer (or equivalent) can oversee the biodiversity management system with results from performance evaluations, post-implementation reviews and internal controls subject to formal approval by a specialist sub-committee of the organisation's governing body (King et al., 2022).

Biodiversity action plans are updated as part of a process of robust internal management characterised by monitoring, review and continuous improvement (Bui & De Villiers, 2018). This includes the use of internal and external auditors to ensure the integrity of the controls and systems used to produce information for management decision-making and reporting to stakeholders (Prinsloo & Maroun, 2018).

The biodiversity reporting indicators are summarised in Table 1. These are organised according to the focus on policy and action.

To explore how the biodiversity reporting indicators are operationalised, the remainder of this paper examines the biodiversity reporting by a sample of UK-listed companies. The approach followed to analyse corporate reports and the results of that analysis follow.

3 | METHOD

As discussed in Section 1, the focus is on UK companies. A UK-specific study is appropriate given the standing of the country as a member of the G7, the size of many UK companies and the global scale of these firms' operations leading to material economic and environmental impacts.

The UK has not created a mandatory sustainability reporting regime similar to the EU's but it requires certain companies to prepare "strategic reports", which explicate principal risks including those linked to the environment. From 2022, mandatory climate-related disclosures have been introduced.[4] A "statememt of intent" published by the Financial Reporting Council (FRC) in 2021 deals specifically with the advancement of extra-financial reporting[5] and has been followed by a commitment to endorse the ISSB's standards and use these as

[4]See https://www.icaew.com/technical/corporate-reporting/non-financial-reporting/uk-sustainability-reporting-requirements

[5]https://www.frc.org.uk/news-and-events/news/2023/01/frc-updates-2021-statement-of-intent-on-esg/

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TABLE 1 Policy and performance elements of biodiversity reporting.

Policy-level	
Indicator	***Themes***
1. Scene-setting	• Definitions • Mission statements • Broad policy objectives
2. Species-related	• Individual species impacted • Site-specific details • Surveys of numbers and state of species • Classifications per IUCN red list
3. Accounting schematics	• Accounting system for biodiversity • Ecosystem and taxa accounts • A statement of Biodiversity Position and Performance is developed
4. Legal considerations	• Biodiversity laws and regulations • Compliance monitoring and response • Alignment with global and regional standards, conventions and agreements
5. External reporting	• Selected codes of best practice • Basis for selection
Performance elements	
Indicator	***Themes***
6. Social engagement	• Partnerships • Awards/accomplishments • Fines/issues • Stakeholder education • Stakeholder feedback
7. Performance evaluation	• Targeted actions • Evaluations of actions and outcomes
8. Reviews	• Post-implementation reviews relating to biodiversity impacts • Feedback loops • Biodiversity concerns "hotline"
9. Valuation	• Quantitative, qualitative or monetary measurement • Cost–benefit analysis • Natural inventory account • Reference to biodiversity valuation frameworks • Productivity and efficiency ratios
10. Risk	• Keys risks and opportunities • Risk management plans • Incidents and remedial plans
11. Inventory management and boundary setting	• Organisational and value chain boundaries are defined, disclosed and evaluated • Management of biodiversity inventory quality
12. Systems and management	• Management control systems to collect and process environmental data and performance • Environmental/social committee dealing with biodiversity impacts • Adaptability to changes in the external environment and environmental challenges • Multi-timeframe analysis • Cross-functional working groups • Supply chain management assessment
13. Internal management	• Biodiversity action plans • Biodiversity officer
14. Assurance	• Internal and external assurance for biodiversity disclosures/environmental risks • Independent third-party sustainability certification

the basis for UK-specific reporting requirements.[6] Whether explicit biodiversity reporting provisions will be introduced is yet to be seen, but, at the time of writing, prominent UK firms have been identified as leading producers of sustainability reports that include a range of social and environmental topics (IFAC, 2023; KPMG, 2022) including those related to biodiversity.

[6] https://www.gov.uk/guidance/uk-sustainability-disclosure-standards

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The researchers examined the largest 75 companies by market capitalisation.[7] Limiting the study to this sub-set of listed firms controls for factors like access to resources, availability of expertise and the absence of formal governance structures impacting how organisations report on biodiversity. The sample included a broad range of business models (34 sub-sectors are represented), which avoids results being limited to a specific industry. Examining the most established/prominent UK entities also ensures that the findings resonate with an international audience.

The annual, integrated and/or sustainability reports of these entities were examined from 2018 to 2022. Organisations can also provide information to stakeholders using other channels including webpages, social media and press releases. These were considered only when referenced in a formal report and when the date of publication could be discerned. The limitation on the scope of information being considered was driven by practicality and the fact that governing bodies are not necessarily required to review and take responsibility for extra-financial information included outside of the primary reports to stakeholders.

3.1 | Data collection

The researchers followed a similar approach to Samkin et al. (2014) and Hassan, Roberts, and Atkins (2020), who examined broadly the extent and quality of biodiversity reporting in different settings. Each corporate report was reviewed to determine its overall structure, subsections and locations in which environmental issues were being addressed. Any disclosure dealing directly or indirectly with the environment was flagged. Each was then re-assessed to determine if it dealt with biodiversity as defined by the GRI (see Section 2) and was recorded on a disclosure register.

Paragraphs were the unit of analysis. This avoided overlooking the context and meaning of disclosures (Guthrie et al., 2004). If biodiversity information was included in a table, the full table was treated as the unit of account and the content of the table was recorded in the disclosure register. Images were not included unless they were specifically cross-referenced to other content in the reports. This was to avoid coding, for example, pictures included in an annual report that may have been used for aesthetic purposes but do not provide context-specific information on biodiversity-related matters.[8]

After a report was coded, it was searched for keywords associated with biodiversity[9] as a completeness check. The disclosure register was updated as required. The completion of the disclosure checklist was an iterative process undertaken by the lead researcher to ensure consistency. If new disclosures were identified as corporate reports were being read, reports that had already been analysed were revisited to ensure that all relevant disclosures had been included on the register.[10]

The final list of biodiversity disclosures (per the register) was coded using the elements and the associated indicators in Table 1 as axial codes and the themes linked to each as secondary or selective ones. Disclosures could be "tagged" with one or more themes/selective codes. The final instrument included 124 themes grouped under the 14 indicators (see Appendix A).

Steps were taken to ensure the accuracy and reliability of the coding. Firstly, the same researcher was responsible for the initial round of coding to ensure consistency. As disclosures were coded, field notes were kept, which guided the researcher in assigning each disclosure to one or more selective codes. Secondly, the remaining researchers reviewed the coding for logic. Rather than computing inter-coder reliability scores, differences were flagged and resolved by the research team. A research assistant provided independent peer review as required.[11] Thirdly, the coding of the disclosures and preliminary results were presented at three working groups/seminars to receive feedback from the academic and practitioner community. The discussions included how the disclosures were identified and coded and the tagging of a sample of disclosures.[12] Finally, the grouping of secondary codes under the axial ones was based on the prior literature (see Section 2). This limited the use of researcher judgement, ensured that the coding had structure and provided a rational basis for organising and presenting results in Section 4.

3.2 | Data analysis

The researchers computed three scores that capture the quantum of disclosures (Wiseman, 1982), the information content of the disclosures (Beretta & Bozzolan, 2004) and the ease with which the disclosures can be read (du Toit, 2017). Refer to Table 2.

Evaluating the determinants of biodiversity disclosures is deferred for future research. Details on the WORD, CONT and READ scores are presented graphically with supporting descriptive statistics. Friedman ANOVA and Wilcoxon Sign Rank tests are used only to confirm if year-on-year differences in scores are statistically significant. A Spearman's correlation is used to analyse univariate associations among the biodiversity disclosure scores.[13]

Examples from corporate reports are included to contextualise the quantitative findings and provide further insights. Editorial changes to examples were limited. Where quotations have been shortened, this is indicated. The researchers relied on reporting practices from the full sample of companies to conclude, but practically,

[7] As at 1 January 2021.

[8] Where pictures were included as part of an analysis/explanation of biodiversity in a paragraph, subjection or table in the applicable report, the content of the picture was summarised and included as part of that analysis/explanation.

[9] The same key words identified by van Liempd and Busch (2013) were used. These included, for example, "biodiversity", "habitat", "eco-system", "conservation", "species", "flora", "fauna", "wildlife," "marine life" and "maritime life".

[10] This was the case for the first third of the reports. After this point, few additional disclosure themes/types were noted and the coding process became less iterative.

[11] The research assistant is based in the same department as the authors but was not involved in writing the paper. The research assistant was used for peer debriefing and to "test" disclosure coding as required.

[12] Approximately 10% of the disclosures.

[13] Non-parametric tests are used because not all of the data are normally distributed and because these tests are less sensitive to the effects of outliers than the parametric alternatives. Results were, however, corroborated using ANOVA's, t-tests and Pearson correlations. In the interest of brevity, these tests are not reported.

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TABLE 2 Disclosure scoring.

Score	Label	Details
The extent or quantity of information reported	WORD	• The quantum of information is a key consideration when determining if environmental matters are being addressed adequately in corporate reports. When reports are incomplete, their utility is reduced (Beretta & Bozzolan, 2004; Wiseman, 1982). • Counting the number of disclosures does not adjust for differences in the amount of information reported to stakeholders. As a result, the average number of words per disclosure is computed for each company and is a continuous measure. • The minimum score is "0". A larger score implies a more detailed disclosure or an increase in the quantity of information reported to stakeholders.
Content of the disclosures	CONT	• The volume of information reported cannot be the only measure of the substance or quality of disclosures. Other factors include, for example, the appropriate mix of qualitative and quantitative information (Al-Tuwaijri et al., 2004); the extent to which disclosures are boilerplate (Beretta & Bozzolan, 2004) and coverage of specific actions taken in addition to policy considerations (Borghei et al., 2016). • An ordinal score is assigned to each disclosure. Following the same approach as that of Hassan, Roberts, and Atkins (2020), a score of "0" is applied if a disclosure does not address the respective indicator. A value of "1" is assigned when a disclosure is included in the report but is generic. A score of "2" is awarded when "*disclosures contained objective, verifiable and current data*". When a disclosure exhibits the features for a score of 2 and also incorporates *quantified measures, forward-looking information, details on specific actions and/or evidence of integration with other core aspects of the business model*,[a] a score of "3" is awarded. (Adler et al., 2018, p.797) • The content scores were determined per indicator and averaged based on the number of disclosures per company per year and are at least ordinal. for example, if Company A includes 10 biodiversity disclosures 4 of which covered scene setting (Indicator 1) and 6 of which covered performance evaluation (Indicator 6), the average score for each indicator would be computed as: $\frac{\sum \text{Score per disclosure for the respective indicator}}{\text{Total number of disclosures for that indictor}}$ • The minimum score per disclosure is "0" which means that no content has been provided on the applicable indicator. A higher score (with a maximum of 3 per disclosure) implies more context-specific content on that indicator.
Readability of the disclosures	READ	• Even if a company provides sufficient detail on biodiversity covering core issues/considerations, the utility of the reporting is reduced if it is difficult for readers to understand (du Toit, 2017). • The Felsch-Kincaid Reading Ease and Felsch-Kincaid Grade Level have been widely used in social science and business research and are employed to gauge the readability of each biodiversity disclosure (du Toit, 2017). • IBM Watson and Spacey Natural Language Processing were used to generate readability scores. The applicable library of terminology should be updated when dealing with specialist content. In this case, however, no adjustments were made because the aim is to determine the level of reading difficulty from the perspective of a non-biodiversity specialist using an organisation's corporate report to make investment or other decisions. • The Felsch-Kincaid Grade Level ranges from 0 (basic text) to 19 (advanced text). Conversely, a higher Felsch-Kincaid Reading Ease score implies that the text is easier to read.

[a]For example, the disclosure is explicitly cross-referenced to the respective parts of the corporate report where the business model is addressed or incorporates directly an explanation of how the biodiversity matter under consideration is factored into risk assessment, strategies and operations concurrently.

the number of reported examples is limited. Quotations were selected that, based on the researchers' judgement, reflected most accurately the reporting practice being illustrated. Effort has, however, been made to include examples from several of the sampled companies rather than relying on data from only a minority of entities.

4 | RESULTS

Descriptive statistics are reported in Figure 1. On average, biodiversity disclosures range from 15 to over 2000 words ($\overline{X} = 322$). Grade level ($\overline{X} = 13.97$) and reading ease ($\overline{X} = 36.22$) scores suggest that the disclosures require a higher level of skill and education to understand.

From 2018 to 2022, the average words per disclosure ($\chi^2_{[df=2]} = 4.58$, $p > 0.05$) and their reading ease ($\chi^2_{[df=2]} = 4.31$, $p > 0.05$) are largely unchanged. There is, however, a marginal improvement in content scores (2018: $\overline{X} = 0.9$; 2020: $\overline{X} = 1.10$, $\chi^2_{[df=2]} = 7.12$, $p < 0.05$) primarily as a result of disclosure addressing more performance-related issues such as social engagement ($\chi^2_{[df=2]} = 10.51$, $p < 0.01$), performance evaluation ($\chi^2_{[df=2]} = 13.22$, $p < 0.01$) and internal management ($\chi^2_{[df=2]} = 17.69$, $p < 0.01$).[14]

A more pronounced change is evident from 2020 to 2021, possibly as a result of COVID-19. The pandemic raised awareness about

[14]Test results from a Friedman's ANOVA (χ^2) are confirmed using an un-tabulated Kendall's W test.

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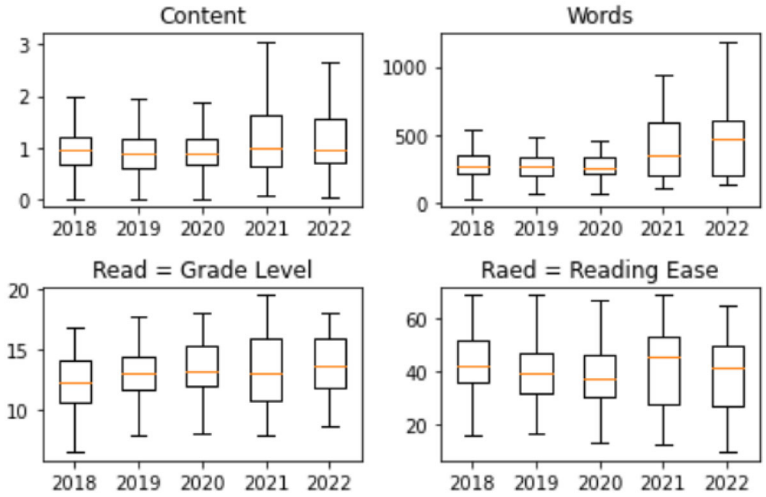

Variables	2018-2022				2018-2020		2021-2022		2020 v 2021
	Mean	STD	MIN	MAX	Mean	X2	Mean	Z	Z
Grade Level	13.97	5.14	-4.20	40.86	13.61	4.52^	14.34	-1.44^	-0.19^
Read_ease	36.22	25.39	-95.36	134.08	36.85	4.31^	35.56	-0.67^	-1.21^
Words	322	247	15	2016	280	4.58^	367	-2.71*	-3.69**
Content	1.04	0.82	-	4.87	0.98	7.12*	1.11	-0.37^	-2.67**
Policy	0.44	0.63	-	3.28	0.49	4.87*	0.39	-0.45^	-2.83**
• Scene setting	0.05	0.09	-	0.86	0.04	5.82^	0.07	-0.16^	-4.49**
• Species-related	0.03	0.12	-	1.50	0.03	0.70^	0.04	-0.71^	-2.57**
• External reports	0.21	0.42	-	2.33	0.29	8.21*	0.13	-0.38^	-5.05**
• Accounting	0.02	0.05	-	0.40	0.02	0.80^	0.02	-0.99^	-2.01*
• Legals	0.12	0.22	-	2.75	0.12	4.06^	0.13	-0.12^	-2.52*
Performance	0.61	0.57	-	3,28	0.49	7.54*	0.73	-0.66^	-6.02**
• Social Engagement	0.05	0.11	-	0.80	0.03	10.51**	0.07	-0.74^	-4.91**
• Perform. Eval	0.06	0.10	-	0.92	0.04	13.22**	0.08	-0.22^	-4.93**
• Risk	0.05	0.11	-	1.25	0.03	10.72*	0.06	-0.39^	-5.27**
• Int Mng	0.12	0.19	-	1.25	0.09	17.69**	0.15	-0.72^	-3.79**
• Valuation	0.02	0.09	-	1.20	0.02	4.48^	0.02	-1.06^	-7.69^
• Inv mg & boundary	0.01	0.04	-	0.71	0.01	0.67^	0.01	-0.28^	-5.12**
• Reviews	0.15	0.21	-	3.00	0.13	4.21^	0.17	-0.57^	-4.07**
• Assurance	0.07	0.14	-	1.00	0.06	4.07^	0.07	-0.80^	-2.37*
• System mng	0.08	0.17	-	1.17	0.07	6.15*	0.09	-1.64^	-3.60**

** significance at the 1% level; * significance at the 5% level; ^no significance

FIGURE 1 Descriptive statistics with box plots.

issues such as the illegal harvesting of species, animal trafficking and habitat destruction and their implications for businesses and the broader economy (Hassan, Elamer Ahmed, et al., 2020). While COVID-19 was not factored into existing biodiversity reporting guidelines, it iterated the need to be more aware of, and report transparently on, environmental factors including biodiversity (Roberts et al., 2021). In this context, the average length of biodiversity disclosures increases from an average of 280 for 2018 to 2020 to 367 for 2020 to 2021 ($Z_{[df=1]} = 3.69$, $p < 0.01$). A shift from policy-related ($\overline{X}_{[2018-2020]} = 0.49$; $\overline{X}_{[2021-2022]} = 0.39$; $Z_{[df=1]} = 2.83$, $p < 0.01$) to performance-focused reporting ($\overline{X}_{[2018-2020]} = 0.49$; $\overline{X}_{[2021-2022]} = 0.73$; $Z_{[df=1]} = 6.02$, $p < 0.01$) occurs leading to a net increase in the information content of biodiversity disclosures ($\overline{X}_{[2018-2020]} = 0.98$; $\overline{X}_{[2021-2022]} = 1.11$; $Z_{[df=1]} = 2.67$, $p < 0.01$).

4.1 | Correlations among disclosures

Table 3 reports non-parametric correlations among key variables. (A complete matrix is reported in Appendix B.)

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TABLE 3 Non-parametric correlations.[a]

	Grade	Read	Words	Content	Policy	Perf
Grade	1	−.936**	−.427**	−.439**	−.392**	−.407**
Read	−.793**	1	.418**	.395**	.363**	.357**
Words	−.296**	.283**	1	.493**	.414**	.490**
Content	−.304**	.269**	.355**	1	.853**	.912**
Policy	−.263**	.243**	.282**	.674**	1	.589**
Perf	−.276**	.238**	.354**	.749**	.414**	1

Note: Spearman correlations above the diagonal and Kendal's Tau-b below the diagonal.
**Significance at 1% level.
*Significance at 5% level.
[a]Not all of the data are normally distributed. As a result, the non-parametric Spearman Rho and Kendal Tau b are used. Both are less sensitive to non-normal distributions and outliers than Pearson correlations.

Companies with more developed biodiversity policies tend to have high-quality performance-related disclosures ($r_s = 0.589$, $p < 0.01$). Appendix B shows that well-developed mission misstatements ($r_s = 0.230$, $p < 0.05$), accounting systems ($r_s = 0.506$, $p < 0.01$) and a focus on compliance with laws and regulations ($r_s = 0.678$, $p < 0.01$) are associated with disclosures providing more information content on how biodiversity is actively managed by a firm.

As companies start to understand the commercial and moral imperatives of biodiversity conservation, they become more likely to identify risks posed to biodiversity by their operations and to introduce initiatives to mitigate adverse biodiversity impacts. This is affirmed by moderately strong and statistically significant ($r > 0.25$, $p < 0.01$) correlations between the content score for policy disclosures, on the one hand, and risk, valuation, reviews and systems management, on the other.

The link between biodiversity at the policy and performance levels is not the result of more content being included in corporate reports. The correlation between the average number of words, and the content of, each disclosure is only moderate ($r_s = 0.493$, $p < 0.01$). In addition, none of the correlations between disclosure word counts and each of the individual content measures exceed 0.6.

More detailed reporting on the biodiversity elements tends to be more difficult to read. The inverse relationship between reading complexity and the content of biodiversity disclosures probably reflects the inherently technical nature of biodiversity reporting. Figure 2 aggregates the biodiversity indicators and presents the correlations between policy- and performance-related disclosures and readability measured using reading ease (Panel A) and the quantum of information reported (Panel B). Plots are for standardised scores.

Panel A shows that as content scores tend to the mean of the sample, reading ease improves. Companies providing the most detail in terms of biodiversity policy (Figure 2a) and performance (Figure 2b) have disclosures that are more difficult to read. The disclosures are also lengthier (Panel b), especially for performance-related content where the number of words used per disclosure increases at an increasing rate.

The combination of more detailed and technical reporting is probably resulting in disclosure, which, while more informative, is difficult for non-experts to understand. Interestingly, companies providing relatively little content on policy and performance also have disclosures that are difficult to read (Panel a). While less information is being reported (Panel b), what is provided may still be highly technical and, because of less supporting context, less understandable for non-experts.

Correlations reported in Table 3 and presented in Figure 2 do not prove that scene-setting and social engagement are driving the proactive management of biodiversity by organisations. The correlations are also based on relatively low-quality scores (as discussed in Section 4.1), and disclosures have not been formally verified by ethnographic studies, detailed interviews or a formal assurance engagement. To provide additional insights, the nature of specific biodiversity disclosures is considered in more detail. Outliers per Figure 2 are identified and used to explore how biodiversity is being understood by and factored into the activities of companies with the greatest extent, information content and readability scores. Their accounts of policy (Section 4.2) and performance (Section 4.3) contrast with those advanced by companies, which have scores tending towards the means in Figures 1 and 2.

4.2 | Biodiversity at the policy-level

At the policy level, some organisations frame the importance of biodiversity in both ecological and economic terms. For example:

"Biodiversity Green infrastructure plays an important role not only in increasing ecological habitat in dense urban environments, but also as a ***resilience feature*** *to lessen surface rainwater on our sites. Importantly, it provides our customers and local communities with a* ***much-needed connection to nature in their daily lives.*** *Our spaces have a vital role to play in* ***linking enhancements for biodiversity with better customer experiences,*** *and we're committed to maximising the* ***ecological potential*** *of our development and operational sites"* (LAND, 2020, emphasis added[15]).

[15]References and quotations are made from the sample of organisations' reports to illustrate biodiversity disclosures. To anonymise the company, the full name is not used and only a three- or four-letter code and the relevant year is used. The corresponding author can be contacted for further information relating to the sample of companies used.

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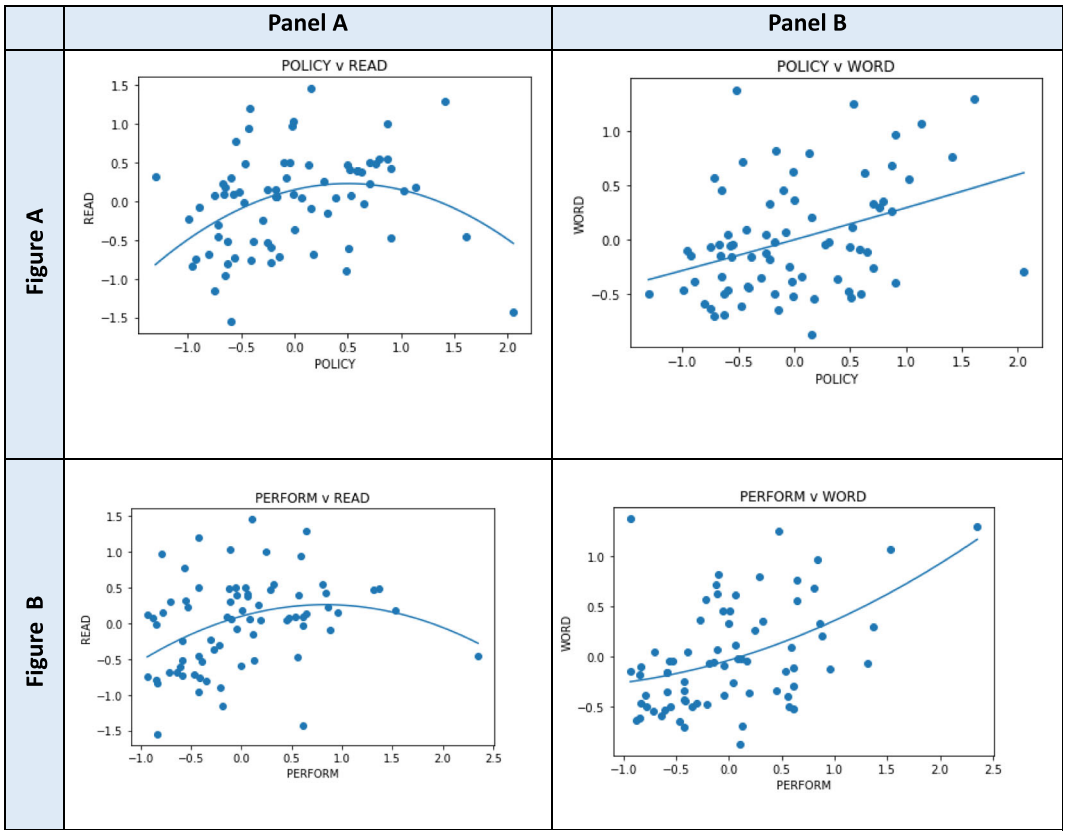

FIGURE 2 Scatterplots based on standardised scores with trend lines.

Consistent with the approach taken by, for example, the GRI (2024) and the World Bank (2021), the immediate business case for protecting biodiversity is established. The "green infrastructure" is a means of improving customer experiences with implied benefits for financial returns while contributing to a more "resilient" business model characterised by lower operational risks. At the same time, biodiversity is not framed in exclusively ecocentric terms; the intrinsic value of biodiversity is also acknowledged[16] (Anthony & Morrison-Saunders, 2023; Samkin et al., 2014). The company appreciates that biodiversity is more than a stock of capital to be used in production processes. There is a sense of nature having an aesthetic, social and cultural value based on the "connection" between people and the environment. As a result, policy considerations by LAND (and other companies) include "increasing ecological habitat" in terms of size and quality as part of a commitment to safeguarding "natural beauty", strengthening the link between stakeholders and nature and balancing financial objectives with environmental responsibility (e.g. LAND, 2022, SVT, 2020; SDR, 2022[15]).

These broader policy objectives are complemented by projects to rewild areas or conserve habitats to avoid the loss of key biodiversity including species, which are at high risk of extinction. In support of the fact that this is more than just impression management, policies are not limited to only plants or animals that are likely to attract the greatest public interest. In addition to developing biodiversity action plans for peregrine falcons, hummingbirds, butterflies and pollinating insects also feature (CRH, 2021[15]), as do moths, other invertebrates and several tree species (AV, 2022; LLOY, 2021[15]).

Expanded accounting systems form part of ecologically-aware policy positions. For example, companies appreciate that growing natural capital requires a focus on "long-term productivity and resilience of landscapes" (MNDI, 2020[15]). As a result, the accounting infrastructure must be expanded to collect details on the extent and condition of habitats affected by the organisation's operations (see Cuckston, 2017; Sobkowiak, 2023) over multiple periods to provide a basis for policy implementation (see Bui & De Villiers, 2018). Examples include the development of databases and charts of accounts to cover water usage (ABF, 2022), emissions (III, 2022), areas of habitat under management (SSE, 2022) and various indicators of ecological health such as the number of species being tracked and changes in their populations (SVT, 2019).

There is also evidence of companies developing guidance on how to identify and account for the most significant biodiversity-related issues. For example, SVT (2022) relies on a "double assessment", which takes cognisance of "the impact that the Company's activities have on the environment, people, and economies" (impact materiality) as well as "the impact of sustainability issues on the financial value of the business" (financial materiality). An expert working group is

[16]For a detailed discussion on environmental paradigms linked to biodiversity including ecocentric and deep ecological framings, see Samkin et al. (2014); Gaia and Jones (2017) and Anthony and Morrison-Saunders (2023).

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engaged to verify the materiality determination, with results approved by a board sub-committee.

How the company classifies biodiversity-related issues as material is guided by external reporting frameworks that deal with impact and financial materiality (see, for example, GRI, 2024, ISSB, 2021, European Commission, 2024). These frameworks are also used by SVT to inform the range of topics being covered by corporate reports. The same is true for other companies. For example, NXT (2022) and IHG (2021) explain how guidance provided by the Sustainability Accounting Standards Board (SASB) and GRI was used as part of a "gap analysis". The goal was not only to demonstrate substantial alignment between what the entity reported and an established discourse but also as a means of ensuring that accounting and reporting policies are current and complete. The Sustainable Development Goals (e.g. WPP), GRI guidelines (e.g. CRH) and TCFD (e.g. FERG) are used similarly by other firms.

The European Union has mandated sustainability reporting for certain organisations, but the provisions only come into effect in January 2024 and are not automatically applicable to all UK firms. As a result, companies have considerable discretion when determining the extent to which biodiversity is addressed by annual or sustainability reports. The adoption of voluntary guidelines; replication of "industry best practices" and continuous engagement with stakeholders (CRH, 2020) are important policy-related considerations for guiding how biodiversity is understood by a firm. Conformance with established reporting conventions can also accord credibility while signalling that the organisation is well-placed to manage environmental challenges (see Atupola & Gunarathne, 2023).

UK companies are not, however, reporting consistently on biodiversity policy. For example, details on the design of accounting systems and account taxonomies are limited ($\overline{X} = 0.02$) as is the content addressing scene setting ($\overline{X} = 0.05$) and specific species ($\overline{X} = 0.03$). Most reports either exclude details on the flora and fauna impacted by operations or address biodiversity only superficially. Biodiversity is covered to some extent but explicit statements on compliance with or commitments to recognised conventions on biodiversity are seldom provided ($\overline{X} = 0.12$). Where reference is made to broader reporting frameworks – such as the GRI and IIRC – it is not always clear how they have been tailored to deal specifically with the respective organisation's biodiversity impact ($\overline{X} = 0.21$).

4.3 | Biodiversity-related performance

At the performance level, leading reports are using a collaborative approach to tackle biodiversity-related risks. This is characterised by firms seeking partnerships with environmental bodies, community groups and other stakeholders as part of an effort to problematise biodiversity more effectively (see Atkins et al., 2022). For example:

> *"When we work with land-connected groups, we want to understand their physical, spiritual and cultural connection with the local environment. As such, we seek their active engagement in monitoring and managing cultural heritage impacts. For example, at our … operation in [Western] Australia, our turtle monitoring programme, a partnership with the Department of Biodiversity, Conservation and Attractions, has been expanded to become a collaboration between operational teams, local communities, regulators and the [related] Corporation"*
>
> (RIO, 2019).

In keeping with policy positions focused on the financial and intrinsic value of biodiversity, collaborations are not only about addressing economic considerations but also about understanding the socio-cultural importance of natural capital to support more refined risk assessments and changes to operational plans (un-tabulated). Engagements with experts and other parties are also used to identify species at risk of extinction; select suitable indicators of ecological health and track progress on environmental objectives discussed in Section 4.2 (e.g. CRH, 2021; AV, 2022; LLOY, 2021).

As a result, while disclosures tagged as "social engagement" play an educative role by supporting explanations of the business case for protecting biodiversity, they are also evidence of how various stakeholders are starting to be co-opted in the operationalisation of policy-level aspirations (see Atkins et al., 2022). In support of this position, details on social engagement are often accompanied by, at least, some level of performance evaluation and review. For example, SDR (2020) reports on donations to charity groups and how these were applied to achieve marine conservation aims. ADM (2022) outlines financial resources allocated to rewilding projects including the number and type of indigenous trees planted with the assistance of community groups. The sizes, locations and diversity of species in various habitats are addressed.

At some companies, accounting and management systems have matured to the point where biodiversity budgets are set and used to compare planned with actual levels of performance. This is gauged by different metrics such as areas under rehabilitation, the number of species affected and the locations of biodiversity. For example:

> *Performance: On track. In the year we extended our biodiversity commitment to our assets in London and are assessing opportunities for installations in the year ahead. We've planned and secured budget for biodiversity enhancements to the five sites offering the greatest potential, which will deliver net gain in biodiversity at each site of between 5% and 25%. Completed projects include a 220 m2 wildflower garden installed … and planting of aquatic plant species in the lakes at White Rose, Leeds. We're also committed to delivering net gain through our development pipeline, and our 21 … development will deliver over 1,700 m2 of new green walls, trees and plants, totalling 76 different species. We are developing a strategy for all future developments to deliver net gain*
>
> (LAND 2019).

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This type of reporting points to a widening of the accounting and management systems to a point where "gains" are not framed in only financial terms but include other "nature-signalling numbers" (see Russell et al., 2017). The company reports on the areas under management, highlighting both locations and sizes. It touches on the number of species being conserved and reports quantified changes in the state of biodiversity at the respective sites. The disclosure is supported by additional detail (un-tabulated) on the costs of the project and the monetary value of commitments. Information on internal management processes and the methodology used to measure biodiversity gains is highlighted (un-tabulated). While not extensive, tentative steps are also taken to expand the accounting for biodiversity by incorporating various entities in the group as well as other parts of the value chain.

A similar approach is followed by SPX(2020–2022). The company sets biodiversity targets, which are linked to specific risk assessments and cover ecological and economic considerations (see Sobkowiak, 2023). Further information on the business activities at each site is provided in cross-referenced disclosures (un-tabulated). An overview of performance is then reported:

> *"The assessment found that the majority of our sites are low risk for biodiversity impacts: 28 of our 31 sites were classified as low risk, three were classified as medium risk (although in two of these sites, this related to the risk of impact under exceptional conditions – such as fire or flooding – and not during normal operating conditions) and no sites were classified as having a high risk. The medium-risk sites were: [the site in] Argentina, where the Rio Reconquista runs close to the site and flows into a network of regionally-important wetlands; [the site in] Mexico, where the Rio Grande River flows close to the site, which is home to two IUCN Endangered Species (the Rio Grande Silvery Minnow and the Golden-cheeked Warbler); and [the site in] USA, which adjoins a local woodland and, as a result, could have a minor local impact on wildlife during normal operations as a result of disturbance from noise or light"*
>
> (SPX, 2020).

Classifying financial risks according to their timing, likelihood of occurrence and impact is common practice. The same structured approach is starting to be applied to extra-financial factors. As a result, what the IIRC (2021) refers to as an integrated thinking logic may be taking hold. Biodiversity is not being addressed separately but as an integral part of an existing risk management discourse. This entails framing biodiversity according to the financial implications for the firm, as well as the impact that the entity's operations have on stocks of natural capital (see also GRI, 2024). Driving a process of continuous improvement is also relevant.

Based on experiences, the company updates its biodiversity action plans. It develops a four-step approach to achieve a "biodiversity net gain", which involves operational changes, offsetting, introducing targets at the site level in addition to firm-wide goals, and enhancing its new facilities (SPX, 2020 & 2021). As a result, the organisation's governance is being informed by its experiences with implementing environmental plans, leading to a reflexive assessment of and amendment to how biodiversity is articulated at the policy-level (Corvellec, 2016a, 2016b). These changes are overseen by management and approved by the governing body with assurance providers bolstering the accuracy and completeness of information used for internal decision-making and external reporting (e.g. PRU & TSCO 2020–2022).

Extensive performance-related reporting is not, however, common practice ($\overline{X} = 0.61$). Most companies are either not relying on partnerships with NGOs, researchers and other experts to identify and mitigate biodiversity-related risks or are limiting the extent of reporting on these collaborations. A low stakeholder engagement content score ($\overline{X} = 0.05$) results. Similarly, reports stop short of providing a structured analysis of performance variances with explanations of the circumstances contributing to the most material favourable or unfavourable outcomes. There is little information on remedial action taken when biodiversity targets are not met or how best practices are being identified and replicated in other parts of the business or value chain. As a result, content scores for performance valuation ($\overline{X} = 0.06$) and reviews ($\overline{X} = 0.15$) are consistent with those for social engagement disclosures.

Biodiversity risk assessments ($\overline{X} = 0.05$) and information on internal management practices ($\overline{X} = 0.12$) are also limited. Few organisations are identifying biodiversity explicitly as a business risk or outlining opportunities linked to growing calls for biodiversity awareness and protection. There were few examples of companies explaining how internal systems, business processes and management controls were being updated to address any adverse impacts of business models on biodiversity ($\overline{X} = 0.08$). Only isolated cases of accounting and reporting being formally assured were noted ($\overline{X} = 0.07$).

Action plans are either not included in corporate reports or provide only generic information. Few companies have a dedicated biodiversity officer and clearly defined lines of authority for reporting biodiversity impacts, overseeing remedial actions and enabling accountability ($\overline{X} = 0.12$). What has been done is limited to specific parts of the business. Details on, for example, biodiversity impacts by different operational or regional units are not explicated and consolidated assessments of risks and performance outcomes for the full value chain are not reported by most entities under review ($\overline{X} = 0.01$).

Neither qualitative nor quantitative analyses of the costs and benefits of biodiversity loss and conservation are being performed consistently. Some information is given on biodiversity offsetting, but it is not always clear how this is factored into the respective organisations' strategies, risk management and operating practices. Biodiversity valuation models/frameworks (e.g. Natural Capital Coalition, 2016), ecological accounting (see Russell et al., 2017) and extinction accounting (see Atkins & Maroun, 2018) are not referenced. There was no indication of quantified measures of biodiversity loss or restoration being tracked consistently and linked explicitly to key performance indicators or strategic objectives. As a result, the valuation indicator reports a low score ($\overline{X} = 0.02$).

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5 | DISCUSSION AND CONCLUSION

This study draws on prior academic research and key developments in international standard-setting to develop a detailed biodiversity reporting schematic. Disclosure themes are organised according to a policy- and performance-related stance. The first provides insights into how biodiversity is defined and understood by organisations at both the economic and ecological levels. The second highlights how biodiversity is being factored into operational and management practices. The schematic is applied to a sample of firms to provide a current assessment of biodiversity gauged according to the extent of reporting, the information content of disclosures and the readability of those disclosures.

Consistent with earlier work on developed (e.g. Hassan, Elamer Ahmed, et al., 2020; Schneider et al., 2014) and developing economies (e.g. Mansoor & Maroun, 2015; Sun & Lange, 2023), biodiversity reporting remains largely under-developed. Low levels of reporting cannot be attributed to a lack of financial resources, managerial expertise or monitoring by governing bodies. The sampled companies are prominent UK-listed firms with significant resources. At the national level, the UK is committed to achieving the Sustainable Development Goals (Rogelj et al., 2021). Leading institutional investors are signatories to the Principles for Responsible Investment, which advocate for, inter alia, the factoring of environmental-related considerations into capital allocation decisions (Slack, 2022). At the preparer level, the "Stewardship Code" and "Corporate Governance Code" promote high-quality reporting that ought to incorporate social and environmental matters (FRC, 2022). The recent introduction of strategic reports and commitment to endorse international standards dealing with sustainability reporting iterate the emphasis being placed on extra-financial reporting, especially by UK-listed entities. Nevertheless, the extent and content of biodiversity disclosures by these firms remain low.

A key limitation of the current study is that inferences about biodiversity policies are based only on what companies include in their corporate reports. One possibility is that biodiversity is being actively managed but is either not reported separately or excluded from the primary reports to investors and other stakeholders because the information is immaterial. Additional research will be required to determine how companies determine the nature and extent of biodiversity reporting including the processes followed to set applicable materiality levels.

A more critical interpretation is that biodiversity is not seen as a business imperative. Entities that do not have natural capital as a direct input in their business model may overlook biodiversity-related considerations. Developing a comprehensive accounting and management infrastructure necessary for collecting a range of data, generating relevant information and factoring it into internal decision-making and external reporting is no easy task. The cost of expanding accounting, management and governance policies and practices may simply exceed the actual or perceived benefits (see Panwar et al., 2023; Wagner, 2023). In the absence of regulation, these entities may take few steps to address biodiversity-related challenges substantively (Atupola & Gunarathne, 2023). This is especially the case if investors – as the primary users of corporate reports – do not link business fundamentals and biodiversity (Atkins & Macpherson, 2019; Carvalho et al., 2023).

From a different perspective, expanded reporting is value-adding for stakeholders in general but can lead to additional scrutiny for firms with adverse cost and legitimacy implications (Atupola & Gunarathne, 2023; De Villiers & van Staden, 2006). Providing only generic information addresses the expectation for, at least, some disclosure while deferring substantive actions and more extensive reporting (Cho et al., 2015; Malsch, 2013).

Even if companies are not engaged in impression management, biodiversity reporting is difficult. A single framework for integrating biodiversity into business models and reporting outcomes to investors does not exist. Codes of best practice issued by, for example, the GRI, IIRC and ISSB are yet to be consolidated. There are significant demands to report on environmental and social dimensions but little guidance on the nature, timing and extent of that reporting. Until "Generally-Accepted Sustainability Accounting" emerges, significant variations in biodiversity and other types of environmental and social reporting should be expected. There are, however, some positive signs.

While not common practice, evidence of biodiversity being understood from an economic and ecological perspective is emerging. A minority of firms recognise the case for protecting biodiversity based on business fundamentals and the intrinsic value of biodiversity. This is laying the foundation for modified accounting and management systems that track economic and ecological performance indicators and inform proactive monitoring and post-implementation reviews. There is room for improvement, but initial steps are being taken to develop and revise biodiversity plans based on an iterative process of policy development and performance assessment. In turn, the accounting and management infrastructure is being expanded to cover multiple operational units and, in some cases, other parts of the value chain. Whether or not these practices become institutionalised as industry and regional standards remains to be seen.

The above conclusions should be interpreted with caution. Findings are based on a sample of UK companies for a limited period only. Future research can make a material contribution by evaluating a broader selection of UK, and other firms, to reach firmer conclusions. The determinants of biodiversity reporting have not been formally assessed. The current paper also assumes a parity between what companies do and report. Ethnographic assessments, detailed interviews and comparison of biodiversity reports prepared by companies with accounts from other sources have not been conducted. Each offers an opportunity to understand in more detail the processes at work when biodiversity reporting is operationalised or resisted.

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APPENDIX A

Biodiversity indicators.[a]

Scene-setting		
Definition	• The company defines biodiversity and its components.	• Grabsch et al., (2012) • Atkins et al., (2014)
Mission statement	• Reporting of any biodiversity-related mission statement. • Existence of a biodiversity policy statement.	• Grabsch et al., (2012) • CBD (2018)
Motivation	• Mention of the World Economic Forum's ranking of biodiversity risk. • The business case for wanting to protect biodiversity is stated. This addresses economic considerations but also covers the ecological importance of biodiversity. • The case to protect biodiversity includes moralor ethical motivations. • The company states why protecting biodiversity important for the company and its stakeholders. • CEO/chairperson letter refers to biodiversity.	• WEF (2019) • van Liempd and Busch (2013) • Rimmel and Jonäll (2013) • CBD (2018) • Samkin et al. (2014) • Anthony and Morrison-Saunders (2023)
Species-related		
Site-specific	• Reporting of biodiversity information relating to specific sites. • The company discloses specific habitats/ecosystems (land, marine, wetlands, rivers, etc.) affected.	• GRI (2016) • Adler et al., (2018) • GRI (2024)
Specific species	• The company provides information about specific species affected at the sites where the company operates. • The company reports on potential risks/impacts on these specific species arising from the company's operations. • The company reports flora and faunal wealth around its operating area. • The company discloses which species are native or indigenous. • Company reports regular assessments of species populations in areas affected by corporate operations.	• van Liempd & Busch, 2013Atkins & Maroun et al. (2018) • Adler et al. (2018) • Anthony & Morrison-Saunders (2023)
IUCN red list	• Mention of the IUCN red list. • The company provides a list of endangered plant and animal species whose habitats are affected by the company's activities. • Incorporates images (photos or drawings) of threatened species • The company reports biodiversity or species loss due to its operations. • Company reports operations with activities in IUCN-protected areas.	• Grabsch et al., 2012GRI (2016) • Atkins & Maroun et al. (2018) • Adler et al. (2018)
Surveys	• The company has included references to CDP questionnaires. • Reporting of biodiversity assessments/surveys conducted.	• Adler et al., (2018) • ACCA (2016)
Accounting schematics		
Accounting system	• The organisation establishes an accounting system for biodiversity: Biodiversity accounting refers to the systematic process of identifying, measuring, recording, summarising and reporting all the biodiversity impacts of an organisation, within its selected organisational and value chain boundaries, over business accounting periods. • Clear ecosystem and taxa accounts are developed which assess direct and indirect impacts on biodiversity. • A "statement of biodiversity position" is developed which assesses the total impacts on biodiversity features as a function of accumulated positive and negative impacts on the ecosystem • A "statement of biodiversity. performance" is developed which assesses the net ecosystem impacts as a function of periodic ecosystem gains and losses. • The organisation discloses the biodiversity accounting events, type and unit and related journal entries in the context of the capitals.	• Wagner (2023) • Anthony and Morrison-Saunders (2023) • Maroun and Atkins (2021) • Roberts et al. (2021) • Alrazi et al. (2015)
Legal considerations		
Legal	• The organisation discloses how it complies with relevant biodiversity laws and regulations. • There is clear disclosure of non-compliance with laws and regulations. Transparency about non-compliance is crucial for building trust with stakeholders and demonstrating a commitment to addressing challenges. • The biodiversity report includes information about the organisation's plans for maintaining and improving compliance in the future. This may involve forecasting changes in regulations,	• Atupola and Gunarathne (2023) • Endangered Wildlife Trust (2020) • Eccles and Serafeim (2015)

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Legal considerations		
	anticipating potential challenges, and outlining proactive strategies to stay ahead of evolving legal requirements. • In addition to local and national regulations, the report may address how the organisation aligns its biodiversity practices with global and regional standards, conventions, and agreements.	
External reporting		
GRI, IR and other frameworks	• The company reports on international conventions for biodiversity conservation and restoration. • Reference to GRI reporting, International Integrated Reporting Council (IIRC) framework or other relevant frameworks. • The company mentions that the Integrated Report is printed on recycled/sustainably sourced paper.	• Adler et al., 2018 Grabsch et al. (2012) • GRI (2024) • IIRC (2021b) • European Commission (2024) • ISSB (2021) • Financial Stability Board (2022), Financial Stability Board (2017) • Natural Capital Coalition (2016)
Social engagement		
Partnerships	• Disclosures of partnerships with biodiversity organisations or NGOs helping with biodiversity conservation. • Company reports details of partnership engagements between wildlife/nature/conservation organisations and the company which aim to address corporate impacts on endangered species. • Disclosures of which NGOs are working on biodiversity conservation in the areas where the company operates. • The company provided a donation that contributed to the conservation or protection of biodiversity. • The company participates in biodiversity associations to improve biodiversity practices in the community. • Existing research is factored into decision-making. • Collaborations with ecologists, scientists, and other experts to address complex challenges and report on key outcomes.	• Adler et al., 2018) • Atkins & Maroun (2018) • van Liempd & Busch, (2013) • Russell et al., 2017Sobkowiak (2023)
Awards	• The company discloses awards or recognition received for biodiversity conservation or restoration	• Grabsch et al. (2012)
Stakeholder engagements	• The company reports its steps taken to create biodiversity awareness among its employees or in the community. • Company reports on the provision of education/training delivered on extinction accounting to all employees. • Information provided about social media interaction regarding biodiversity. • Disclosures of the feedback from stakeholders on biodiversity issues within the company. • The company discusses the relationship between local communities and biodiversity at the sites where the company operates. • Specific examples of stakeholder engagement are provided. • Provide education on extinction initiatives to schools in future. • Update shareholders/stakeholders quarterly with progress and future actions.	• Adler et al., 2018 • Hassan et al., (2020) • Maroun et al., 2018 • Grabsch et al. (2012) • van Liempd & Busch, 2013 • CBD (2018) • Atkins & Maroun (2018)
Performance evaluation		
Targets	• The company discloses biodiversity goals/targets for years to come. • The company describes current biodiversity goals. • Reference to UN SDG 14 or 15 and respective targets. • Reference to CBD post-2020 framework goals. • Report strategy for the future development and improvement of actions/initiatives. • Report on how collaborations with multi-disciplinary experts are used to define and measure targets • Targets incorporate conservation/preservation goals; offsetting arrangements and initiatives to restore/rewild areas	• Adler et al., 2018 • Grabsch et al. (2012) • Adams (2017) • CBD (2020) • Sobkowiak (2023) • Wagner (2023) • Panwar et al. (2023)
Performance	• Discussion of biodiversity-related performance and achievement of targets.	• Grabsch et al. (2012)

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Performance evaluation		
	• The company provides assessment and reflection on the outcome of partnerships and decisions taken about changes to initiatives going forward. • The company assesses whether the company's actions are effective in conserving biodiversity and preventing extinction • Pictorial evidence of successful conservation is provided.	• Atkins & Maroun (2018)
Costs	• The company reports the amount spent on biodiversity conservation/restoration. • The company discloses details and the value of any fines or claims relating to biodiversity loss or damage. • The company reports the potential liabilities relating to future possible fines/claims. • Include a discussion of ways in which the company is working to prevent future liabilities related to harming endangered species.	• Grabsch et al. (2012) • Atkins & Maroun (2018)
Reviews		
Reviews	• The organisation discloses the results of post-implementation reviews relating to biodiversity impacts. • The organisation has established feedback loops that enable continuous improvement. • There is a biodiversity concerns "hotline" to disclose or report any concerns related to environmental issues or to raise any malpractice/offer suggestions or improvements.	• Maroun et al. (2023) • Lodhia et al. (2022) • Sobkowiak (2023)
Valuation		
Quantitative, qualitative or monetary measurement attempts	• Doesthecompanyperformcost–benefit analyses for biodiversity projects? • Does the company participate in a biodiversity offsetting scheme? • Does the company develop a natural inventory account? • Does the company refer to NCA or any biodiversity valuation frameworks? • Doesthecompanyprovidebiodiversity productivity or efficiency ratios?	• van Liempd and Busch (2013) • Jones & Solomon, 2013 Endangered Wildlife Trust (2020) • UNEP-WCMC (2015) • Natural Capital Coalition (2016) • Büchling and Maroun (2021) • Anthony and Morrison-Saunders (2023)
Risk		
Risk	• There is a biodiversity policy which incorporates risk as a key element • The company reportsand assesses biodiversity risk. • The company describes business opportunities created by biodiversity. • The company uses tools to measure both positive and negative impacts of biodiversity. • The company identifies which areas require biodiversity action plans.	• Grabsch et al. (2012) • van Liempd and Busch (2013) • CBD (2018) • Carvalho et al. (2023)
Risk management	• The company provides information relating to systems/processes developed to manage or mitigate biodiversity risk. • The company has researched methods to reduce its impact on biodiversity. • The company discloses the use of ecosystem services assessment tools such as InVEST.	• Grabsch et al. (2012) • Maroun et al., (2018) • Feger and Mermet (2017)
Incidents	• The company reported any specific incidents/accidents which impacted biodiversity. • Company provides pictorial evidence of incidents. • The company outlines a plan for the rehabilitation and restoration of areas affected by the incidents.	• Grabsch et al. (2012) • Atkins & Maroun (2018) • van Liempd and Busch (2013)
Materiality	• The company classifies biodiversity as a material risk for the company. • Thecompanyprovidesmateriality assessments on biodiversity issues.	• IIRC (2021) • van Liempd and Busch (2013) • GRI (2024)
Inventory management and boundary setting		
Organisational and value chain boundaries	• The organisation defines clear organisational and value chain boundaries so that impacts are organised in individual accounts which can be aggregated and disaggregated according to different business units, or geographic scales (e.g. regional, national). • The organisation discloses the approach to define boundaries i.e. the equity share and the control approaches. For companies with joint entities, the organisational boundary and the	• Atkins and Maroun (2018) • Panwar et al. (2023)

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Inventory management and boundary setting		
	resulting biodiversity impact inventory may differ. Depending on the approach used. in both wholly owned and joint entities, the choice of approach may change how biodiversity impacts are categorised when value chain boundaries are set • The organisation sets and differentiates between entity and value chain boundaries.	
Biodiversity impacts management	• The organisation distinguishes between the direct and indirect impacts on biodiversity across ecosystems and taxa. • Establishing a team responsible for managing inventory quality. • The organisation develops a quality management plan and performs quality checks including institutionalising formal feedback loops to the quality management team for each quality check undertaken. • The organisation defines clear biodiversity indicators for each metric category.	• Wagner (2023) • Anthony and Morrison-Saunders (2023)
Systems and management		
Management control systems	• Does the organisation have well-developed management control systems and information systems in place to collect and process data on environmental and biodiversity impact and performance? • Have suitable biodiversity-related performance indicators been developed to deal with the ecological health of biodiversity and the link between biodiversity and economic objectives? • Incorporation of recent technologies into accounting and management solutions such as blockchain, remote sensing and other forms of artificial intelligence to enable expanded data collection and analysis in financial and extra-financial terms.	• Bui and De Villiers (2018) • De Villiers and Dimes (2020) • Sobkowiak (2023) • White et al. (2021) • Wagner (2023)
Governance structure	• Is there a separate environmental/social committee dealing with biodiversity impacts? • Has the organisation disclosed how it has adapted quickly to changes in the external environment and environmental challenges?	• Ahmed (2023) • Myeza et al. (2023) • Maroun and Cerbone (2020) • Tricker (1984)
Integrated thinking	• Biodiversity action plans, targets and performance evaluation are set over a multi-timeframe analysis: Short-, medium- and long-term. • There is evidence of cross-functional working groups interacting at multiple levels of the company to address biodiversity concerns.	• Ecim & Maroun et al. (2023) • Di Vaio et al. (2020) • Dimes and de Villiers (2023) • Maroun et al. (2023)
Supply chain management	• The organisation examines how biodiversity considerations are integrated with its supply chain management. This involves assessing the impact of supply chain activities on biodiversity and implementing strategies to minimise negative effects.	• Ahlqvist et al. (2020) • Gu et al. (2021)
Internal management		
Biodiversity action plans	• The company discloses information relating to biodiversity action plans. • The company reports biodiversity in top-level management plans and details management's approach to biodiversity. • The company provides details of land management or rehabilitation activities. • The company reports biodiversity projects undertaken to enhance biodiversity in and around the areas of operation. • The company provides details about its involvement in afforestation activities. • Company reports its involvementin the protection/conservationof "Ecological • corridors" in and around areas of operation.	• Grabsch et al. (2012) • CBD (2018) • GRI (2016) • Adler et al., 2018
Biodiversity officer	• A biodiversity officer is identified, and their responsibilities are outlined. • The company identifies to whom the biodiversity officer reports.	• Grabsch et al. (2012) • van Liempd& Busch (2013)
Products and value-chain	• Disclosures around the impact of the company's products and activities on biodiversity. • Information about whether the company's processes contribute to the mitigation, restoration or improvement of biodiversity. • The company details the importance of biodiversity as a natural capital in the value-creation process. • Description of how natural capital and biodiversity loss affect the other capitals.	• GRI (2016) • van Liempd& Busch (2013) • IIRC (2021)
Assurance		
Internal assurance and practices	• Internal sources of assurance are used to address biodiversity disclosures/environmental risks in place e.g. internal audits, experts, management.	• Baboukardos et al. (2021) • Donkor et al. (2021)

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Assurance		
	• Boards of directors take responsibility for the design and operation of sustainability and biodiversity practices. • There is a clear statement of compliance with codes of best practice and/or existing professional standards/guidelines in companies' integrated and/or sustainability reports. • The organisation discloses the extent to which assurance services cover the systems processes and controls required to support accurate, complete and reliable reporting.	• Maroun and Prinsloo (2020) • Prinsloo and Maroun (2021) • Maroun (2017)
External and third-party assurance	• External sources of assurance are used to address biodiversity disclosures/environmental risks in place e.g. external auditors. • Independent third-party sustainability certification is obtained to enhance the reliability of information reported such as suitable biodiversity practices (e.g. seafood practices).	• Baboukardos et al. (2021) • Donkor et al. (2021) • Maroun and Prinsloo (2020) • Prinsloo and Maroun (2021) • Maroun (2017)

[a] Each biodiversity theme incorporates sub-elements and examples of specific disclosures. Note that the examples are not intended to be exhaustive.

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APPENDIX B

Non-parametric correlations (full table).[a]

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Grade	(1)	1	−.936**	−.427**	−.439**	−.392**	−.407**	0.212	0.174	−.411**
Read	(2)	−.793**	1	.418**	.395**	.363**	.357**	−0.205	−0.129	.431**
Words	(3)	−.296**	.283**	1	.493**	.414**	.490**	−0.068	−0.213	.256*
Content	(4)	−.304**	.269**	.355**	1	.853**	.912**	0.136	−0.03	.433**
Policy	(5)	−.263**	.243**	.282**	.674**	1	.589**	−0.016	0.014	.712**
Perf	(6)	−.276**	.238**	.354**	.749**	.414**	1	.230*	−0.045	0.138
Scene-setting	(7)	0.155	−0.15	−0.043	0.092	−0.028	.169*	1	0.035	−.366**
Species-related	(8)	0.131	−0.094	−0.161	−0.024	0.008	−0.034	0.029	1	−0.025
External reporting	(9)	−.281**	.297**	.176*	.301**	.534**	0.089	−.256**	−0.018	1
Accounting	(10)	−0.112	0.099	.231**	.472**	.443**	.390**	−0.005	−0.145	0.161
Legals	(11)	−.199*	0.142	.313**	.624**	.600**	.502**	0.069	−0.149	.173*
Social engagement	(12)	0.025	−0.023	−0.066	−0.06	−0.152	0.028	0.064	0.105	−0.164
Perform. Eval	(13)	0.145	−0.12	−.280**	−0.007	−0.057	0.026	.389**	0.161	−0.155
Risk	(14)	−.177*	0.159	.340**	.353**	.196*	.419**	0.077	0.01	−0.01
Int Mng	(15)	.200*	−.217**	−.205*	−0.025	−0.135	0.076	.228**	.220*	−.260**
Valuation	(16)	−.197*	.222**	.208*	.369**	.266**	.345**	0.096	−0.05	.173*
Inv mg & boundary	(17)	−0.178	0.159	0.101	0.151	0.061	0.131	0.04	0.014	0.088
Reviews	(18)	−.289**	.261**	.316**	.618**	.486**	.587**	0.012	−0.067	.224**
Assurance	(19)	−.368**	.346**	.390**	.427**	.267**	.476**	0.113	−.220*	.178*
System mng	(20)	−.275**	.289**	.392**	.441**	.320**	.435**	0.084	−0.05	.214**

Note: Spearman correlations above the diagonal and Kendal's Tau-b below the diagonal.
**significance at 1% level. *significance at 5% level.
a Not all of the data are normally distributed. As a result, the non-parametric Spearman Rho and Kendal Tau b are used. Both are less sensitive to non-normal distributions and outliers than Pearson correlations.

Non-parametric correlations (full table).[a]

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Grade	−0.146	−.286*	0.029	0.189	−.238*	.291*	−.262*	−.237*	−.423**	−.528**	−.382**
Read	0.139	0.21	−0.021	−0.166	0.214	−.290*	.302**	0.204	.371**	.499**	.417**
Words	.300**	.444**	−0.107	−.413**	.486**	−.299**	.279*	0.127	.431**	.525**	.535**
Content	.600**	.807**	−0.081	−0.015	.482**	−0.048	.486**	0.181	.810**	.580**	.579**
Policy	.572**	.777**	−0.204	−0.08	.273*	−0.185	.370**	0.08	.668**	.362**	.446**

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(Continued)

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Perf	.506**	.678**	0.043	0.037	.572**	0.089	.446**	0.158	.772**	.635**	.575**
Scene-setting	0.009	0.099	0.089	.503**	0.109	.302**	0.127	0.04	0.001	0.148	0.119
Species-related	−0.173	−0.191	0.135	0.208	0.015	.300**	−0.062	0.019	−0.088	−.296*	−0.071
External reporting	0.22	.247*	−0.226	−0.22	−0.017	−.370**	.231*	0.114	.293*	.233*	.297*
Accounting	1	.616**	−0.075	−0.093	.234*	−0.027	.375**	0.08	.516**	0.211	.308**
Legals	.484**	1	−0.165	−0.047	.366**	−0.033	.312**	0.067	.683**	.395**	.406**
Social engagement	−0.066	−0.129	1	0.185	−0.05	.316**	−0.102	−0.075	−.295*	−0.063	0.159
Perform. Eval	−0.065	−0.024	0.127	1	−0.104	.566**	0.076	−0.179	−0.141	−0.214	−.244*
Risk	.193*	.272**	−0.039	−0.076	1	−0.07	0.175	0.12	.366**	.344**	.425**
Int Mng	−0.021	−0.031	.227**	.415**	−0.057	1	−0.037	−.269*	−0.186	−.269*	−0.15
Valuation	.303**	.232**	−0.073	0.06	0.127	−0.019	1	.408**	.390**	.296*	.333**
Inv mg & boundary	0.072	0.06	−0.063	−0.144	0.103	−.212*	.347**	1	0.109	.242*	.278*
Reviews	.415**	.504**	−.217*	−0.085	.269**	−0.122	.307**	0.093	1	.421**	.264*
Assurance	0.162	.285**	−0.046	−0.149	.231**	−.179*	.222*	.202*	.321**	1	.618**
System mng	.242**	.302**	0.12	−.170*	.315**	−0.105	.250**	.232*	.206*	.448**	1

Note: Spearman correlations above the diagonal and Kendal's Tau-b below the diagonal.

**significance at 1% level. *significance at 5% level.

[a] Not all of the data are normally distributed. As a result, the non-parametric Spearman Rho and Kendal Tau b are used. Both are less sensitive to non-normal distributions and outliers than Pearson correlations.

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