Journal of Environmental Management 351 (2024) 119808

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Review

The inclusion of biodiversity into Environmental, Social, and Governance (ESG) framework: A strategic integration of ecocentric extinction accounting

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ARTICLE INFO

Handling Editor: Lixiao Zhang

Keywords:
Biodiversity loss
Ecocentrism
Environmental, social and governance (ESG) factors
Extinction accounting
Intermediate ecology
Pragmatic extinction accounting

ABSTRACT

Traditional Environmental, Social, and Governance (ESG) metrics have primarily focused on promoting sustainable finance, positive screening, and sustainability reporting. However, recent research highlights the urgency for greater accountability and action to counter species extinction. This article explores the potential of ESG frameworks in guiding corporate and managerial decision-making to address biodiversity loss. As the current ESG indicators exhibit an anthropocentric bias, limiting their effectiveness for protecting biodiversity, this article aims to strategically integrate pragmatic extinction accounting with an ecocentric (deep ecology) perspective. This perspective addresses the root causes of biodiversity loss and offers support to species that are perceived as economically, socially, or culturally unimportant. We present our findings as a call to all stakeholders—business and policy decision-makers, conservationists, and environmental organizations—to formulate robust, inclusive, and ecologically sensitive strategies incorporating deep ecological perspectives. The findings of this study include recommendations for the Global Reporting Initiative (GRI). This study provides an important contribution to stakeholder theory that supports non-human stakeholders. Besides, this paper showcases how the improved ESG framework could empower companies to confront extinction risks in a more proactive and accelerated manner.

1. Introduction: Environmental, Social and Governance (ESG) framework and biodiversity

The significance of biodiversity to business has been widely acknowledged by the United Nations Environmental Program (UNEP), The Convention on Biological Diversity (CBD), and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Environmental, Social and Governance (ESG) frameworks for both accounting and investment are proliferating, leading to the development of numerous sustainability reporting metrics, guidelines, and standards (e.g., Coolsaet et al., 2020; Mgbame et al., 2020; La Rosa and Bernini, 2022). These frameworks encourage companies to report on economic matters in addition to social and environmental ones to complement the one-dimensional focus of conventional financial statements (Melinda and Wardhani, 2020; Al-Hiyari and Kolsi, 2021; Lisin et al., 2022). ESG metrics that enable investors to access relevant information (Widyawati, 2020) are often seen as a collective term for 'positive' social and environmental investments (Linnenluecke, 2022:2). ESG has evolved to meet the demands of institutional and retail investors, as well as public sector authorities (Koppenjan and Enserink, 2009; Brest and Born, 2013). Examples of such frameworks include the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), the International Integrated Reporting Council (IIRC),[1] and the Task Force on Nature-related Financial Disclosures

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[1] The SASB and IIRC were merged to form the Value Reporting Foundation (VRF). In 2022, the VRF was acquired by the International Financial Reporting Standards Foundation as part of the formation of the International Sustainability Standards Board.

https://doi.org/10.1016/j.jenvman.2023.119808
Received 19 September 2023; Received in revised form 20 November 2023; Accepted 6 December 2023
Available online 15 December 2023

(TNFD). A few of them focus on biodiversity (Weir, 2018; Marco-Fondevila and Álvarez-Etxeberría, 2023).

Biodiversity accounting has been an essential tool for measuring the change and loss of biological diversity over time (Jones and Solomon, 2013; Siddiqui, 2013). The Biological Diversity Protocol (BD Protocol[2]) provides companies with a robust tool for assessing, monitoring and reporting their biodiversity performance. Several forward-thinking firms have already piloted this novel approach, demonstrating its potential utility in fostering sustainable business practices and safeguarding the planet's rich array of plant and animal species (CBD, 2021).

Extinction accounting builds on biodiversity accounting. It is not only concerned with explaining the "stocks" of natural resources, capitals, and species (Jones, 1996) but also with understanding the factors contributing to species loss, the rate of extinction, and the overall effectiveness of conservation actions (Hassan et al., 2020; White et al., 2023). This perspective allows researchers and organizations to create effective strategies for biodiversity preservation (Weir, 2018) with the result that extinction accounting has been described as "emancipatory" accounting (e.g., Gallhofer and Haslam, 2019) and informed by the need to drive positive change for biodiversity (Atkins and Atkins, 2018; Maroun and Atkins, 2018). Extinction accounting seeks to address biodiversity loss by integrating ecological, economic, and social dimensions to assess the consequences of extinction on ecosystems and human welfare (Bebbington and Larrinaga, 2014; Hassan et al., 2020; Roberts et al., 2021). This holistic approach to accounting aims to evaluate and report the impacts of anthropogenic actions on biodiversity (Roberts et al., 2021; Virk et al., 2023).

However, while there is evidence that forward-thinking companies support a mutual relationship between businesses and biodiversity (Hassan et al., 2022; Roberts et al., 2022), Hassan et al. (2020) show that biodiversity reporting is often greenwashing. So far, investments targeting ecosystem restoration have failed to halt biodiversity loss (International Union for Conservation of Nature [IUCN] 2022). Despite the need for urgent action expressed by the scientific community (Ceballos et al., 2020) and extra-governmental bodies (IUCN, 2022; IPBES, 2019; UN, 2022), most ESG reporting guidelines provide incomplete coverage of biodiversity factors (Hassan et al., 2021; Milan, 2022).

While a "more positive and ecological perspective may be validly constructed by corporate reports" (Atkins et al., 2018: 681), many corporations "only specify tallies, offer records and reports species, and these species are still allowed to die out" (Zhang and Noronha, 2023, 32). Corporate reporting provides only a 'fossil record' with insufficient detail on how extinction is being tackled (Atkins and Maroun, 2018a,b). Roberts et al. (2022) confirmed that 75% of the top global firms omit any species numbers, and most companies are failing to address the biodiversity crisis.

There is some progress. Emerging work in business ethics supports non-human stakeholders. For example, Starik (1995), Boiral and Heras-Saizarbitoria (2017), Allen et al. (2019), Phillips and Reichart (2000), Pilon-Summons et al. (2022), Kortetmäki et al. (2023), Virk et al. (2023) and Roberts et al. (2022) argued that other species should be included as stakeholder categories and companies should take them into account for their strategic decisions.

Yet, while some companies are adopting and communicating progressively ecocentric values, supporting the intrinsic value of biodiversity (Maroun and Atkins, 2018; Atkins et al., 2018; Corvino et al., 2021), the focus on non-human stakeholders remains limited in business literature and practice. In addressing this gap, we intend to build upon the emerging research supporting an extension of the stakeholder theory to include non-human nature and ecocentric values. We employ the principles of ecocentric ethics or deep ecology (Naess and Sessions, 1986) and 'compassionate conservation' (Wallach et al., 2020) to illuminate and manage the multifaceted relationship between human activities and the all-encompassing environment.

We commence with section 1.1 discusses relevant concepts related to biodiversity. Section 2 establishes the current state of biodiversity accounting and the evolution of pragmatic extinction accounting. This section also explains what is meant by "pragmatic" or "emancipatory" accounting, and how a more radical ecocentric version of it ought to be integrated into ESG frameworks. Current ESG frameworks are explored in Section 3. Section 4 then explains the proposed fusion of ESG frameworks and extinction accounting which is followed by an explanation of how this can encourage greater biodiversity conservation in section 5. Sections 6 and 7 explore new business models and stakeholder engagement respectively. Finally, section 8 concludes with a summary of the key findings.

1.1. Concepts related to biodiversity

This paper distinguishes between "pragmatic" or "emancipatory" accounting and proposes a more radical ecocentric version to be integrated into ESG frameworks. "Biodiversity" refers to the variety of species, ecosystems, and genetic material present in an environment (DeLong, 1996; National Geographic, 2022). This variety is critical for ecosystems' stability, resilience, and long-term sustainability (Mace et al., 2018).

This positive change may be perceived through the distinction between human-centred (anthropocentrism) and ecology- or ecosystem-centred (ecocentrism) perspectives. Anthropocentrism largely focuses on the use of the environment by people."Environmental justice" (Baxter, 2005) is a form of social justice referring to the distribution of environmental "goods" (such as natural resources) and externalities (such as pollution) among groups of people. In weak anthropocentrism (Norton, 1984) motivation for saving the environment is human interest, for example to address poverty (Brörken et al., 2022), or to address historical imbalances in natural resource distribution between nations (Linares, 2022).

While not all biodiversity can be seen as economically valuable, it can be perceived "either from a natural or a cultural viewpoint, rather than just a pool of economic resources that could be used to satisfy basic needs" (Azqueta and Delacámara, 2006: 524). Within the instrumental conception of biodiversity, Brörken et al. (2022) speak of nature's contribution to people to aid economic development. This implies, however, that the "left-over" (not perceived as economically, socially, or culturally important) "assets" can be "depleted or transformed accordingly, whether directly or indirectly" (Azqueta and Delacámara, 2006: 524). Kumar (2012), Washington et al. (2017) and Piccolo et al. (2022) question whether biodiversity can ever flourish if it is only seen as an economic asset.

By contrast, ecocentrism is aligned with higher levels of biodiversity protection (Bond et al., 2021) as it supports stricter biodiversity conservation measures (Samkin et al., 2014; Atkins et al., 2018). Deep ecology (Naess and Sessions, 1986) or ecocentrism accords ecosystems or habitats and species intrinsic value, and therefore can include "ecological justice" or justice between species (Baxter, 2005; Kopnina et al., 2018). Zoocentrism recognises the intrinsic value of both domestic and wild animals, including humans (Washington et al., 2018; Anthony and Morrison-Saunders, 2023). Biocentrism recognises the intrinsic value of all other species, such as plants (Piccolo et al., 2018; Anthony and Morrison-Saunders, 2023).

Non-anthropocentric environmental philosophies can be associated with levels of biodiversity protection, with anthropocentric perspectives aligning with protecting only that which is beneficial for humans (with zoocentrism not privileging wild over domestic animals), and ecocentric and biocentric perspectives centred on protecting all biodiversity. However, while the economic benefits of biodiversity for industries such as pharmaceuticals and tourism are obvious, the values that emphasize the intrinsic worth of ecosystems promise to protect "left-over" species (Piccolo et al., 2018; Washington et al., 2018; Taylor et al., 2020), or

[2] as an output of the Biodiversity Disclosure Project (BDP).

animal welfare (Johansson-Stenman, 2018), are often ignored in corporate policy. Pragmatic extinction accounting, which has been linked to intermediate ecology values which combine both anthropocentric and ecocentric perspectives (Anthony and Morrison-Saunders, 2023), serves as a useful tool, but more is needed to assess and manage biodiversity and extinction-related risks and opportunities.

2. Biodiversity, extinction, and corporate sustainability

Until recently, management, businesses and ESG researchers "have been reluctant to develop a sufficient body of knowledge on how companies could measure and report their business impacts to help prevent species extinction and biodiversity loss" (Zhang and Noronha, 2023). Ethically, ESG metrics have a strong anthropocentric framing because they inform the amount, timing, and certainty of profit generation (see, for example, ISSB, 2022). The approach fits neatly into existing methods to account for and report on how companies manage financial resources but will not lead to planetary sustainability (Kopnina et al., 2023; Milne and Grey, 2013). Therefore, extinction accounting, which is specifically concerned with species preservation on deeper ecological grounds, should be placed at the centre of corporate reporting (Hassan et al., 2020).

Although orientated toward countries, the Sustainable Development Goals (SDGs) have implications for corporations and SDG 14 (life below water)/SDG 15 (life on land) are largely anthropocentric with a focus on natural resources without consideration as to what happens to economically less "useful" species (Washington et al., 2017; Kopnina and Benkert, 2022). The failed AICHI targets set by the CBD (2020) indicate the inability of political bodies, leading corporations, and research/teaching institutions to address ecosystem decline (Piccolo et al., 2018; Washington et al., 2018; Taylor et al., 2020). In their article on biodiversity accounting, Sobkowiak et al. (2020) compellingly argue that capacity-building efforts for conservation may need to be broader than the 2030 Agenda for Sustainable Development. The United Nations report on the state of nature has admitted that not a single target to stem the destruction of wildlife and ecosystems has been met (Greenfield, 2020), Table 1.

Atkins and Maroun (2018) proposed the idea of an extinction accounting framework that integrates social, environmental, and economic dimensions for better accountability of the impacts of economic activities on biodiversity and extinction risk. Atkins et al. (2018) use extinction accounting to analyse rhinoceros conservation and show how extinction would affect tourism, heritage, culture, and ecosystem services. They conclude that extinction accounting is necessary for better decision-making to protect endangered species and to capture the costs associated with species extinction, develop mitigation plans, and promote sustainable business practices (Maroun and Atkins, 2018).

Accounting for species extinction expands the traditional scope of accounting practices by recognizing and quantifying ecosystem services[3] and has emerged as an essential tool for capturing the impact of biodiversity loss (Maroun and Atkins, 2018; Roberts et al., 2022). The extinction accounting framework is an evolving concept. Many researchers have sought to broaden the application of extinction accounting by incorporating additional elements (e.g., Maroun and Atkins, 2018; Corvino et al., 2021; Hassan et al., 2022); developing sector-specific extinction accounting frameworks (Weir, 2018; Gaia and Jones, 2019; Büchling and Maroun, 2021; Zhang and Noronha, 2022) and expanding the framework to include investor guidance and governance recommendations (Atkins and Macpherson, 2021; King et al., 2022). This stream of literature advocates for the integration of extinction accounting into mainstream business activity and regular accounting practices, emphasizing its essential role in conserving biodiversity and preventing species extinction.

[3] These are the benefits derived from ecosystems by people (Kumar, 2012).

Table 1
Progress towards targets set at the Aichi 2010 summit by 2020.

No.	Target	Target status			
		Met (0)	Partially met (15)	No progress (1)	Negative progress (4)[a]
1	Increase public awareness		✓		
2	Include biodiversity in national policies		✓		
3	Reform or phase out incentives & subsidies		✓		
4	Start sustainable consumption and production		✓		
5	Decrease habitat loss by at least half				✓
6	Better manage marine resources		✓		
7	Better manage farming and forestry		✓		
8	Reduce pollution to non-harmful levels				✓
9	Prevent and control invasive species		✓		
10	Reduce pressure on vulnerable ecosystems				✓
11	Increase protected areas		✓		
12	Stop the extinction of threatened species				✓
13	Maintain genetic diversity		✓		
14	Restore ecosystems by providing services			✓	
15	Enhance ecosystem resilience		✓		
16	Nagoya Protocol on Genetic Resources		✓		
17	Implement biodiversity strategies		✓		
18	Respect traditional knowledge of biodiversity		✓		
19	Share biodiversity technology		✓		
20	Increase financial resources for biodiversity		✓		

[a] On some aspects of the target.
Source: Convention on Biological Diversity

Cuckston (2018a & b) argues that while extinction accounting's calculative practices can suggest solutions, these efforts should be explicitly linked to biodiversity conservation. Table 2 illustrates a summarised extinction accounting framework.

3. The missing piece: Biodiversity concern in existing ESG frameworks

Companies are encouraged to integrate biodiversity conservation and the prevention of species extinction fully into their business activities which are, in turn, covered by 26 general issue categories.[4] The IIRC takes a similar approach with the recognition of the importance of

[4] Source: https://www.sasb.org/wp-content/uploads/2021/11/MMap-2021.png.

Table 2
Extinction accounting framework (adapted from Atkins and Maroun, 2020; Hassan et al., 2022; Roberts et al., 2022).

Theme	Content
Reporting on previous actions	This theme provides companies with the opportunity to report on past events on their impact on biodiversity and extinction and report their accountability, with 26 disclosure items.
Reporting on preventing activities happening in the future	This theme allows the disclosure of strategies to prevent impact in the future, with 8 disclosure items.
Reporting on activities contributing to extinction/ biodiversity loss	Through this theme, companies can take into consideration their impact and make informed decisions to prevent further extinction, with 13 disclosure items.
Reporting on guidelines or adopting the following	This theme encourages accountability in an integrated reporting format, with 4 disclosure items.
Reporting on company fines	This theme allows companies to disclose negative impacts, with 2 disclosure items.

biodiversity as part of the accounting for natural capital, which includes ecosystem health.[5] However, not much progress in biodiversity protection can be observed, as discussed in section one. The current mainstream ESG frameworks and assessment criteria offer only minimal consideration for biodiversity as despite its importance in environmental health and sustainability, there is a conflict within the "economic and policy networks over "value-oriented", or total financial return, and "values-oriented", or "comprehensive non-financial impact, capital investment" (Passas et al., 2022:12,879). For instance, MSCI ESG Ratings, which is currently one of the most widely used ESG assessment standards, places biodiversity as a solitary indicator within the 'environmental' category.[6] Equally, the SASB only includes one topic ('Ecological Impact') in its typology.

The GRI is one of the most prevailing and widely used frameworks for reporting on social and environmental issues (Rahdari and Rostamy, 2015). The GRI, while incorporating more biodiversity indicators than other standards/frameworks[7] (GRI 304),[8] has been criticised because GRI disclosures do not incorporate detailed action plans for preventing biodiversity loss and are often used to legitimise irresponsible business practices (Atkins et al., 2018; Gray and Milne, 2018). The GRI (2022) is currently conducting a significant revision to its biodiversity standards, which has resulted in an exposure draft available for public review and feedback. While the exposure draft has made considerable strides in pushing for corporate transparency and accountability for biodiversity conservation, the proposed guidance still falls short in terms of emphasizing extinction risk and the type of action-orientated reporting envisioned by extinction accounting.

At the same time, there is a lack of consistency and comparability in biodiversity disclosures, which limits the potential for driving real change in corporate practices. The GRI's exposure draft deals mainly with direct operations and the immediate supply chains of the reporting organization. This approach may not fully capture a company's impact on biodiversity and species extinction, particularly for organizations with extensive and complex supply chains or indirect impacts (see Atkins and Maroun, 2020; Cuckston, 2017). An organization's indirect impacts can be significant, encompassing the entire product lifecycle, sourcing of raw materials from distant suppliers and the effects of product use and disposal. An effective evaluation of a company's biodiversity footprint should assess its direct and indirect impacts on biodiversity, including both positive and negative aspects, and encompass activities such as supply chain sourcing, land use, waste management, and emissions, through implementing a circular economy (de Jesus and Mendonça, 2018).

While the GRI's exposure draft emphasizes the importance of stakeholder engagement in assessing biodiversity impacts, it excludes some potentially salient stakeholder voices into decision-making processes around species extinction. Those voices include local communities and indigenous peoples, but also eco-representatives ("voices of and for biodiversity") supporting biodiversity custodians involved in conservation (Ruiz and Vernooy, 2012).

Presently, the stakeholders involved in biodiversity initiatives are mostly non-governmental organizations (NGOs), academic experts, public authorities, and businesses engaged in management practices. Thus, the value orientation towards non-human stakeholders in conventional business practice or ethics needs integration into wider ESG (Starik, 1995; Allen et al., 2019; Phillips and Reichart, 2000; Kortetmäki et al., 2023).

Since the non-human stakeholders cannot speak for themselves, building strong partnerships with biodiversity custodians as well as eco-representatives that would support ecocentric representation is crucial (Starik, 1995; Boiral and Heras-Saizarbitoria, 2017; Allen et al., 2019; Phillips and Reichart, 2000; Pilon-Summons et al., 2022; Kortetmäki et al., 2023; Virk et al., 2023). These custodians, often local communities that have lived sustainably with their environment for centuries, possess traditional knowledge and practices that can support biodiversity conservation (Scartazza et al., 2020). They contribute essential local knowledge regarding species, habitats, and ecosystem dynamics, while also providing first-hand insights into the effectiveness of conservation (Washington et al., 2018; Taylor et al., 2020). It is important to consider and respect their rights and cultural values throughout the conservation planning process (Piccolo et al., 2018). To foster this advancement, education, public awareness campaigns, and community outreach programs centred around extinction prevention can help society understand the interconnectedness of environmental and social issues and foster a conservation ethic that promotes sustainable living.

4. Discussion: Integrating ecocentric pragmatic extinction accounting in ESG frameworks

A disconnect between critical stakeholder groups and organizations with high biodiversity impacts may result in the measures taken by organizations falling short of key stakeholders' expectations. This problem may limit the adoption of the GRI's guidelines. For those organizations which do use the GRI, providing specific guidance on addressing indirect impacts and strengthening stakeholder engagement, particularly with biodiversity custodians, will be essential for enhancing the effectiveness of the GRI standard in promoting meaningful biodiversity conservation. In summary, the current ESG frameworks prioritize human interests by primarily detailing various aspects of business activities (diamond facets). As a result, these frameworks may lead to unintentional neglect, reprioritisation, and underestimation of the intrinsic value of biodiversity and ecosystems. When organizations solely focus their ESG frameworks on economic gains and social welfare, it can lead to the oversight of natural resources and preserving ecosystems.

By paying attention to biodiversity and ecosystem health, companies can recognise emerging risks and opportunities more effectively, anticipate new markets, mitigate their environmental impacts, and improve stakeholder engagement (Bebbington and Larrinaga, 2014; White et al., 2023).

This study proposed the incorporation of several pragmatic extinction accounting indicators into the prevailing ESG frameworks. Biodiversity footprint, measuring a company's impact on biodiversity, through such metrics as habitat destruction, species loss, and disruption

[5] Source: https://www.integratedreporting.org/wp-content/uploads/2021/01/InternationalIntegratedReportingFramework.pdf.
[6] Source: https://www.msci.com/esg-ratings.
[7] Examples include high-value areas, description of impacts and protected/restored habitats.
[8] Source: https://www.globalreporting.org/standards/media/1011/gri-304-biodiversity-2016.pdf.

of ecosystems, is already measured by some companies. There are also associated cost burdens and financial asymmetries among actors who would need to account. Examination of the biodiversity footprint can be extended to land use reporting including companies' proactive commitment to biodiversity conservation and ecosystem restoration initiatives, such as reforestation, or habitat preservation while evaluating their efforts to mitigate species extinction. This reporting dimension includes a quantitative and qualitative assessment of habitat conservation, species protection, and support for biodiversity-centric projects in which their business operations are located.

The management of invasive species, balanced with animal welfare concerns (Johansson-Stenman, 2018; Kopnina et al., 2022b), is another important initiative for biodiversity conservation that should be included in existing ESG frameworks. This disclosure, which could be termed "compassionate conservation" (Wallach et al., 2020), can help determine the impact of the company's operations on ecosystems as well as individuals within the species - thus, necessitating stricter controls due to a combination of animal rights and conservation policies (Stucki, 2020).

Additionally, incorporating disclosure requirements for biodiversity credits into a company's ESG reporting can provide investors with a better understanding of the company's efforts to minimize and compensate for its environmental impact. This information is particularly relevant to responsible investors who prioritize businesses with strong ESG performance when making investment decisions, for example in green banking (Hang, 2022), brand-enhancement in EDG (Puriwat and Tripopsakul, 2022), or stock returns (Lapinskienė et al., 2023). Biodiversity credits describe positive impacts resulting from targeted actions aimed at preserving nature. They help businesses achieve net positive biodiversity gains, which can be integrated into ESG reporting to demonstrate their commitment to nature-positive outcomes. By incorporating information related to biodiversity credits into ESG reporting and extinction accounting, businesses can identify potential threats and develop strategies to mitigate or reverse the negative effects on biodiversity. This is vital as RI becomes increasingly aware of the relationship between biodiversity and business risk. Companies that invest in biodiversity credits and report on their actions may have easier access to capital due to reduced perceived risk. By incorporating biodiversity credit investments into their ESG reporting, companies can position themselves as sustainable and responsible investments.

It is widely accepted that extinction prevention is not solely an environmental issue, but also a compound one that interacts with various aspects of social and governance dimensions (Atkins and Macpherson, 2022). Therefore, the underlying philosophy of the proposed pragmatic extinction accounting approach aims to prevent species extinction by actively involving a variety of stakeholders in the decision-making process (Virk et al., 2023).

Additionally, companies could disclose their partnerships with local NGOs, governmental bodies, and industry organizations in terms of extinction prevention in areas where they operate. Presently, in the non-profit sector, due to the increasingly competitive donation conditions, only 3% of donations are going to conservation and animal welfare organizations (Septianto et al., 2020). Collaboration and sharing of experiences among such companies can result in the development of innovative approaches (Azmat et al., 2023) to managing risks related to biodiversity and habitat exploitation. These innovative approaches should not stop at "nature-inspired innovation policy", which is typically used to "leverage biodiversity for economic development" (Lebdioui, 2022).

Furthermore, it is important to report a company's level of compliance with biodiversity-related regulations, as well as any ethical/legal disputes, as this information can provide valuable insights into the company's commitment to preventing or mitigating species extinction. Finally, we draw insights from TNFD[9] to link ESG reporting elements to various international reporting standards related to biodiversity conservation[10], promoting transparency, consistency, and comparability of information on nature-related dependencies and impacts, ultimately helping stakeholders make informed decisions.

Fig. 1 illustrates the incorporation of pragmatic extinction accounting indicators into current ESG frameworks for a more comprehensive evaluation of companies' impact on biodiversity and species extinction. By integrating these indicators into existing ESG frameworks, companies are better equipped to assess and monitor their impact on ecosystems and species, consequently facilitating the identification of areas that require improvement. The ESG indicators in Fig. 1 facilitate transparency and accountability, which are imperative for effective environmental management.

Several indicators/recommended practices are used to emphasize the pragmatic characteristics of the proposed model. Firstly, when engaging in ESG disclosures, companies must identify the points at which extinction accounting and ESG frameworks intersect in addressing biodiversity conservation and sustainable use of natural resources. By doing so, organizations can streamline their reporting processes and prioritize the development of strategies that mitigate the negative impacts of natural resource usage on ecosystems and species.

Secondly, traditional materiality assessments must be broadened to account for corporate responsibility in mitigating biodiversity loss and habitat exploitation, allowing for a more holistic approach to risk mitigation. For example, companies in the agricultural sector require pollination, nutrient cycling, and natural pest control courtesy of healthy ecosystems (Power, 2010). Corporate failure to consider biodiversity and extinction risks not only negatively impacts biodiversity, but can cause operational and supply disruptions (Adler et al., 2018; Atkins & Atkins, 2018; Bebbington and Larrinaga, 2014; Hassan et al., 2020; White et al., 2023).

Thirdly, a looped and long-term reporting philosophy is of utmost importance. By consistently disclosing their activities and initiatives over a sustained period, stakeholders can gain a comprehensive understanding of the impact of their operations on the extinction of species. With the incorporated pragmatic extinction accounting elements, the proposed ESG framework aims to align business and financial sectors with biodiversity conservation goals and enable organizations to integrate nature-related considerations into their operations, while simultaneously revealing opportunities for nature-positive solutions.

[9] The Taskforce on Nature-related Financial Disclosures (TNFD) was established in 2021 in response to the growing need to factor nature into financial and business decisions. The TNFD is a global, market-led initiative with the mission to develop and deliver a risk management and disclosure framework for organizations to report and act on evolving nature-related risks and opportunities, to support a shift in global financial flows away from nature-negative outcomes and toward nature-positive outcomes. The TNFD aims to build a risk management and disclosure framework that can be used by organizations of all sizes in all jurisdictions to identify, assess, manage and disclose nature-related dependencies, impacts, risks and opportunities.

[10] See more at https://framework.tnfd.global/wp-content/uploads/2023/03/23-23882-TNFD_v0.4_Short_Summary_v5.pdf.

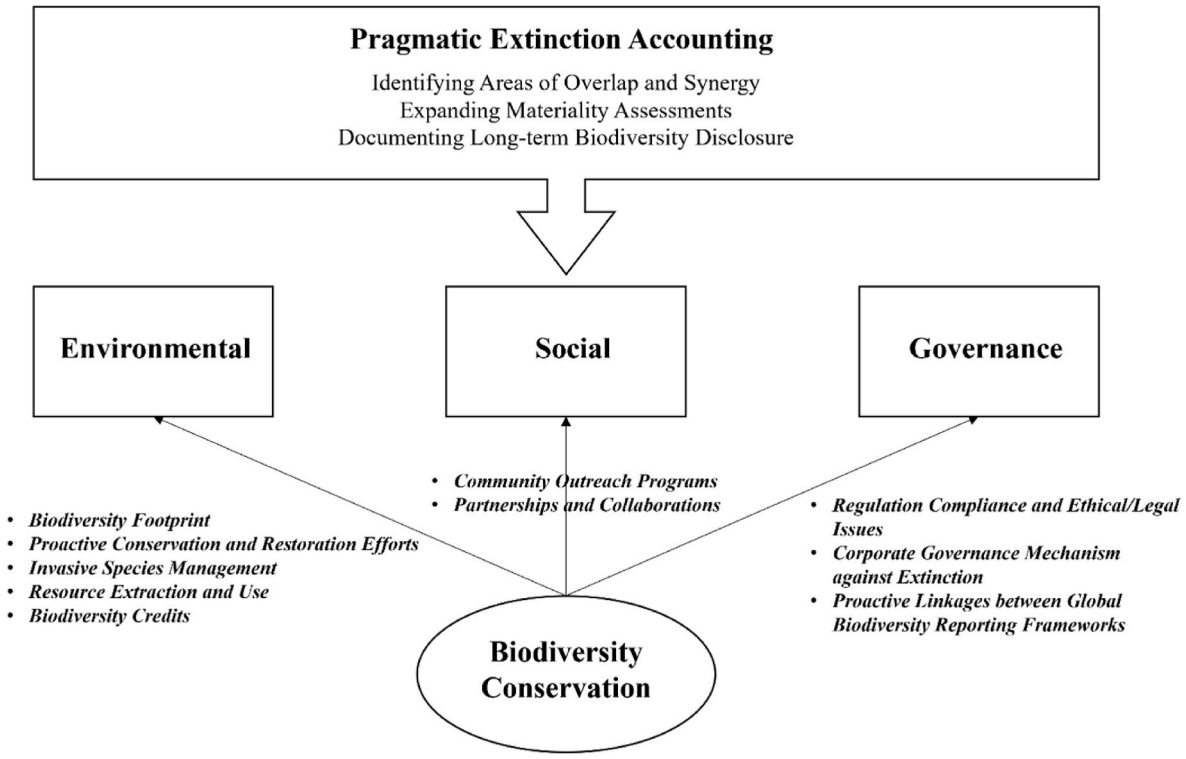

Fig. 1. The proposed fusion of ESG frameworks and pragmatic extinction accounting.

5. Pragmatic extinction accounting and intermediate ecology perspective as a lever for change

Corporate perspectives can shift towards an ecocentric perspective if biodiversity is placed at the centre of corporate behaviour and reporting (Hassan et al., 2020; Roberts et al., 2021). While ecocentric values could be considered incompatible with corporations using biodiversity for human needs (Atkins et al., 2014), research has identified some organizations do recognise ecocentric values in corporate disclosure (Atkins et al., 2018; Maroun and Atkins, 2018; Corvino et al., 2021; Roberts et al., 2022). While these findings are encouraging, anthropocentric values are still far more common in corporate disclosure (Anthony and Morrison-Saunders, 2023). The evidence from the select South African companies' websites examined by Atkins et al. (2018), demonstrates that very few companies pay more than lip service to the intrinsic value of nature. As Atkins et al. (2018) admit, specific commitments to protecting biodiversity are "infrequent and often couched as long-term considerations rather than pressing issues which require immediate attention" (p. 680). In the case of rhinoceros, for most cases, "biodiversity" is still understood in anthropocentric terms of "element of financial risk management" rather than real commitment (Atkins et al., 2014). Hence the ESG frameworks must encourage perspectives that can give greater intrinsic value to biodiversity so that the case for conservation is clear. Cuckston (2018a) suggests that without explicitly linking accounting to the conservation of biodiversity, not much progress can be made.

The ecocentric pragmatic extinction accounting and intermediate ecology perspectives (Atkins and Maroun, 2018a,b), which sit between the extremes of anthropocentrism and ecocentrism, represent a compromise between the economic and natural world. In acknowledging corporate profit-seeking goals, and the improbable scenario in which companies consider the value of biodiversity to be equivalent to human needs, a middle ground is supposed to encourage greater biodiversity conservation (Anthony and Morrison-Saunders, 2023). With the adoption of intermediate ecology perspectives, there is the potential to encourage more corporations to recognise biodiversity as a key stakeholder, an attribute only currently represented by the most forward-thinking corporations (Roberts et al., 2022). The most progressive biodiversity accounting will then need to integrate an ecocentric perspective.

6. New business models

With improved biodiversity accounting and recognition of its importance, new business models will be required. One solution to the depletion of natural resources and associated biodiversity loss is 'dematerialisation' or the 'product to service shift' (PSS) that aims to limit virgin material use in extractive industries (Bocken et al., 2014; Tukker, 2015; Savini, 2021). A shift to a more circular (closed-loop production) business model promotes regenerative practices, moving away from the linear 'take-make-dispose' model (Tittensor et al., 2014; de Jesus and Mendonça, 2018). This includes the reuse of materials and waste to reduce demand for natural resources, which subsequently alleviates pressure on ecosystems (Lewandowski, 2016; Roberts et al., 2023). A circular economy has the potential to mitigate some of the root causes of biodiversity loss, such as habitat destruction, land conversion, climate change, resource extraction and waste (Lieder and Rashid, 2016; Roberts et al., 2023). However, it does not directly address the issues of overconsumption and unchecked economic growth (Kallis et al., 2020).

In comparison, degrowth strategies emphasize a more radical shift in societal values, which may significantly address biodiversity loss but face more significant barriers to widespread acceptance and implementation (Jackson, 2017). Degrowth questions the notion of continuous economic growth as a sustainable and equitable strategy for societal welfare (Kallis et al., 2018). Instead, it promotes conscious and responsible consumption, aiming for a more balanced relationship between humanity and the natural world (Kallis et al., 2018), alleviating pressures on biodiversity (Washington et al., 2017; Kopnina et al., 2018). For instance, organizations striving for a degrowth-oriented approach can adopt sustainable purchasing policies, ensuring that their supply chains are maintained responsibly and do not contribute to biodiversity loss (https://livingplanet.panda.org/).

Ultimately, business models must evolve to reduce biodiversity loss through the circular economy and degrowth concepts (Fig. 2). This approach highlights the importance of adaptation and evolution within the ESG framework to effectively address complex environmental challenges. This perspective triggers a translocation from a predominantly anthropocentric viewpoint towards an appreciation of ecosystem constituents, thus providing an important contribution to the literature on pragmatic extinction accounting.

7. Stakeholder engagement

The policy implications, utility, and application of this work will result in various stakeholders' benefits, especially for non-human stakeholders. The inclusion of diverse perspectives, capacities, values, and knowledge in formulating extinction prevention strategies from various human stakeholders is essential. This necessitates establishing collaborations and partnerships among key stakeholders in species conservation, including government agencies, NGOs, civil society groups, research institutions, and local communities. These collaborations should concentrate on well-defined goals, joint planning, and resource mobilization for extinction prevention initiatives. For example, environmental and conservation organizations possess invaluable knowledge of species, habitats, and ecosystems. Their experience in implementing conservation projects and gathering public support for such initiatives is a great asset.

We need to note that there are also limitations to these approaches. While the companies' motivations for ecocentric or intermediate ecology accounting can include (pre-emptive) regulatory compliance, sanction avoidance or mitigation, reputation management, talent engagement, and capital access, there remain challenges/barriers to the adoption of ecocentric practices and reporting. The main ideological and pragmatic constraint has to do with traditional corporate and shareholders' support for a growth economy. The belief that economies must constantly grow and expand results in land conversion for resource extraction, agriculture or industry, one of the, the root causes of biodiversity loss (Kopnina et al., 2018; Washington et al., 2018; Taylor et al., 2020; Strauβ et al., 2022). Thus, it becomes evident that the conventional profit-oriented accounting systems and associated ESG reporting are not sufficient. This necessitates a shift advocated by Washington and Maloney (2020) in their article "The Need for Ecological Ethics in a New Ecological Economics". The four approaches they advocated were achieving ecocentrism; advocating Earth jurisprudence; supporting ecojustice; and dealing ethically with the commodification of nature.

Indeed, even as extinction accounting promises to be holistic by

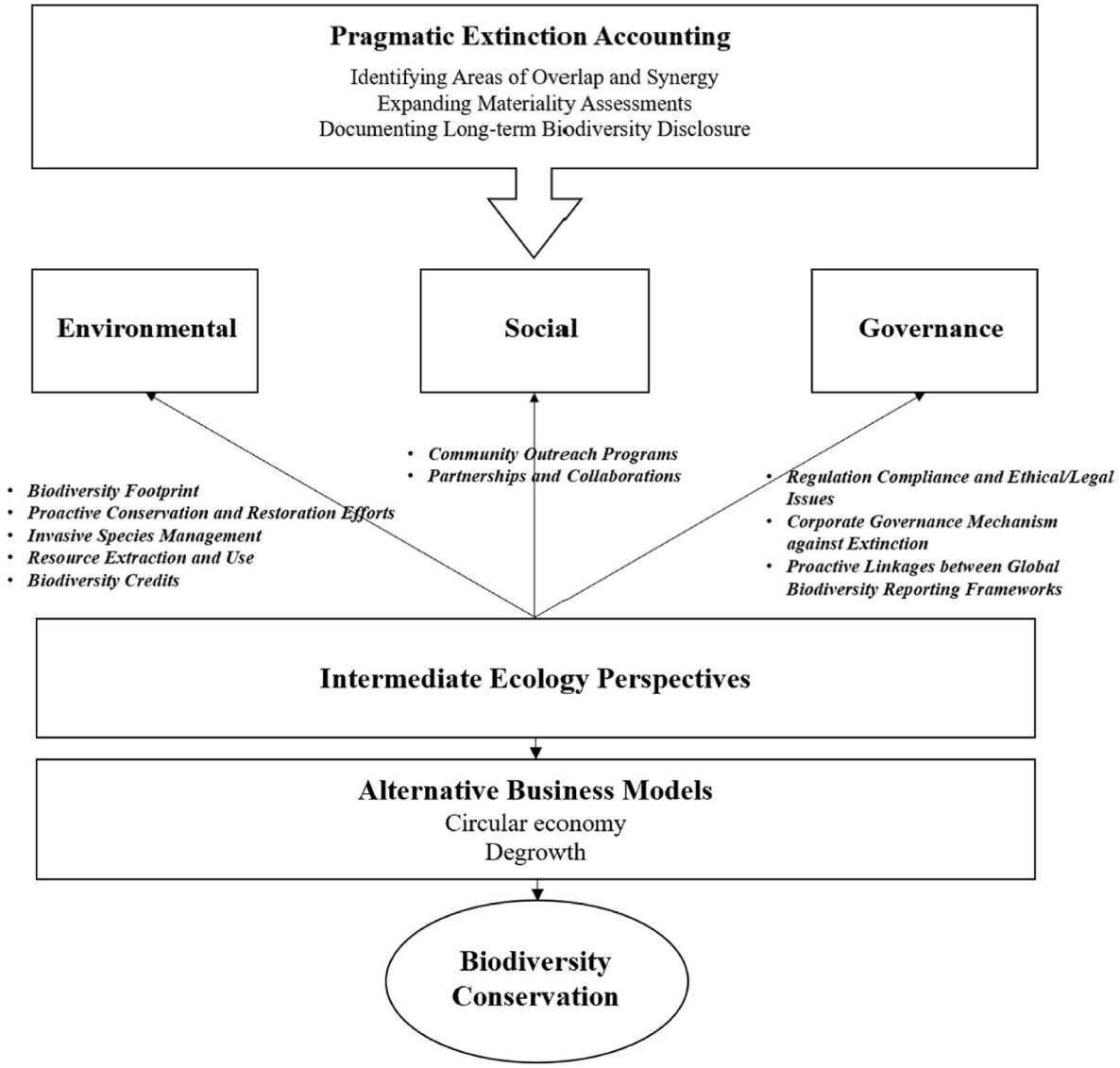

Fig. 2. Enhancing ESG through intermediate ecological perspectives and alternative business models.

integrating ecological, economic, and social dimensions, it may be regressive in its mimicking of the oxymoronic sustainable development rhetoric (Washington and Maloney, 2020). The conventional corporate literature on ESG and SDGs advocates a supposed balance between social, economic, and ecological interests, or the triple P approach (Rosamartina et al., 2022; Azmat et al., 2023). However, the more critical approaches suggest that without a healthy Planet, neither People nor Profit can be sustained (Washington and Maloney, 2020; Kopnina and Benkert, 2022). Moreover, observing that sustainable development is often equated with sustainability, the "business case for sustainability" has been complicit in perpetuating environmental degradation (Washington et al., 2017). Simply, sustaining industrial development is not the same as supporting the natural systems that underpin life on Earth (Washington et al., 2018; Washington and Maloney, 2020). Thus, biodiversity accounting framed in terms of the supposed balance optimistically supported by the SDGs falls short of safeguarding ecological integrity (Sobkowiak et al., 2020).

Acknowledging this shortcoming, this study contributed to the existing literature and practice by integrating a more radical ecocentric version into ESG frameworks to empower companies to adopt effective measures to mitigate biodiversity loss. The integration has the potential to empower companies to take tangible steps to mitigate or eliminate behaviours that contribute to habitat exploitation, environmental degradation, and, ultimately, biodiversity loss.

8. Conclusion

This study underscores the urgent need to refine ESG frameworks to better account for biodiversity and extinction. This enhancement provides fertile ground for crafting environmentally sustainable policies. This paper critically demonstrates that fortified with actionable extinction accounting that incorporates ecocentric values and non-human stakeholders, corporations can navigate environmental risks more effectively, exploit unique benefits, and incorporate biodiversity preservation into their fundamental business strategies efficiently. This outcome maps a trajectory for the evolution of business practices geared towards biodiversity conservation. Businesses, non-profit organizations, and even national governments can harness these strategies as powerful catalysts for sustainable resource use and conservation. Further, our study legitimizes the necessity of limiting dependence on natural resources and mitigating habitat exploitation and biodiversity loss.

Further research about barriers that prevent businesses from addressing biodiversity is still needed. Perhaps one of the bigger biodiversity accounting challenges is long and complex supply chains given diverse actors and practices. The incorporation of the ecocentric extinction accounting framework into ESG is a transformative and integrative solution for various types of companies, regardless of their geographic location, industry type, and firm size. Using extinction accounting that forcefully integrates an ecocentric perspective associated with stricter protection and addressing root causes of biodiversity loss, promises to enhance the positive impact of business activities on biodiversity and ecosystem services. This, in turn, enables companies to manage their environmental risks and opportunities more effectively and create value by incorporating the preservation of biodiversity into their core business objectives. To raise public awareness of species extinction and to enhance corporate disclosure on biodiversity, the more pragmatic and actionable disclosure guidelines must be. Therefore, pragmatic measures for extinction accounting are needed to guide ESG frameworks in reducing or eliminating their dependence on natural resources that lead to habitat exploitation and biodiversity loss. These are the main points this article addressed.

- While current ESG frameworks serve as valuable tools in assessing sustainability performance, the emphasis on anthropocentric perspectives can result in the underestimation of the intrinsic value of biodiversity and the neglect of ecosystem preservation. By taking a holistic approach that includes biodiversity and ecosystem considerations, organizations can better achieve sustainable outcomes.
- Ecocentric pragmatic extinction accounting is a practical way of improving biodiversity accounting. The latest GRI biodiversity guidance has the potential to shift towards pragmatic extinction accounting if the ecocentric perspective is more forcefully integrated.
- To improve biodiversity accounting, we support the evolution from anthropocentric to more intermediate/ecocentric perspectives.
- This should also support the evolution of business models that support biodiversity conservation such as, at least in ideal terms, the circular economy and degrowth.

From a practical standpoint, the alternative business models and strategies proposed in this paper carve out a tangible roadmap for stakeholders. These strategies can guide businesses and organizations towards resource-efficient practices that minimize biodiversity loss and promote environmental sustainability without undermining operational efficiency or profitability. Our paper underscores the need to transition from anthropocentric viewpoints, advocating for a more substantial concentration on ecosystem preservation and the intrinsic value of biodiversity.

The advent of pragmatic extinction accounting which integrates an ecocentric perspective, promoting biodiversity-friendly business models such as the circular economy and degrowth, ushers in a marked transition from anthropocentric views to perspectives supportive of more inclusive biodiversity preservation. Our paper outlines how extinction accounting, which includes species not traditionally seen as economically valuable, can refine ESG frameworks and foster ecocentric perspectives. Thus, the proposed ESG framework's success is inextricably linked to the active engagement and cooperation of various stakeholders. Future research should continue fine-tuning the practical application of eccentrically informed extinction accounting and studying the holistic impact of biodiversity-friendly business models.

CRediT authorship contribution statement

Helen Kopnina: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing - original draft, Writing - review & editing. **Scarlett Ruopiao Zhang:** Conceptualization, Methodology, Validation, Writing - original draft, Writing - review & editing. **Sam Anthony:** Investigation, Validation, Writing - original draft. **Abeer Hassan:** Resources, Writing - original draft, Writing - review & editing. **Warren Maroun:** Conceptualization, Writing - review & editing.

Declaration of competing interest

On behalf of all co-authors, the corresponding author, Helen Kopnina, states that there is no conflict of interest and that this article has not been published elsewhere.

Data availability

No data was used for the research described in the article.

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