

Accounting for biodiversity: a systematic literature review

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Abstract

Purpose – Following a recent worldwide regulatory push to improve the identification, assessment and disclosure of climate and, more narrowly, biodiversity risks, this paper provides a timely review of the state-of-the-art of literature on biodiversity.

Design/methodology/approach – We employ a systematic literature review. The final corpus comprises 120 academic papers published in accounting, finance, economics and management journals ranked in the *Academic Journal Guide* (AJG) from 2021 to 2024. From this, we identify five thematic clusters and critically analyze how biodiversity is conceptualized, measured, disclosed and financialized in the literature.

Findings – Our review reveals that biodiversity accounting is still at an embryonic stage. Despite new regulations, an ongoing challenge is linked to the difficulty in establishing what constitutes biodiversity from a firm perspective and what data should be collected, how it should be reported, disclosed and verified.

Research limitations/implications – Further research is required to support the efforts of policymakers to ensure firms can better capture biodiversity-related risks and impacts, while also examining the assurance and reporting mechanisms that can support credible disclosure.

Originality/value – Our paper makes several contributions. First, we provide the most up-to-date synthesis of interdisciplinary research in the fields of accounting, finance, economics and management. Second, we identify tensions that arise when accounting logic of comparability, aggregation and periodic reporting faces the complexity and context-specific biodiversity information. Third, we develop a future research agenda that links biodiversity measurement choices to recognition, accountability and assurance debates in accounting research.

Keywords Biodiversity, Reporting, Biodiversity loss, Climate accounting, Literature review

Paper type Literature review

1. Introduction

Biodiversity loss is one of the most important planetary threats (Jones and Solomon, 2013). It gives rise to substantial, yet underappreciated risks that impact the real economy and all sectors. Recent research indicates that investors, notably values-based investors, have become increasingly concerned about the impact of businesses on biodiversity (e.g. Starks, 2023; Ma et al., 2024) and want their investments to align with the United Nations sustainable development goals (SDGs) (Starks, 2023). Biodiversity risks are already taken into consideration by financial markets: firms that are exposed to biodiversity risks often experience a risk premium on their stocks (Kalhor and Kyaw, 2024; Liang et al., 2024), while companies involved in environmental controversies tend to face higher equity costs (La Rosa and Bernini, 2022).

From an accounting perspective, these developments increase the demand for credible accounting information on biodiversity-related risks and impacts. Moreover, they raise important questions about how biodiversity impacts should be identified, measured and disclosed in corporate reports. As biodiversity conservation becomes a central issue in sustainable finance, investors, policymakers and other stakeholders are calling for improved accounting tools and stronger corporate engagement of biodiversity information into corporate decision making and reporting (Dechow, 2023; Karolyi and Tobin-de la Puente, 2023; Laine,



2024). For example, there is a growing global push for companies to identify and report on climate and biodiversity risks. Initiatives such as the Task Force on Nature-related Financial Disclosures (TNFD, 2024) and Europe's European Sustainability Reporting Standards (ESRS) E4 under the Corporate Sustainability Reporting Directive (CSRD) provide frameworks for translating biodiversity impacts into corporate reporting. Further, the International Sustainability Standards Board's (ISSB) IFRS S1 and S2 set international standards for sustainability-related financial disclosures, including risks linked to nature degradation and biodiversity loss. However, despite these developments, mandatory biodiversity reporting remains very limited and mainly focuses on large publicly listed companies [1].

Biodiversity presents conceptual challenges for accounting. Unlike carbon emissions that can be aggregated across a company's operations into a single GHG figure, biodiversity is multidimensional, context-specific and is difficult to aggregate into standardized indicators that are at the core of accounting practices. Consequently, attempts to account for biodiversity raise even deeper questions on how to link accounting numbers with complex ecological problems. The emerging academic literature on the topic increasingly reflects the existing challenges with accounting for biodiversity.

Against this background, this paper provides a timely review of the state-of-the-art of academic research on biodiversity. Focusing on the latest biodiversity research in the fields of accounting, finance, economics and ethics-csr-management (further referred to as management), we conduct an extensive search of published literature in journals ranked within the Chartered Association of Business Schools' Academic Journal Guide (AJG) (Chartered Association of Business Schools ranking 2021) to understand what we have learnt from recent high-quality contributions in these disciplines. We establish that biodiversity features in 120 papers published in accounting, finance, economics and management journals from 2021 to 2024. Synthesizing this corpus, we identify five focused areas of research: *Biodiversity as an economic object*; *The emergence of biodiversity disclosure within accounting practice*; *Institutional environment, stakeholder pressure and legitimacy incentives of biodiversity reporting*; *Making biodiversity accountable*; and *The financial mechanisms and consequences of biodiversity disclosure*, which we review [2]. As we articulate herein, understanding what we know about biodiversity in these areas helps inform the future research agenda, which we also outline in this review. It is worth mentioning that in our review, we interpret these themes through the tensions inherent in accounting for biodiversity.

Our review demonstrates that current accounting frameworks play an important role in determining when biodiversity becomes visible in corporate reports. Materiality rules that are embedded in accounting standards shape what organizations consider worthy of recognition or disclosure (Dechow, 2023). For instance, under the single materiality approach, which is dominant in the United States, biodiversity appears primarily as a financial risk, meaning that environmental issues are disclosed only when they have direct financial implications for investors (Fenichel and Dean, 2024). In contrast, the European approach to double materiality under the CSRD requires companies to disclose not only financial risks but also environmental impacts, which further extends the scope of biodiversity accounting (Dechow, 2023).

Further, our paper reflects that much of the literature focuses on the empirical documentation of disclosure practices (Sun and Lange, 2023; Blanco-Zaitegi et al., 2024), market responses (La Rosa and Bernini, 2022) and conservation mechanisms (Granado-Diaz et al., 2024; Villanueva et al., 2024), often drawing insights from environmental economics. However, this body of literature addresses biodiversity disclosure rather than the accounting treatment of biodiversity itself. Studies that discuss reporting practices either examine historical examples of nature capital reporting (McBride et al., 2023; Quinn et al., 2022) or offer conceptual ideas on the limitations of the existing accounting frameworks (Dechow, 2023; Laine, 2024). The development of aggregate biodiversity indicators, such as the Corporate Biodiversity Footprint, illustrates how the accounting drive toward standardization attempts to transform ecological complexity into standardized metrics (Garel et al., 2024). It is important to keep in mind that even though these indicators enhance the comparability of

biodiversity disclosures, they simplify ecological complexity, and the key conceptual problem of biodiversity reporting is still not solved (Dechow, 2023; Laine, 2024; Morrison *et al.*, 2023). Taken together, these tensions form the conceptual spine of this review: accounting seeks standardized, comparable and verifiable information, while biodiversity is a multidimensional and context-specific concept that is difficult to aggregate. Our five clusters are organized around this key contradiction.

Our paper contributes to understanding how the theme of accounting for biodiversity is incorporated into the most recent interdisciplinary research in the fields of accounting, finance, economics and management. This is important since accounting for biodiversity is a fast-moving area and the regulatory environment has shifted dramatically over the last few years. Perhaps closest in spirit to our paper are two earlier review papers by Maione *et al.* (2023, 2024). Examining almost identical corpora of papers to one another, these two papers offer useful overviews of the earlier biodiversity literature published in accounting, business and management journals, with Maione *et al.* (2023) mainly focusing on the historical evolution of biodiversity accounting literature.

We depart from these studies in several ways. First, we include the latest literature published between January 1st, 2021, and December 31st, 2024. This time frame is particularly relevant as earlier research on biodiversity has been dominated by ecological and economic perspectives, while accounting and finance scholars have only recently started to investigate biodiversity-related issues (as we demonstrate in a bibliometric analysis in a [supplementary internet appendix](#), very few studies in either accounting or finance focused on biodiversity before 2023). Therefore, restricting the analysis to the most recent years allows us to focus on the evolving body of literature that addresses biodiversity from a corporate reporting perspective. Another important motivation for selecting this period is the recent regulatory changes that have increased academic attention to biodiversity disclosure. This change has led to the growing body of literature examining how companies measure, report and manage biodiversity-related information not examined in prior literature reviews on the topic. Second, we expand the relevant disciplines by including economics journals, as these journals have been active in considering biodiversity for the longest period of time and because “*there is a clear need for studies across all areas including the recording, valuing and communication of biodiversity*” (Jones and Solomon, 2013, p. 682). Incorporating interdisciplinary lenses from other fields helps to enrich the conceptual understanding of biodiversity. Third, our focus allows us to derive practical implications from the existing literature against the backdrop of recent major changes in the reporting environment, which were not covered by prior literature reviews. Therefore, by considering biodiversity through broader debates, the paper highlights the conceptual tensions between ecological complexity of biodiversity and the need for standardization, comparability and measurement that are in the focus of the accounting and reporting systems.

2. What is biodiversity and what role should organizations have?

Biodiversity is a complex and multifaceted concept, with various definitions and motivations for its consideration (Hanley and Perrings, 2019; Karolyi and Tobin-de la Puente, 2023). For accounting research, this complexity raises questions about how biodiversity can be made visible in company reports, how it can be measured and disclosed in practice. Therefore, before we proceed to the literature review, it is important to define what constitutes biodiversity as well as some of the key factors that may encourage or discourage firms to address and disclose on biodiversity.

Hanley and Perrings (2019) explore various ecological approaches to measure biodiversity and emphasize that economists are increasingly recognizing the economic costs of biodiversity loss. Nehring and Puppe (2002) urge caution in valuing diversity by merely counting species and ecosystems; instead, they propose a “multi-attribute approach” based on similarity-based counting. Typically, biodiversity is defined at the species level and assessed through two measures: *species richness* (the number of different species in a given area) and

species evenness (the balance of species within that area) (Whittaker, 1972; Karolyi and Tobinde la Puente, 2023). Biodiversity can also be measured at the community level, focusing on species variety and their interactions within specific ecosystems (e.g. Cardinale et al., 2012). Irrespective of the specific biodiversity focus, most approaches used to “quantify” biodiversity are based on the concepts of alpha, beta and gamma diversity (Whittaker, 1972). Alpha diversity refers to species richness within a specific habitat, beta diversity to variation in species composition between habitats, and gamma diversity to total species diversity in a region (combining local habitat diversity (alpha) and inter-habitat differences (beta)).

Taken together, these insights help quantify what constitutes biodiversity. However, given that biodiversity can be interpreted in different ways, it is challenging from policy and regulatory perspectives to define precisely what firms should be doing and reporting on in relation to biodiversity. Nevertheless, firms remain vital in addressing biodiversity loss; as Jones and Solomon (2013, p. 683) assert: “if organizations were being called to account for their contribution to extinction of life on earth or to produce reports on how their operations are endangering wildlife would this perhaps help to convey the urgency, the critical and crucial need for such accountability”. From an accounting perspective, this raises a broader question about the extent to which existing accountability mechanisms are able to capture ecological problems that are long-term and are difficult to quantify.

At the same time, there are significant obstacles that may limit corporate engagement with biodiversity. First, there is the issue as to why firms should care about biodiversity and what factors motivate, or otherwise, organizations to address and disclose on it. Armsworth et al. (2004) suggest several reasons why organizations might be concerned about biodiversity. First, some companies consider biodiversity conservation as an ethical obligation, believing nature should be protected regardless of cost. Second, others prioritize biodiversity because of its broader benefits to society. Third, and most commonly, organizations approach biodiversity through a cost–benefit perspective, treating ecosystems as natural assets that can be preserved and utilized based on economic and other relevant factors.

These aspects are particularly important for accounting debates as they reflect the growing tendency to conceptualize biodiversity through the link to assets, associated risks and financial value. While this framing may help to integrate biodiversity in corporate reporting, it still raises important questions about the possibility of financialization of nature and getting complex ecological processes meaningfully captured through figures. Therefore, in the absence of regulatory or stakeholder pressure, businesses may have limited incentives to fully account for their impact on biodiversity. For example, a company might choose to conserve biodiversity near its headquarters for reputational benefits while exploiting natural resources in distant locations. Therefore, from these perspectives, weak economic incentives for conservation may discourage firms from integrating biodiversity into their financial strategies (Dalheimer et al., 2024). Although outcome-based payments could enhance engagement, current regulations do not sufficiently promote them (Granado-Diaz et al., 2024).

Consequently, corporate disclosures often serve as symbolic actions rather than meaningful commitments (Sun and Lange, 2023; Blanco-Zaitegi et al., 2024). Weak regulatory guidelines on biodiversity-related financial risks also reduce the usefulness of biodiversity disclosures for investors (Garel et al., 2024). From the accounting perspective, this raises questions not only about disclosure practices but also about assurance, comparability and credibility of information related to biodiversity. In this case, stronger enforcement, clearer standards, more precise measures and financial incentives are needed to enhance meaningful corporate biodiversity actions and reporting (Lebdioui, 2022; Walls and Vogel, 2023; Laine, 2024).

Another major issue, which we highlight within this review paper, is the absence of clear biodiversity valuation metrics and standardized indicators. Monitoring efforts and data availability are also inconsistent globally. This makes it difficult for individual companies to quantify and report on biodiversity, as well as undermining the usefulness of cross-firm and industry performance comparisons (Ratzke, 2023; Laine, 2024; Azizi et al., 2025). Underlining this issue, several authors highlight the difficulties of defining and measuring

biodiversity (Dechow, 2023; Ratzke, 2023; Meinard and Grill, 2011), with Sharma and Kreye (2022) also noting its complex nature.

More broadly, these challenges reflect deeper tensions between ecological complexity and the calculative idea that is behind the accounting system. For example, Metrick and Weitzman (1998) consider biodiversity as a public good that is difficult to quantify for optimization. Similarly, Gollier (2010) critiques standard cost–benefit analyses since these underestimate long-term environmental impacts. Later, Ruault *et al.* (2022) suggest that biodiversity actions cannot be treated uniformly, as socioecological factors vary across regions and stakeholders. For these reasons, regulatory initiatives require not only strong organizational commitments but also wider coordination among policymakers, investors and other stakeholders to address biodiversity loss (Dasgupta and Besley, 2023). For accounting scholars, these challenges highlight the need to critically examine the limits of the existing accounting practices and explore alternative approaches to recognition, measurement and accountability that can address the complexity of the biodiversity concept.

3. Research methodology

We adopt a hybrid review methodology which facilitates integration of key components from related literature review methodologies. This approach allows to combine the transparency and replicability of a systematic review with the depth required to identify conceptual patterns within an emerging research field. In particular, bibliometric approach helps us to identify structural relationships within the literature, while coding and reading of the papers enabled us to interpret these links and derive the key narratives and themes. We implement the following procedure to identify relevant articles on biodiversity in accounting, finance, economics and management:

Phase 1. Literature search. We search published journal articles listed on Web of Science with “biodiversity” as the research topic between 2021 and 2024, and which belong to the disciplines of accounting, finance, economics and management. To ensure topic relevance, we require biodiversity to be mentioned within the title, abstract or as an authors’ keyword. With the latest search date being December 31st, 2024, we identify 58,609 articles for further review.

Phase 2. Journal choice. To ensure the quality of research reviewed, we compose a list of all accounting, finance, economics and management journals ranked at the time of search in the AJG list (Chartered Association of Business School ranking 2021). This yields 651 potential journals.

Phase 3. Disciplinary focus. We restrict articles to those published in journals identified in Phase 2. This reduces the dataset from 58,609 articles to 278 papers.

Phase 4. Topic relevance. Many papers from economics journals focus on pure biological and ecological conservation perspectives, rather than from organizational or economic viewpoints. To improve the alignment and relevance of the topic, we restrict the dataset of 278 papers by selecting only those that have Web of Science Meso citation topics closely related to accounting, finance and management papers: Economic theory, Economics, Climate Change, Management and Operations Research and Management Science. This procedure reduces the number of papers from 278 to a final corpus of 120 papers, which include 27 in accounting, 14 in finance, 20 in management and 59 in economics.

Phase 5. Bibliometric mapping. We conduct bibliometric analysis of 120 (presented in a [supplementary internet appendix](#)) using data from Web of Science with the help of VOSviewer, which is a powerful software to construct and view bibliometric maps and cluster articles. Following Baker *et al.* (2024), we use several methods, including co-occurrence of keywords and bibliographic coupling to define the clusters. Bibliographic

coupling is a method for measuring semantic similarity by analyzing citations to determine connections between documents. Two documents are considered bibliographically coupled if they reference at least one common source. The strength of their connection increases with the number of shared references. According to [Donthu et al. \(2021\)](#) documents with more overlapping citations have a stronger relationship. We group papers that share at least two citations. Using this approach, VOSviewer categorizes papers from our sample into seven initial thematic clusters.

Phase 6. Coding and theme development. While bibliometric clustering provides an initial mapping and clustering of literature based on bibliographic coupling, it does not by itself establish meaningful conceptual themes. We therefore complement bibliometric analysis with a detailed qualitative review of the papers. VOSviewer identifies 10 main keywords that are specific to each of the clusters that help with the initial theme development. Both co-authors read in detail the 120 papers from the seven initial thematic clusters identified by VOSviewer. Following the approach from [Baker et al. \(2024\)](#), the name given to each cluster represents a joint opinion of the authors of this paper, ensuring that the titles reflect the conceptual idea of the papers within clusters rather than solely a mechanical bibliometric approach. As two of the suggested clusters were very small with only three and two papers included, respectively, we manually reassigned these papers to one of the other main clusters depicted by VOSviewer based on careful reading of the texts. This resulted in five final clusters for further analysis and discussion.

To ensure the transparency and rigor in the coding process, both authors additionally coded a sub-sample of 30 papers that comprise 25% of the corpus against initial coding. The Cohen's kappa coefficient is 0.81, reflecting strong agreement between co-authors ([Landis and Koch, 1977](#)). Minor disagreements were resolved through discussion until a consensus was reached. The final five clusters were jointly determined by the authors to reflect the conceptual ideas of the papers within each of the VOSviewer-generated groups.

In a [supplementary internet appendix](#), we present *The results of bibliometric analysis*, which provide further analytical insights into the sample of papers. This includes 1) the numbers of papers published in each subject discipline over time, 2) the top five countries of universities affiliated with the first author, 3) the ten most cited papers, 4) the number of mentions of specific biodiversity assets in papers and 5) the co-occurrence of keywords output, which is used to identify the five main biodiversity research clusters.

4. Results

4.1 Biodiversity as an economic concept

The papers in the first cluster provide a useful starting point for understanding the definition and origin of the biodiversity concept. Taken together, the studies tend to treat biodiversity mainly as a technical measurement problem rather than a socio-ecological concept. This reflects a neoclassical tradition of economics papers in which biodiversity matters when it can be measured. But every measurement involves different choices: what to include, how to combine different elements and whose values to prioritize ([Porter, 1995](#)). This is important for the accounting perspective, since many studies assume that improving the measurement of biodiversity will naturally improve governance and management outcomes. However, the critical point is that the way biodiversity is measured shapes what appears further in corporate reports, and this information is further taken into decision-making processes by companies and other stakeholders.

The main concern in economic papers is the difficulty of making biodiversity visible and comparable. [Ratzke \(2023\)](#) highlights the complexity of the biodiversity concept and emphasizes that a key challenge pertains to a lack of identifiable, observable and concrete measures that can serve as reliable indicators for biodiversity. Building upon [Meinard and Grill \(2011\)](#), [Ratzke \(2023\)](#) further argues that biodiversity is not just a biological concept but an

abstract one, and finding an appropriate proxy depends on the context in which it is applied. Therefore, even the common proxies, such as species richness or structural traits, are not so straightforward and depend on professional judgments. She advocates for using satellite-based biodiversity indicators, such as the Dynamic Habitat Indices developed by [Hobi et al. \(2017\)](#), as a viable alternative to traditional biodiversity metrics. While this approach supports standardization needed from an accounting perspective, it may still lead to measuring what is easy to measure and overlooking local or qualitative aspects of biodiversity, an issue that accounting scholars have also noted in other areas of accounting, e.g. environmental accounting ([Laine, 2024](#)).

The economic papers further reinforce a number-driven approach by translating biodiversity into monetary terms. Even though scholars acknowledge that biodiversity and ecosystems are “*often multifaceted*” ([Sharma and Kreye, 2022](#), p. 1), many studies focus on willingness-to-pay methods and cost–benefit analysis. For example, [Batini et al. \(2022\)](#) show that green spending and investments in clean energy and biodiversity conservation can generate higher economic activity than investments in non-green sectors. From this perspective biodiversity is treated as something valuable because of its economic contribution. However, it is important to understand that when biodiversity is valued through monetary terms, it tends to appear in financial reports and decisions only when there are clear financial effects. From the accounting perspective, this is a limited approach as strong monetary focus may reinforce financial materiality while underrepresenting the double materiality with the organizations’ broader impact on biodiversity.

Several related studies on market mechanisms to enhance biodiversity conservation, such as willingness-to-pay ([Sharma and Kreye, 2022](#); [Hynes et al., 2021](#); [Ratzke, 2023](#)), suggest that well-designed conservation programs can benefit both biodiversity and public well-being through reduced pollution and mitigation of climate change. However, these studies often assume that stakeholders have similar preferences and the markets are well-functioning, so the measurement tools are neutral to the differences in the environments. [Cousins \(2021\)](#) begins to address this gap in the context of nature-based solutions (NBS) by pointing out that more attention is needed to address the questions of fairness, equity and inclusivity of biodiversity measurement tools. This brings more questions to solve from the accounting perspective. With the accounting approach of data standardization, how is it possible to take into account the context-specific nature of biodiversity?

Several economic papers provide useful practical insights. For example, [Granado-Diaz et al. \(2024\)](#) and [Villanueva et al. \(2024\)](#) show that land managers and farmers often favor outcome-based payments with clear goals when supported by advanced monitoring technologies, such as satellite-based tracking. In a similar vein, [Greaker et al. \(2024\)](#) discuss a more precise approach, proposing the establishment of an offset market combined with ecological taxes to manage wind power development on land. While these approaches improve policy clarity, they also reinforce managerial logic in which biodiversity is governed by targets and performance indicators that align well with results-based accounting systems. However, it is important to keep in mind that such approaches may unintentionally favor what can be measured at reasonable cost over what is ecologically meaningful, especially taking into consideration the ecological uncertainty and long-time horizon of biodiversity.

Several studies explore public attitudes toward biodiversity. Attitudes differ by education, age, gender and economic background ([Halkos and Matsiori, 2022](#); [Joalland and Mahieu, 2023](#)). Evidence from offshore wind farms ([Joalland and Mahieu, 2023](#)) and wildlife-friendly food labels ([Mameno et al., 2023](#)) suggests that provided information provision can influence support for biodiversity initiatives. However, even though these papers reinforce the idea that integrating public education and conservation programs is an effective strategy to influence biodiversity loss, they are disconnected from accounting. The authors do not ask how heterogeneous public preferences might be captured in disclosure frameworks, how verified information should be produced and how assurance is performed.

Lebdioui (2022) explores the concept of “biomimicry”, an approach to innovation that draws inspiration from nature and biological designs for solving human problems and create a more sustainable future (Benyus, 1997). One example of this is the US Department of Defense who have examined insects in order to inspire the development of next-generation drones (Lebdioui, 2022). Concerns about biopiracy highlight how biodiversity knowledge can be appropriated for commercial gain, further raising governance, ethics and accountability questions that remain unsolved.

Having established how biodiversity is framed as an economic concept, the next cluster examines how this shapes what accounting tries to make visible in corporate reports. The transition from economic valuation to accounting disclosure is not straightforward: accounting introduces its own logic of recognition, periodic disclosure and verification that is not easily aligned with the ecological complexity of biodiversity identified in the economics cluster.

4.2 *The emergence of biodiversity disclosure within accounting practice*

The papers in this cluster focus specifically on biodiversity accounting and reporting; however, the majority of papers remain descriptive. The majority of authors talk about the importance of biodiversity, yet the accounting implications are under-theorized. For example, Maione *et al.* (2024) conduct a bibliometric analysis of the literature on biodiversity published in all business, accounting and management journals between 2000 and 2021. Their findings reveal a limited engagement with what accountants actually do in practice and how accounting logic is incorporated in biodiversity disclosure.

Several studies propose new frameworks trying to account for biodiversity. Kortetmäki *et al.* (2023) emphasize the importance of context when recognizing nonhuman nature, while Vignieri (2023) and Costa *et al.* (2023) develop environmental performance indicators that integrate natural-science targets into accounting measures. Although these frameworks are constructive, they often assume that biodiversity can be translated into indicators, without fully considering accounting approaches to recognition, valuation and assurance mechanisms. Therefore, these frameworks do not help to understand how biodiversity challenges should be accounted using the foundations of financial and sustainability accounting.

Laine (2024) more explicitly addresses these tensions by arguing that existing accounting systems are not yet sufficient to capture biodiversity and climate externalities. Building on the initiatives of the International Sustainability Standards Board (ISSB) and the Task Force on Climate-Related Financial Disclosure (TCFD), he calls accountants and auditors to look “*beyond existing numbers*” (Laine, 2024, p. 5). Moreover, Laine highlights a central accounting dilemma: while accounting is focused on quantification, aggregation, comparability and verifiability, biodiversity is characterized by complex, multifaceted and uncertain information. Therefore, as straightforward quantification of biodiversity may mask the real ecological complexity, this tension deserves more systematic approach from the accounting perspective.

As noted in previous clusters, related discussions also appear in papers published in economics journals (e.g. Ratzke, 2023; Sharma and Kreye, 2022). Feger and Mermet (2021) state that biodiversity cannot be meaningfully assessed purely at the organizational level and call for a multi-level ecosystem assessment (global, national and regional) before constructing the “*corporate ecological balance sheet*”. In these respects, the recent development of the “*corporate biodiversity footprint*” (CBF) by Garel *et al.* (2024) may hold promise. In CBF, the authors develop a quantifiable aggregate indicator for a firm’s biodiversity footprint based on the idea of mean species abundance (MSA), which is expressed based on a comparison of the relative abundance of native species in ecosystems with undisturbed ecosystems. As the authors explain, CBF has the salient quality that it captures both the direct impact of the firm on biodiversity and the entire value chain and contrasts two popular existing measures of biodiversity (MSCI’s biodiversity and land use exposure score and Refinitiv’s biodiversity

impact reduction indicator). [Garel et al. \(2024\)](#) argue their measure represents a more holistic measure that properly captures the concept of biodiversity.

While these are promising developments, unfortunately, largely because biodiversity is considered complex and context-specific, there is no widely accepted way of incorporating it into financial statements. As a result, the literature focuses on biodiversity disclosure, using tools such as disclosure indices (e.g. [Orazalin et al., 2024](#); [Solimene et al., 2024](#)), textual analysis of corporate reports ([Garel et al., 2024](#); [He et al., 2024](#)) or biodiversity risk indicators to assess corporate engagement with biodiversity issues ([Giglio et al., 2023](#); [Ma et al., 2024](#)). While these approaches definitely advance disclosure discussion on biodiversity, they still do not address key accounting questions: Should companies also recognize any assets, liabilities, income or expenses in financial statements related to biodiversity? If yes, on what valuation basis? How should all biodiversity uncertainties be disclosed and audited? How do aggregated indicators align with financial reporting principles? Recent regulatory changes, notably ESRS E4 (2023), the TNFD framework (2023) and ISSB IFRS S1/S2 (2023), attempt to close some of these gaps but leave the core recognition and valuation questions unresolved, which remain central to accounting research.

Several authors call for more interdisciplinary and critical engagement. [Nyberg and Wright \(2022\)](#) recommend management researchers switch focus from a shareholder value perspective to a wider stakeholder view. [Lukka and Becker \(2023\)](#) call for critical interdisciplinary accounting research, based on the assertion that it is only this type of research that will help to address global “wicked” problems, including climate crisis and decreasing biodiversity. However, while interdisciplinary approach can definitely add value, it should not eliminate the contribution from the accounting discipline. Instead, accounting scholarship should in the future provide conceptual clarity on the opportunities and challenges to address recognition, measurement, assurance and accountability areas, which are the most challenging in relation to biodiversity.

Regulatory developments further highlight the role of accounting in tackling biodiversity problem. [Fenichel and Dean \(2024\)](#) discuss why European and US disclosure standards on climate and biodiversity might remain different in the upcoming future. In the US companies follow a single materiality, meaning they disclose information only if it has financial relevance to investors. This means that companies only need to report on environmental issues if they have a direct financial impact on the company’s performance, profitability or stock price. However, in Europe there is an approach of double materiality used. It requires companies to disclose both the financial materiality (the impact on the company’s performance) and the environmental and social materiality, which is how a firm’s activities influence the environment and society ([Dechow, 2023](#)). For example, the EU’s Corporate Sustainability Reporting Directive (CSRD) emphasizes this dual focus, making companies report on their environmental and social impacts alongside financial performance. This distinction has profound implications for recognition and accountability. Under single materiality, biodiversity appears primary as a financial risk, while under double materiality, it may also become an accountability object in its own right. Therefore, the fact that we rarely see clearly identified biodiversity assets in corporate reports may not only be due to difficulties in measuring them. It may also result from the materiality rules embedded in accounting regulations, which determine what companies consider important enough to recognize and disclose.

The accounting literature already has relevant precedents for similar recognition problems. For example, the treatment of intangible assets under IAS38 illustrates how standard bodies struggle with the recognition of assets that generate future economic benefits but do not have reliable measurement ([Hussinki et al., 2025](#); [Barker et al., 2022](#)). In a similar vein, contingent liability disclosure under IAS 37 offers a framework for reporting environmental liabilities and that have not yet led to identifiable costs. Accounting researchers could further work on analyzing the question of when biodiversity-related cases should be recognized as contingent liabilities in reports or disclosed in the notes to financial statements. This cluster also reveals a

gap in biodiversity assurance. Therefore, future accounting research could examine which forms of assurance for biodiversity information are applicable and how existing assurance standards should be revised or developed.

The next logical question is addressed in the next cluster: given the recognition and measurement constraints, what factors drive companies to disclose biodiversity information at all and how does it influence the quality of such disclosure?

4.3 Institutional environment, stakeholder pressure and legitimacy incentives of biodiversity reporting

This cluster of papers is focused on the determinants of biodiversity reporting and disclosure, focusing on such factors as institutional environment, stakeholder pressures, sectoral and regional differences. Across the studies, biodiversity reporting is addressed as a legitimacy tool that is characterized by vague disclosure with a lack of standardized metrics. Therefore, papers call for stronger regulatory frameworks and internal governance mechanisms that will enhance accountability and reporting quality that will be useful for decision making.

Institutional context plays an important role in shaping reporting practices. [Bedarkar et al. \(2024\)](#) demonstrate that Indian companies face many constraints, including insufficient investment and weak government support in integrating biodiversity into business strategies. The authors call for further application of institutional and stakeholder theories in research to explore how external factors shape specific biodiversity strategies and initiatives. This is particularly relevant for accounting scholarship, as the normative pressures influence not only whether companies disclose biodiversity information or not but also the way it is framed and measured. In a similar vein, [Marco-Fondevila and Álvarez-Etxeberria \(2023\)](#) find significant variability in reporting practices of EU-listed companies that is influenced by sector, country and activity intensity. Therefore, even though the policy ambitions progress, the relevance of standard quantitative indicators remains limited that undermines regulatory comparability.

Several papers prioritize the legitimacy incentives of biodiversity reporting ([Dutta and Dutta, 2024](#); [Roberts et al., 2022](#); [Sun and Lange, 2023](#); [Velte, 2023](#)). [Roberts et al. \(2022\)](#) integrate deep ecology, legitimacy and stakeholder theories and find that ecologically conscious companies disclose more extensively, suggesting that internal values shape the scope of biodiversity reporting. Yet [Sun and Lange \(2023\)](#) show that biodiversity reporting at the “Yili Group” (the largest dairy company in China) is predominantly symbolic and driven by stakeholder pressure rather than by embedded accountability systems. These findings reflect a structural tension in accounting when the voluntary disclosure approach shapes biodiversity disclosure without necessarily changing internal operational systems. Further, [Buchling and Maroun \(2023\)](#) explore a case of “South African National Parks” (SANParks), where biodiversity is integrated into strategic and risk management processes. Therefore, substance in biodiversity reporting depends on internal organizational commitment and not merely on external pressures.

Stakeholder influence can also shape biodiversity disclosure. [Pujiningsih and Utami \(2024\)](#) and [Blanco-Zaitegi et al. \(2024\)](#) demonstrate how firms strategically manage the tone of their disclosure, trying to distance themselves from environmental harm associated with their company. From the accounting perspective, this reinforces the concerns about impression management due to the absence of measurement standards that might constrain such behavior. Therefore, the disclosure flexibility on biodiversity without rigorous assurance creates space for selective transparency. [Velte \(2023\)](#) advocates for internal mechanisms, such as sustainability-linked executive compensation or a Chief Sustainability Officer role, in order to strengthen social legitimacy. However, as it was mentioned earlier, the governance innovations alone are insufficient unless biodiversity metrics are formally integrated into performance evaluation, capital allocation and risk assessment systems within the company. Only in this case, improved corporate governance will also lead to more measurable and clear outcomes.

Evidence that companies with weaker environmental performance disclose more biodiversity information (Dutta and Dutta, 2024; Orazalin *et al.*, 2024) further reinforce concerns about strategic biodiversity disclosure. Companies in environmentally sensitive industries tend to be more likely to report biodiversity risks when facing regulatory scrutiny. Therefore, the key accounting challenge lies in moving from descriptive disclosure toward proper recognition and performance-oriented metrics that will help to reduce managerial opportunism.

The external pressure and legitimacy background documented in this cluster explains why biodiversity reporting is often symbolic rather than substantive. But these findings also raise the next question: what happens when companies try to go beyond storytelling and make biodiversity accountable in a broader environmental accounting system? This is the topic covered in the next cluster.

4.4 Making biodiversity accountable

The papers in this cluster examine how organizations approach biodiversity to be visible and measurable through accounting practices, drawing on historical examples and trying to link biodiversity practices with environmental accounting. Unlike the previous cluster that focused on external reporting incentives, these studies are more linked to key accounting questions: what qualifies as an accounting object in biodiversity context, how it should be recognized and what is the cost of ecological simplification.

This cluster also reveals a link and controversy to climate reporting. Although biodiversity loss and climate change are closely connected to each other (Dechow, 2023), accounting does not treat them in the same way. Climate accounting has already developed in a more standardized way with widely accepted measures, such as carbon emissions. In contrast biodiversity accounting still remains fragmented and lacks a clear and uniformed approach. This difference exists because biodiversity is much harder to measure and its impacts are complex, vary by location and involve many interconnected elements.

The first group of studies demonstrate that biodiversity has long been a subject to only selective recognition in accounting systems. The early form of environmental accounting can be traced back to ecological observations that provide a foundational basis for biodiversity accounting through tracking of natural resources. Bigoni *et al.* (2022) conclude that even early environmental accounting in the Tuscan Grand Duchy already in the sixteenth and seventeenth centuries was primarily driven by regulatory compliance rather than to protect ecosystems. Further, Quinn *et al.* (2022) and McBride *et al.* (2023) illustrate how biodiversity reporting historically centered on management and exploiting of natural resources, rather than ensuring accountability for wider ecosystem impacts. As a result, traditional accounting systems focus only on a narrow set of aspects, directly connected to the economic resource use and broader ecological interdependencies remain invisible. This raises the fundamental question of what qualifies as an accounting object in biodiversity context.

Maione *et al.* (2023) describe how biodiversity gradually became a more visible topic in accounting research and practice, especially in the context of environmental accountability. The authors show that accounting for biodiversity still remains fragmented without accepted measurement approaches. Further by taking a historical perspective on biodiversity accounting, Atkins *et al.* (2023) argue that we can learn important lessons from earlier ways of recording plants and animals by companies that might help to find alternative ways of documenting ecological relationships. While these conceptual origins provide important philosophical understanding related to the development of biodiversity accounting, they often are related to cases of single companies lacking the ways to trace scalability and standardization that are at the core of the accounting perspective.

Recent studies question the adequacy of current measurement approaches and stress an urgent need to integrate biodiversity into long-term corporate strategies. Tregidga and Laine (2022) argue that short-term accounting horizons undermine meaningful responses to

biodiversity loss. [Morrison et al. \(2023\)](#) critique the logic of quantification embedded in voluntary reporting frameworks, including the Global Reporting Initiative (GRI). The authors claim that metrics such as GHG emissions, species counts, water volumes and waste figures may create an illusion of measurement, underestimating the ecological complexity behind the numbers. This critique raises a fundamental accounting question. On the one hand, the authors call for a robust and systematic quantification of biodiversity impacts to improve transparency and comparability ([Laine, 2024](#)). On the other hand, reliance on simplified metrics might constrain accountability to those aspects of biodiversity that are easiest to measure, therefore, overlooking broader and context-specific ecological effects.

Cross-national studies reinforce the importance of institutional context in relation to biodiversity reporting. [Hummel et al. \(2024\)](#) show that regulatory and cultural environments shape biodiversity disclosure practices, while [Zou and Paisey \(2024\)](#) argue for integrating ecological beliefs and cultural values into accounting frameworks to enhance environmental accountability. [Qian et al. \(2021\)](#) reveal that firms in developing countries often prioritize social issues over environmental accounting, neglecting biodiversity concerns. These findings do not just emphasize contextual differences but reflect variation in underlying accounting regimes: what is considered material for accounting recognition and who is accountable. This fact highlights that biodiversity accounting is embedded within broader political and economic systems and whether its standardization and assurance is even possible across different jurisdictions.

A key concern raised by several scholars is the prevalence of greenwashing in biodiversity reporting. [Bigoni and Mohammed \(2023\)](#) argue that profit-driven corporations are unlikely to fully take responsibility for biodiversity loss without regulatory intervention. Similarly, [Dechow \(2023\)](#) highlights that environmental costs are often shifted onto society rather than recognized by firms. To counter this, [Dechow \(2023\)](#) calls for advanced accounting metrics that capture the true impact of corporate activities on biodiversity. [Dechow \(2023\)](#) stresses that, even though measuring sustainability issues, including climate and biodiversity, is extremely complex, this should not be a barrier to further development in this area. Therefore, the literature suggests that without resolving underlying measurement and valuation problems, mandatory accounting and disclosure on biodiversity loss will just reproduce the existing problems.

Emerging circular economy models call for a more transformative approach to biodiversity accounting ([Marreiros-Barbosa et al., 2024](#); [Palakshappa et al., 2023](#)). However, from an accounting perspective, these models will only make a meaningful difference when the measures capture genuine environmental regeneration. If biodiversity is not built into core accounting processes, such as investment decisions, asset valuation, impairment assessment and risk management, these initiatives might remain just symbolic.

While this cluster explored how accounting attempts to make biodiversity visible within environmental reporting, the final cluster analyzes how biodiversity information is translated into the language of financial markets, risk pricing and company valuation. This raises the fundamental tension that is reflected in the whole review: whether the financialization of biodiversity helps to protect nature or does it just make it easier for capital markets to get information for their own purposes?

4.5 *The financial mechanisms and consequences of biodiversity disclosure*

Papers from this cluster move beyond disclosure and examine how biodiversity is translated into corporate outcomes and valuation metrics. The papers in this cluster do not only show that biodiversity matters, but reveal that biodiversity is related to financial risk, investment decisions and has an impact on valuation.

[La Rosa and Bernini \(2022\)](#) show that negative ESG controversies related to biodiversity are associated with a higher cost of firm equity of European companies, suggesting that markets price biodiversity risk. [Jalilibal and Bozorgi-Amiri \(2022\)](#) similarly demonstrate that

biodiversity considerations influence project selection decisions, particularly where climate and disaster risks are salient. However, even though biodiversity is incorporated into financial decision-making, this raises a critical question of whether the focus only on financial risks overlooks wider ecological and ethical significance of biodiversity to only what can be monetized.

Several studies explore biodiversity-focused financial instruments. [Mutarindwa et al. \(2024\)](#) investigate the role of ESG bonds, including biodiversity preservation bonds in Africa, and argue that regulatory development may reduce information asymmetry and strengthen financial markets. Similarly, [Arjaliès and Banerjee \(2024\)](#) highlight the effectiveness of conservation impact bonds as a mechanism in mobilizing capital and facilitating collaboration between Indigenous and Western actors. [Karolyi and Tobin-de la Puente \(2023\)](#) suggest that biodiversity may become central to sustainable finance, requiring clear innovative financing and policy mechanisms and measurement tools. However, [Arjaliès and Gibassier \(2023\)](#) question whether financialization of nature can truly address the rapid loss of biodiversity or whether it just turns ecological losses into tradable assets. Therefore, the same idea is reinforced: while accounting may enhance visibility of biodiversity instruments, it might undermine genuine conservation by focusing only on metrics.

Market-based evidence further illustrates this shift. [Garel et al. \(2024\)](#) introduce a Corporate Biodiversity Footprint (CBF) metric and find that before key events, such as the Taskforce on Nature-related Financial Disclosure and the 2021 Kunming Declaration, biodiversity was largely ignored by investors. Similarly, [Kalhor and Kyaw \(2024\)](#) and [Liang et al. \(2024\)](#) find that biodiversity risk exposure affects stock prices and financial stability. However, mixed market reactions following the 2022 UN Biodiversity Conference suggest that investor responses remain uncertain and event-driven. This reinforces an important issue: biodiversity influences market reactions when it is framed as material risk, which is more linked to the economic perspective rather than its ecological importance.

In summary, the papers in this cluster reflect a clear financialization of biodiversity translated into risk metrics, financial instruments and valuation models. However, the critical question is not only whether biodiversity affects firm value, but how accounting reshapes the meaning of biodiversity itself for companies. Current research tends to assume that improving measurement will lead to better outcomes, yet it seldom examines whether relying on market-based tools will genuinely help protect biodiversity without prioritizing investor interests over ecological goals and objectives.

5. Further discussion and conclusions

Biodiversity loss and climate change represent the twin environmental crises of our time and the collective choices we make in addressing them are vital for the future of our planet. In this paper, we conducted a detailed review of the recent literature on biodiversity in AJG ranked journals in the disciplines of accounting, finance, economics and management to identify five distinct areas of biodiversity research. As we discuss, research in biodiversity in accounting, finance and management is still new. Most pertinently, our bibliometric analysis (presented in the Internet appendix) infers that accounting and finance disciplines have only just begun to consider biodiversity. By contrast, research on biodiversity has a long history in economics, with early works emphasizing its social and economic value. Economic studies have explored the definition of biodiversity, mechanisms like market-based solutions, public willingness to pay and the economic impact of green vs non-green investments ([Hynes et al., 2021](#); [Batini et al., 2022](#); [Ratzke, 2023](#)). While these economic insights offer valuable frameworks for assessing the financial implications of biodiversity loss, their integration into corporate accounting and financial decision-making remains limited, with unresolved conceptual tensions regarding how accounting can help address biodiversity loss.

A central point across the reviewed studies is that measurement challenges dominate current research, yet the foundational accounting questions of recognition, measurement and

accountability remain largely unresolved. Many papers, especially published in economics and finance journals, treat biodiversity as a technical problem (Ratzke, 2023; Sharma and Kreye, 2022). Initiatives such as corporate biodiversity footprints and satellite-based indicators implicitly assume that improved metrics will lead to improved governance outcomes (Garel *et al.*, 2024). However, our review reveals that biodiversity is a more complex concept that is context-specific and is characterized by high ecological uncertainty, while accounting is focused on aggregation, comparability and periodic reporting (Dechow, 2023; Laine, 2024). Therefore, advances in measurement may help to improve visibility while simultaneously narrowing the definition of biodiversity to what can be counted (e.g. Morrison *et al.*, 2023). From the future accounting perspective, it means that the key issue is not only how to measure biodiversity but how these measurement choices and metrics influence managerial decisions and overall company responsibility in relation to biodiversity loss.

There remains significant uncertainty about what accountants should measure when dealing with biodiversity. It is not clear whether the focus should be on ecosystems, species counts, a company's dependency on nature, its environmental impacts or the financial risks linked to biodiversity (Jones and Solomon, 2013; Garel *et al.*, 2024; Dechow, 2023). As this foundational question remains unresolved, biodiversity often falls outside the conventional approach in financial reporting.

Different measurement approaches also create problems. While monetary valuation of biodiversity supports comparability but prioritizes financial relevance over ecological significance (Batini *et al.*, 2022), biophysical indicators (such as species or habitat measures) more accurately reflect ecological conditions (Karolyi and Tobin-de la Puente, 2023), but they are harder to compare between companies and are more difficult to verify through assurance. Similarly, using a single aggregated biodiversity score may help capital markets to get information quicker, but an aggregated score might hide serious local damage and be incomparable across different regions. To sum up, these tensions show that biodiversity is not just another topic that can be easily aligned with the current reporting systems. Instead, it reveals deeper limits in current accounting approaches about what can be measured, compared and be visible in financial reports.

The literature review also highlights that current disclosure practices are often driven by institutional and stakeholder pressure (Sun and Lange, 2023) and companies' goals to become legitimate (Dutta and Dutta, 2024; Orazalin *et al.*, 2024). This may often lead to symbolic practices rather than real transparency and actions (Sun and Lange, 2023; Blanco-Zaitegi *et al.*, 2024; Velte, 2023). As biodiversity reporting requirements are flexible and underdeveloped, firms have wide discretion over the scope and tone they use in biodiversity disclosure. Therefore, an important research direction lies in investigating the governance and credibility of biodiversity disclosures by drawing on resource dependency theory (Pfeffer and Salancik, 1978) and impression management theory (Goffman, 1959).

Future research should focus not only on how board composition influences biodiversity disclosure and reporting but also investigate how companies build biodiversity-related capabilities and access critical ecological resources. Accounting scholars could examine how governance structures, expertise and external partnerships influence both the quality and substance of biodiversity information disclosed by companies. As our literature review indicates that many companies use symbolic practices, it is important to develop future methods to detect greenwashing in biodiversity information and to evaluate the role of external assurance in enhancing its reliability. Furthermore, research should examine whether market-based biodiversity instruments, such as conservation impact bonds, offset credits and biodiversity-linked loans, produce independently verifiable ecological outcomes, and what assurance protocols under ISSA 5000 or ISAE 3000 sustainability assurance standards would be needed to distinguish substantive environmental improvement from symbolic compliance. This work will provide important insights for regulators and standard setters who develop reporting and assurance frameworks.

We identify three directions in which theory-grounded accounting research could make further contributions. First, drawing on institutional theory, stakeholder theory and legitimacy theory, researchers should empirically examine whether the introduction of mandatory biodiversity disclosure under CSRD/ESRS E4 leads to substantive behavioral changes in firms' management practices or whether companies just engage in compliance under mandatory regimes. Researchers could compare biodiversity-related capital expenditures and operational decisions of companies subject to ESRS mandatory reporting against a matched group of non-reporting firms. Second, building on accountability theory and stewardship frameworks (Gray, 2010), future research could examine how the choice of biodiversity measurement approach, monetary valuation versus biophysical indicators versus narrative disclosure, affects decision making in companies. For example, does assessing biodiversity loss in monetary units (e.g. as in corporate biodiversity footprint methods) lead to more visible actions within corporate decision making? Or if biodiversity loss is framed in financial terms, is it treated just as another business risk that is balanced against returns? Some experimental research or qualitative approaches within accounting could provide more evidence for this mechanism, which is currently mentioned in papers but not investigated. Third, research grounded in common-pool resource theory (Ostrom, 1990) should examine how multi-stakeholder governance perspectives, including co-management agreements between companies, indigenous communities and conservation organizations, shape the quality of biodiversity accounting. Some authors, e.g. Arjaliès and Banerjee (2024) and Costa *et al.* (2023), suggest that diversity in governance may lead to accounting diversity and that ecologically meaningful accounts may emerge when different stakeholders participate in the development of frameworks.

These research directions may get further attention when connected to complementary theories. Resilience theory (Holling, 1973) is particularly relevant. As companies begin mandatory reporting under ESRS E4, the question is not only whether they disclose biodiversity data but whether disclosure supports adaptive management over time. Accounting research could examine whether the periodic, retrospective logic of financial reporting can be aligned with the nonlinear dynamics of ecosystem resilience and how it can be incorporated in current policy frameworks. Natural capital theory provides a complementary idea, connecting biodiversity directly to the asset recognition debate and the unresolved question of when ecosystem-related obligations should appear on the balance sheet and under which valuation approach. Further unexplored directions are related to ecocentric theory. Deep ecology theory (Naess, 1973) challenges the idea of financial materiality and the assumption that nature matters only when it affects firm value or investors' returns. Accounting scholarship has not yet examined this perspective. Future research could examine whether ecocentric principles can be incorporated into reporting practices, for example, through species-centered accountability accounts, and how this might influence assurance practice not yet addressed in ISSA 5000.

Empirical evidence shows that biodiversity controversies and risks are priced by markets (La Rosa and Bernini, 2022; Kalhor and Kyaw, 2024; Liang *et al.*, 2024). However, while translating biodiversity into financial risk attracts more attention from stakeholders, it may mask ecological priorities. While studies document this problem (Arjaliès and Gibassier, 2023), fewer examine the real implications for existing accounting systems. Therefore, future research should address biodiversity not merely as a disclosure practice priced by markets but as an integral part of a broader accounting system (Laine, 2024), including performance measurement, internal controls and assurance, which will help ensure that biodiversity disclosure is meaningful from both societal and financial materiality perspectives. As Karolyi and Tobin-de la Puente (2023) point out, biodiversity reporting requires the integration of diverse disciplines, which complicates efforts to develop standardized frameworks for measurement and disclosure.

One consistent narrative was that addressing biodiversity loss requires the joint efforts of companies, regulators and other stakeholders (Vignieri, 2023; Costa *et al.*, 2023; Antolín-López *et al.*, 2022). McBride *et al.* (2023) emphasize that biodiversity reporting guidelines are only a supportive mechanism; to be effective, they require human resources and buy-in from

firms' senior managers. As biodiversity becomes an increasingly urgent issue, there will be a growing need for professionals with the skills and expertise to address these challenges (De Serres, 2022; Nyberg and Wright, 2022). In this context, future research could explore the role of corporate leaders and financial institutions in driving biodiversity-related initiatives, including the potential for "green FinTech" solutions to address biodiversity challenges. Assurance and verification of data is another urgent question for practitioners, especially with further reliance on satellite-based biodiversity metrics.

Our findings have clear implications for regulators and standard setters. With respect to the implementation of ESRS E4, the measurement tensions we document across the five clusters suggest that EFRAG and the European Commission face a difficult trade-off between standardization and the loss of the uniqueness of the biodiversity concept. It might be useful to develop a biodiversity disclosure framework in which companies are required to report a standardized metric for cross-company comparability while additionally disclosing location-specific narrative and quantitative information that captures context-specific biodiversity impacts. This idea mirrors the approach already taken in climate disclosure (e.g. IFRS S2 separation of Scope 1/2/3 emissions from physical and transition risks) and could be further developed for future ESRS E4 revisions.

With respect to assurance, the International Auditing and Assurance Standard Board's version of International Standard on Assurance Engagement (ISAE) 3000 and the development of new sustainability assurance standards (International Standard on Sustainability Assurance, ISSA 5000) present an opportunity to develop biodiversity-specific assurance guidance. Our review reveals that the challenge is not only related to the absence of metrics but also to their low verifiability. Finally, our review supports the idea that nature-related financial disclosure goes beyond the current focus of IFRS S1 on biodiversity as a financial risk and starts to address the double materiality dimensions within European standards.

Overall, while awareness of biodiversity disclosure is growing, current corporate practices and research still lack the depth and specificity needed to fully address this issue. The gap in data, valuation methods and regulatory alignment underscores the need for interdisciplinary collaboration and globally harmonized disclosure standards. Only then can we embrace the future and let stakeholders know about "*how the raw material used in the gadget impacted biodiversity*" (Dechow, 2023, p. 492).

Data availability

Data are available from the public sources cited in the text.

Notes

1. Within an Internet appendix we provide a more detailed discussion around the evolving regulatory frameworks for biodiversity.
2. A [supplementary internet appendix](#) provides extensive detail regarding the literature review sample and the results of bibliometric analysis.

Supplementary material

The supplementary material for this article can be found online

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