

Biodiversity and Business – A Literature Review and Future Research Agenda

Paper submitted to the Corporate Responsibility Research Conference 2023, sub-theme 8: Management and the Anthropocene or open call sub-themes 14-15.

Authors

Professor Satu Teerikangas, *satu.teerikangas@utu.fi*

Dr. Milla Unkila, *milla.unkila@utu.fi*

Dr. Marileena Mäkelä, *marileena.t.makela@jyu.fi*

Juulia Möksy, *juulia.moksy@utu.fi*

University of Turku

Ville Kervinen, *ville.kervinen@utu.fi*

University of Jyväskylä

Otto Lappalainen, *oeolap@utu.fi*

Dr. Marja Turunen, *marja.turunen@utu.fi*

Keywords: biodiversity, biodiversity loss, biodiversity crisis, business, management, economic system, literature review, transformative change

Abstract

Biodiversity loss threatens the health and viability of all kinds of ecosystems and civilization, including ours, in their present form. While business activity is a key driver of biodiversity loss, to date the lack of appreciation of the connections between biodiversity and business has been lamented. In this paper we take stock of how the business and sustainability literatures, broadly defined, has addressed biodiversity. We conducted a systematic literature review for academic articles connecting biodiversity & business appearing in 74 academic journals between 1970-2022. From a total sample of 252 articles, 42 articles were selected for inclusion in the final sample. We present our findings along four themes and ten observations that recurred in our inductive analysis. Given the fragmented state of the art in current research on biodiversity and business, in guise of synthesis, we develop an integrative analytical canvas. In closing, we offer an agenda guiding future research. The main contribution of our paper is in offering academic and business readers an overview of the present state of the art of research on biodiversity in leading academic business and sustainability journals. It is our sincere hope that by summarizing the scholarly discussion thus far we can offer the next researchers a spring board from which to jump start their subsequent explorations into this critical nexus, while inspiring business practitioners toward biodiversity protection.

Introduction

In addition to climate crisis and pollution, the viability of our planetary systems is increasingly threatened by biodiversity loss, referring to the loss of species. Put simply, biodiversity refers to the diversity of life, in all its forms (Chivian & Bernstein, 2008). Biodiversity loss threatens the health and viability of all kinds of ecosystems and civilization, including ours, in their present form (Amel et al., 2017).

IPBES reports (2019, 2021) and the Dasgupta review (2021) call for transformative societal change to address the biodiversity crisis. Companies cause biodiversity loss via several channels, while all sectors bear on biodiversity loss (Panwar et al., 2022). Seeking to quantify the biodiversity footprints of Dutch sectors via a global supply-chain analysis, Wilting & Oorschot (2017) identified that the largest footprints appear in land- and/or energy-intensive sectors, such as agriculture, food, electricity production and transport. Focusing on food and the chemical industry, they further found that 45%-50% of the impact on biodiversity was caused upstream of the direct suppliers of the sectors. While business activity is a key driver of biodiversity loss, to date the lack of appreciation of the connections between biodiversity and business has been lamented in business (Panwar et al., 2022), supply chain management (Wilting & Oorschot (2017), accounting (Roberts et al., 2021; Lee et al., 2021), and organization and management literature (Westley & Vredenburg, 1999).

In this paper we take stock of how the business and sustainability literatures, broadly defined, have addressed biodiversity. To this end, we review academic literature, across disciplines, on the connection between biodiversity and business. Methodology-wise, we conducted a systematic literature review for academic articles connecting biodiversity & business appearing in 72 academic journals spanning the fields of business and management, corporate responsibility, sustainability science and ecological economics between 1970-2022. This led to a total sample of 254 articles. To maintain a business and management focus, 42 articles were selected for inclusion in the final sample.

We present our findings along four themes that recurred in our inductive analysis. This leads to a set of ten critical observations about the field of research on biodiversity and business and/or prevailing business practices related to biodiversity that are organized around the main four themes that emerged in our analysis. Given the fragmented state of the art in current research on biodiversity and business, in guise of synthesis, we develop an integrative analytical canvas. In closing, we offer an agenda guiding future research. The main contribution of our paper is in offering academic and business readers an overview of the present state of the art of research on biodiversity in leading academic journals in business and sustainability. It is our sincere hope that by summarizing the scholarly discussion thus far we can offer the next researchers a spring board from which to jump start their subsequent explorations into this critical nexus, while inspiring business practitioners toward biodiversity protection.

Research method and sample

Our search for relevant articles proceeded as follows. We began initially by searching with the keywords biodiversity AND business/finance/management in the article title. Our focus was on nine leading international academic journals in the fields of responsible business and sustainability science, starting from 1970 to 2022. As this initial search only yielded 29 articles, we proceeded with a broader search, from which the findings presented in this paper emerge from. In this latter search, we narrowed our search to only the keyword biodiversity, as appearing in the article title. Yet, we broadened the scope of the disciplines searched, to also include the broad range of disciplines in business, management and ecological economics, totalling 72 journals. We argued that the single keyword of biodiversity suffices given that the journals added to the sample represented the fields of business, management and finance. This search yielded 254 articles in the year range 1970-2022.

We then proceeded to an initial coding of the articles, building a master excel sheet covering the following themes per article: (1) basic details about the publication (authors, title, year, journal), (2) basic details about research methodology, such as research design, studied country and sector, (3) details about biodiversity, i.e. whether and how the concept of biodiversity is defined, the role of biodiversity in the article (e.g. central, peripheral), and what biodiversity is connected to in the article, (4) the objective of the article and its main findings of the article. This activity was conducted by two research assistants close to MSc-graduation.

Upon closer look, though, we observed that most of the articles were not connected to business or management. Based on the search results and the initial coding of the articles, three of the article authors (including one of the above research assistants) proceeded to a selection of the articles to be selected for analysis in our review. In order to enhance inter-rater reliability, we compared the sample of core articles selected per researcher. While the researchers agreed on the bulk of the articles to be analysed further, there were discrepancies as regards nine of the articles, which, after joint consideration, were all finally selected for inclusion in the full sample. The final sample consisted of 42 articles.

A critical look at the current state of research on biodiversity in business

Based on our analysis, we have made a number of critical observations concerning the state of research on biodiversity and business. These are presented next.

1) Appreciating the field of research

We start our critical review with a look at the field of research on biodiversity and business.

Observation #1: The field of research - A very small, focused research field, gaining traction

Paralleling the considerable literatures on corporate responsibility, business and the natural environment, and environmental management, extant research on biodiversity and business, can be characterized as a very small and focused research field. In recent years, it has been gaining some traction, though.

Indeed, while our search began in 1970, the first articles on business and biodiversity in the sampled journals appeared in 1995. We observed publication numbers to start rising, though via fluctuations, after 2003, Figure 1. Nevertheless, on an annual basis, publication numbers remain low, with $n = 5$ in 1995 and $n = 26$ in 2022. As regards the focal sample studied in this paper (appearing in black in Figure 1), publications are rare from 1995 onward, yet start to appear on an annual basis from 2017 onward. All the while, publication numbers remain small, ranging at best between 2 to 10 papers annually.

Figure 1. Full and focal article sample 1970-2022.

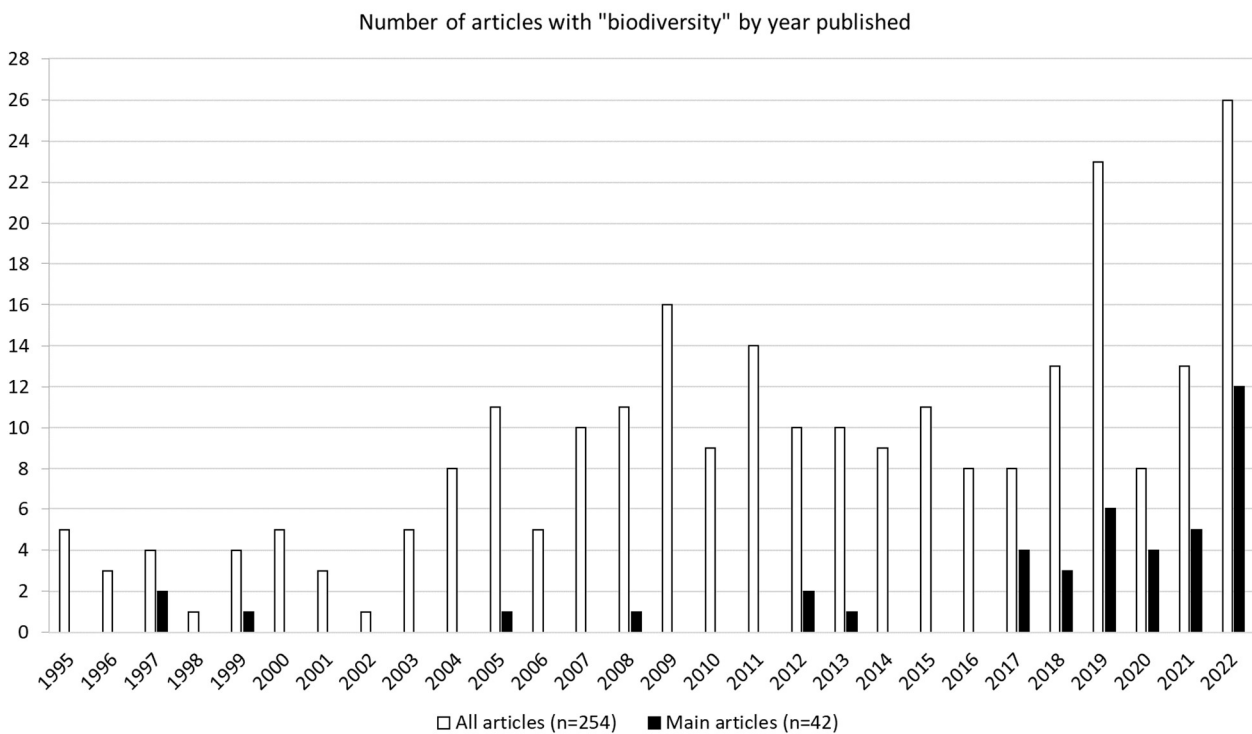


Table 1. Business-related journals and the appearance of biodiversity in article titles 1970-2022.

Name of the Journal	All articles (n=254)	Final sample (n=42)
Ecological Economics	134	1
Journal of Cleaner Production	34	10
Global Environmental Change	34	
Business, Strategy and the Environment	21	21
Journal of Environmental Economics and Management	8	
Organizations and Environment	6	5
Journal of Industrial Ecology	5	
Policy Sciences	3	
Energy Research and Social Science	3	1
Organization Science	1	1
Greener Management International	1	1
Corporate Governance	1	1
Accounting Forum	1	1
59 journals: Academy of Management Annals; Academy of Management Discoveries; Academy of Management Journal; Academy of Management Learning & Education; Academy of Management Perspectives; Academy of Management Executive; Academy of Management Review; Accounting Horizons; Accounting Review; Accounting, Administrative Science Quarterly; Auditing and Accountability Journal; Accounting, Organizations and Society; Administrative Science Quarterly; American Behavioral Scientist; British Journal of Management; Business & Society; Business Ethics; A European Review; California Management Review; Contemporary Accounting Research; Decision Sciences; European Accounting Review; European Journal of Management; European Management Journal; European Management Review; Harvard Business Review; Human Relations; International Journal of Management Reviews; Journal of Business Research; Journal of Business Venturing; Journal of Economics and Management Strategy; Journal of international business studies; Journal of International management; Journal of Knowledge Management; Journal of Law and Economics; Journal of Management; Journal of Management Information Studies; Journal of Management Studies; Journal of Marketing; Journal of Operations Management; Journal of Small Business Management; Leadership; Long Range Planning; Management Learning; Management Science; Manufacturing and Service Operations Management; Operations Management Research; Organization Studies; Organization Theory; Organizational Research Methods; Production and Operations Management; Research Policy; Review of Accounting Studies; Scandinavian Journal of Management; Sloan Management Review; Strategic Entrepreneurship; Strategic Management Journal; Strategic Organization; The Leadership Quarterly	0	0

Moreover, present research on business and biodiversity is focused on the disciplines of ecological economics, sustainability science and responsible business. Indeed, in both searches, we observed that the bulk of the research on biodiversity and business is published in four journals, i.e. *Journal of Cleaner*

Production; Business, Strategy and the Environment; Global Environmental Change; and Ecological Economics, with the latter dominating as regards articles numbers (see Table 1).

Surprisingly, the bulk of the mainstream journals we surveyed in business, management, finance and economics had not published a single paper on biodiversity. Notwithstanding, the lack of academic understanding on the connections between biodiversity and business has been lamented in business (Panwar et al., 2022), supply chain management (Wilting & Oorschot (2017), and accounting research (Roberts et al., 2021; Lee et al., 2021), while the organization and management literature has hardly addressed the matter (Westley & Vredenburg, 1999).

Summing up, while there is an extensive body of literature, building up from the 1970's onwards that ponders the responsibility and sustainability of firms, and there is an impressive literature accumulated in the natural sciences about the state of our biosphere. There is a whole field of ecological economics devoted to the study of how our economies should evolve to better operate within the safe and just boundaries between the society's needs and the planetary constraints, and even a number of journals looking into business and natural environment from one angle or another. However, of the impacts of the firm, the fundamental component of our economies, on biodiversity, the very foundation of life, we know little. Fortunately, the direction at least seems to be right: of the 42 relevant papers we identified for our focal sample, 12 were published after May 2022, noting an increase in the attention this critically relevant area is garnering.

2) Present state of corporate practice on biodiversity

In this section, we shift our attention to the present state of corporate practice vis-à-vis biodiversity protection. This leads us to four critical observations.

Observation #2: Lacking corporate engagement toward biodiversity

It appears that companies are not yet paying sufficient attention toward biodiversity (Panwar, 2022). Despite corporate responsibility and environmental management programs, certifications and standards, companies have not adopted biodiversity strategies as part of these (Wagner, 2022; Boiral et al., 2018). Extant research has confirmed the poor take-up of companies toward biodiversity (Grigg, 2005), as they seem not to have internalized biodiversity protection as part of their operations and thus responsibility. This has been confirmed in studies published in recent years focused on the biodiversity practices of companies across countries, sectors, and using different research methods, as reviewed chronologically next.

Studying companies listed on the Brazilian stock exchange, Reale et al. (2018) find that despite a weak status quo, there is appetite to improve companies' practices. Yet, progress toward action is slow, as companies do not seem to understand the actual environmental situation. Studying companies' corporate no net loss and net positive impact biodiversity commitments over the past two decades, De Silva et al. (2019) found that half

had made biodiversity-related commitments, while only 17 firms had made active commitments. Taking a closer look, none of the latter met all the requirements. Studying 200 Fortune Global companies' reporting motivations on biodiversity and species protection, Hassan et al. (2020), in turn, found lacking reporting, leading the authors to conclude that companies' interest toward biodiversity protection is driven by seeking reputational gains toward stakeholders and shareholders. These findings are confirmed in Hassan et al. (2022) who find that reporting on biodiversity is scarce, at a generic level and lacks a systematic approach. In light of the lack of management, control and reporting tools to address biodiversity loss, most companies engage in symbolic activity (Wagner, 2022). Building on large-scale survey data, Wagner (2022) finds that direct actions to protect ecosystem services remain very low compared to indirect actions. Similar findings are found from the public sector. Despite the legal requirements regarding disclosure, only 20% of Canadian public organizations are committed toward biodiversity disclosure (Talcot & Boiral, 2021). What is more, many of the commitments are symbolic or measured by unclear indicators that are difficult to measure. There further appear to be differences between companies and sectors. For one, larger companies appear to be better at direct ecosystem protection than small- and medium-sized firms (Wagner, 2022). For another, there appears less interest in addressing the biodiversity crisis in firms that do not produce or purchase natural raw materials (Quarshie et al., 2019).

Observation #3: Some promising signs of corporate engagement

Nevertheless, there are promising signs of a change. Already Grigg's study (2005) concluded that companies have identified the significance of biodiversity toward a healthy economy, as biodiversity offers companies a healthy operating environment. Similarly, attitudes and behaviours toward biodiversity protection are changing, for example in the forestry sector (Smith et al., 2018). Boiral et al. (2018), in turn, argue that companies starting to use biodiversity-standards can be considered early adopters. Similarly, Hassan et al. (2022) observe that front-runner companies are emerging that portray genuine interest toward the wellbeing of nature.

Despite signs of promise, front-runners related to biodiversity would appear to remain in the minority. Indeed, a recent study categorized companies' approaches toward biodiversity protection. Comparing forest firms' corporate disclosure on biodiversity, Anthony & Morrison-Saunders (2022) identified three approaches. Broadly speaking, an anthropocentric approach was prevalent, focused on economic value and reputation protection. Adopting such a perspective, companies protect biodiversity if it bears benefit to humans. In parallel, a less strong anthropocentric approach was identified, where biodiversity was considered if it enabled addressing stakeholder pressure. A third, though least prevalent approach, was a biocentric or ecocentric approach, addressing extinction risk and at best the intrinsic value of nature.

Observation #4: Extrinsically motivated company action

Whose role is biodiversity preservation? Prior research paints a mixed image of the shifting faces of this responsibility. While early studies lamented the lack of multinational governance and argued for the key role of companies (Raufflet et al., 2008), recent studies find that companies' actions toward protecting biodiversity are oftentimes driven by extrinsic pressures, as the following findings attest. Nevertheless, more external steering is needed.

Focusing on companies' certification processes, Boiral et al. (2018) found companies to be driven by institutional pressures and the search for social legitimacy. Indeed, certifiable standards offer a socially accepted means for biodiversity protection for activities that bear a direct relationship to ecosystem types. Yet in sectors that utilize natural resources, implementing certifiable standards appears to be used as a bargaining chip to gain social acceptance toward activity that can harm natural species (Boiral et al., 2018). Notwithstanding, despite some action as a response to spiralling ecological crisis and social pressure, the forestry sector's approach remains critiqued as insufficient (Smith et al., 2018). In the mining and forest industry, motivations to address biodiversity relate to showcasing corporate practices, improving stakeholder relations, securing economic opportunities and complying with legal- and non-regulatory requirements (Boiral & Heras-Saizarbitoria, 2022). Similarly, companies in the Sri Lankan tea plantation sector are driven by coercive pressures, such as regulations and certifications (Atupola & Gunarathne, 2022).

Yet, institutional pressure is not only a solution as in the example of salmon farming, governmental actions have led to restricting or even stopping social learning on the ground (Smith et al., 2018). Moreover, even where they exist, regulations and certifications are translated across companies into a set of heterogeneous practices, depending on the users' attitude and know-how, the company's environmental maturity and the company's top management's philosophy (Atupola & Gunarathne, 2022).

In seeking to appreciate companies' practices toward safeguarding biodiversity, Grigg (2005) suggested that markets need to provide companies with better incentives toward biodiversity protection. Presently, regulation does not seem to be sufficient; for example, companies in the energy sector are expecting regulation from the EU toward biodiversity protection (Modeira, 2019).

Observation #5: Emerging management frameworks toward biodiversity

In seeking to appreciate the role of companies as biodiversity actors, Houdet et al. (2012) argue that maintaining and/or offering biodiversity and ecosystem services could become a central part of companies' business models and strategic planning in the near future. They suggest combining strategies to decrease losses in biodiversity and ecosystem services (i.e. polluter pays principle) and ones that increase the productivity of biodiversity and ecosystem services (i.e. beneficiary pays principle). This would enable developing new forms of arbitrage that combine use of land and business process development. Feger & Mermet (2020), in turn, consider how environmental results can be the primary service that dedicated

consulting companies seek to offer and sell their customers, instead of trying to make their existing business model greener. The authors develop an interdisciplinary theoretical business model framework combining company-centric and ecosystem-centric value creation models at the ecosystem level.

Recent research has offered frameworks and typologies toward addressing biodiversity in business. Building on conservation science, Prue et al. (2020) provide a framework to guide biodiversity indicator development for business performance management. This iterative framework consists in the following steps (1) defining the business decision context, (2) setting biodiversity goals and targets, (3) explore and set management actions, (4) develop or select indicators, (5) monitor, evaluate and report, (6) adapt and refine. Panwar et al. (2022), in turn, offer a decision-making typology for biodiversity protection strategies for companies. This typology builds on the basic premises of time (i.e. temporal questions) to pre-emptively and reactively address biodiversity loss, and space (i.e. location), be it onsite or offsite. All the while, White et al. (2021) propose different technological solutions that can be used by companies in identifying their current state, while also foreseeing and following their impacts on biodiversity. The proposed solutions can be used across all phases of the mitigation hierarchy framework, which enables companies to decrease their impacts on biodiversity.

(3) Managing or measuring in the void?

A difficulty vis-à-vis working with the concept of biodiversity is clearly defining what the concept means, and further, what elements can be included into its realm. This ensues difficulties toward the business management and particularly the measurement of biodiversity efforts.

Observation #6: The challenge of making sense of what biodiversity is

In the natural sciences, biodiversity is often viewed at three levels of analysis, thus referring to the genetic diversity within species necessary for the health of the species, the plurality of species necessary for upholding the circular processes of sustenance creation and re-creation, and the variety of ecosystems, each evolved to maximize the life-giving possibilities of any given geographical location on our Earth (United Nations Convention on Biodiversity, 1993). The specific definition of biodiversity is however not unanimous but instead a subject of redefinitions and interpretations (Diaz & Malhi, 2022). Besides being a natural scientific concept, biodiversity can also be seen as a social and cultural construction which also includes a political dimension. (e.g. Peuhkuri & Jokinen 1999.)

In order to appreciate how research on business views the concept of biodiversity, we proceeded to an analysis of a) whether and b) how the papers in the focal sample had defined biodiversity. In the studied papers, the definition of biodiversity was included in nearly half, i.e. 20 out of 42, papers. In the many papers, where biodiversity was not defined, it was mostly treated as a general concept not requiring further

definitions. The concept was, however, often defined indirectly by presenting phenomena such as soaring extinction rates and biodiversity loss, other concepts such as ecosystem services, and impacts of business on biodiversity (or vice versa).

In the papers in which the definition of biodiversity was included, the definitions were quite uniform. Many of those papers trusted the definitions from the UN Convention on Biodiversity, IPBES or other major inter-governmental organizations. Most of those papers defined biodiversity in its basic natural scientific meaning as all the variety of life on Earth and as a trifold combination of diversity within species, between species and of ecosystems. Few of the papers also included the dynamic nature of biodiversity in their definitions – however, the majority of the papers also discussed issues such as extinction rates, decreases in population sizes or other features of biodiversity loss even though the dynamicity was not present in their definitions. Besides the basic biological meaning of biodiversity, biodiversity was also tied by many papers to the foundation of all life on earth and thus, in an anthropocentric manner, defined as the critical basis of human societies and economy.

The vast majority of definitions in the studied papers were concise and considered the concept of biodiversity as non-problematic concept which did not require challenging. Only a minority of papers considered biodiversity as a difficult concept – one which is constantly changing with the evolution of scientific knowledge (Sobkowiak 2022), one which changes depending on the context, its user and the audience (Quarshie et al. 2019; Weir 2017; Smith et al., 2018), and one which does not have an unanimous definition shared by scientists (Winn & Pogutz 2013). Interviewed sustainability change-makers argue that as the terms biodiversity or nature's diversity are abstract and difficult to apprehend, this makes discussing about the topic challenging with those who do not understand them (Quarshie et al., 2019). What is more, different perceptions of biodiversity bear on strategic decisions made vis-à-vis addressing biodiversity loss (Houdet et al., 2012).

Observation #7: Challenge of measurement

Measuring a company's biodiversity impact is a necessary part of managing biodiversity in firms (Kennedy et al., 2022). The difficulty of measuring biodiversity stems from the difficulty of clearly defining it (Kassar & Lasserre, 2004; Farnsworth et al., 2015). Thus, all biodiversity indicators are mired by imperfection (Sobkowiak, 2022). Further, it is difficult to measure biodiversity in a way that enables comparisons across time (Montgomery et al., 1999).

Critically reviewing prior studies, Farnsworth et al. (2015) show that the bulk of prior research of economic valuation of biodiversity has not studied biodiversity, but an element related to biodiversity. Similarly, reviewing extant research on means of evaluating biodiversity, Bartkowski et al. (2015) find that most measures build on simplifications, instead of seeking to represent the multifaceted and complex nature of biodiversity. Farnsworth et al. (2015) argue that even were a clear definition of biodiversity available, its

economic valuation remains a challenge. Given the difficulty of measuring biodiversity, any organization seeking to address biodiversity loss would need to adopt a bottom-up contextual approach to developing its own indicators, supported by an organization-wide governance system (Sobkowiak, 2022).

Novel methods are being developed, such as a product biodiversity footprint (Asselin et al., 2022) which compares the impact of products on biodiversity. Verburg & Osseweijer (2019), in turn, develop a framework to estimate biodiversity loss and associated costs due to nitrogen emissions from single power plants. Yet, Hanfiah et al. (2012) observed differences between products' ecological and biodiversity footprints, when the latter is determined based on direct land use vs. carbon emissions, on time horizons ranging from 20-100 years.

Observation #8: The sorry state of biodiversity reporting

One tool in sustainability work is sustainability reporting. Sustainability reporting covers companies' economic, environmental, and social impacts. Currently, the most commonly used international reporting framework is Global Reporting Initiative (GRI 2023). The framework gives companies guidelines on reporting the various sustainability aspects. One of these aspects is biodiversity. GRI has given instructions on biodiversity reporting since early 2000's.

Depside the sustainability reporting guidelines covering already decades biodiversity issues, the research on biodiversity reporting is scarce or embryonic as Roberts et al. (2021) call it. In 2021, Roberts et al. reviewed the literature on biodiversity and species extension accounting finding 40 articles published in 2013-2020. Whereas, in 2022, Blanco-Zaitegi's et al. found 63 publications focusing on biodiversity accounting from 1996-2020 with 39 directly focusing on biodiversity reporting. Both studies found the year 2018 to be a peak year of biodiversity reporting analysis. Blanco-Zaitegi et al. (2022) further highlight the increase in biodiversity reporting from 2010 onwards.

Regarding the content of the previous studies Roberts et al. (2021) raise two points. From geographical point of view, Roberts et al. (2021) review noticed that global studies dominate the data and UK-based studies are common. Also, in general there are more studies conducted in developed countries than in developing countries. Data wise, Roberts et al (2021) saw the main research data to be companies reports and only a very few studies combine the interviews with the reports as data source.

Based on biodiversity accounting, Blanco-Zaitegi et al. (2022) identified five clusters in the previous studies: sustainability, biodiversity reporting, corporate environmental management, environmental protection, and emancipatory accounting. Regarding the biodiversity reporting, they raised four aspects on the previous studies. First, corporate reporting often focuses on specific, iconic species. Second, the anthropocentric view dominates the reporting, where the biodiversity should be protected for human benefit. Third, non-anthropocentric view is rare. Fourth, companies' main motivation in biodiversity reporting is to improve

legitimacy. In this regards, Blanco-Zaitegi et al. (2022) noticed that there are typical sustainability reporting problems in the biodiversity reporting, including positive, selective reporting and even green-washing.

(4) Lacking appreciation of behavioural dynamics involved in biodiversity protection

A striking observation in our review is that the focus of the field of research has been on strategy, reporting and measurement. All the while, less attention has been paid to the individual or collective level dynamics that enable biodiversity protection.

Observation #9: Lacking appreciation of the role of individuals

Prior research on biodiversity is strikingly silent as regards the role of individuals, be it consumers, employees, managers, executives, or board members. Our review identified individual papers that dealt with managers and biodiversity, both positing instances where managers are less likely to act. For one, Sharma & Nguan (1999) were interested in managers' interpretations and risk propensity. Despite recognizing the need to protect biodiversity, if they perceive a risk therein, managers are less likely to act. For another, Quarshie et al. (2019) observed that executives representing companies not purchasing or producing raw materials perceive engagement in biodiversity protection as challenging. Furthermore, interviewed sustainability change-makers argue that as the terms biodiversity or nature's diversity are abstract and difficult to apprehend, this makes discussing about the topic challenging with those who do not understand them (Quarshie et al., 2019). What is more, different perceptions of biodiversity bear on strategic decisions made vis-à-vis addressing biodiversity loss (Houdet et al., 2012). Finally, decision-makers in companies appear to not bear biodiversity on their attention span (Panwar et al., 2022).

Observation #10: Biodiversity is protected in collaboration

Present research attest to the fact that biodiversity is protected in collaboration (Westley & Vredenburg, 1999). Our analysis pointed to three types of collaboration. To begin with, an early paper by Westley (1997) points to the significance of collaboration between academics and industry executives toward the preservation of global biodiversity. The author suggests that such collaboration can occur via a joint international cross-sector network. Moreover, collaboration between NGOs and companies, including multinationals is also needed. Atkins et al. (2021) find that such collaboration is at best collaborative, featuring characteristics of narrative therapy. However, this requires for the company partner to trust the collaboration and the commitment of the NGO partner, instead of fearing for retaliative measures or critique. Third, collaboration can connect local and global players (Raufflet et al., 2008). Based on their study of babassu-nut breaker women in Brazil, Puppim de Oliveira et al. (2022) emphasized that the questions of biodiversity protection are strongly related to local questions and therefore the engagement of local

communities is needed. It is yet in collaboration with multinational businesses that local communities, at best, find means of protecting biodiversity while making business. In conclusion, these examples posit how collaboration brings different players together to address biodiversity protection. Despite its importance, cross-sector collaboration, in all its forms, does not meander the need for regulation and external pressure by other powerful stakeholders, such as investors (Atkins et al., 2021).

Integrative canvas

As often is the case in new scholarly discussions, there is often no clear red thread flowing through the accumulating knowledge. Instead, metaphorically speaking, the findings remind of the patches of a quilt being prepared for sowing together. In what follows, we propose one possible design for the overall blanket, which we call our analytical canvas. We trust that with the contributions of forthcoming research, the number of patches grows and their stitching together advances.

We propose stretching the canvas onto two axes, forming a matrix to support the growing quilt. The first axis constitutes the identified locus of the problems addressed with the internal functions of the firm at one end, and the external interfaces at the other. The internal end of the axis consists of ideas regarding the firm strategies, business models, management accounting, individuals, practices, perceptions, attitudes and the like, whereas the external end views accountability, i.e. the relationship of firms with the stakeholders, investors, regulations, and customers to name a few.

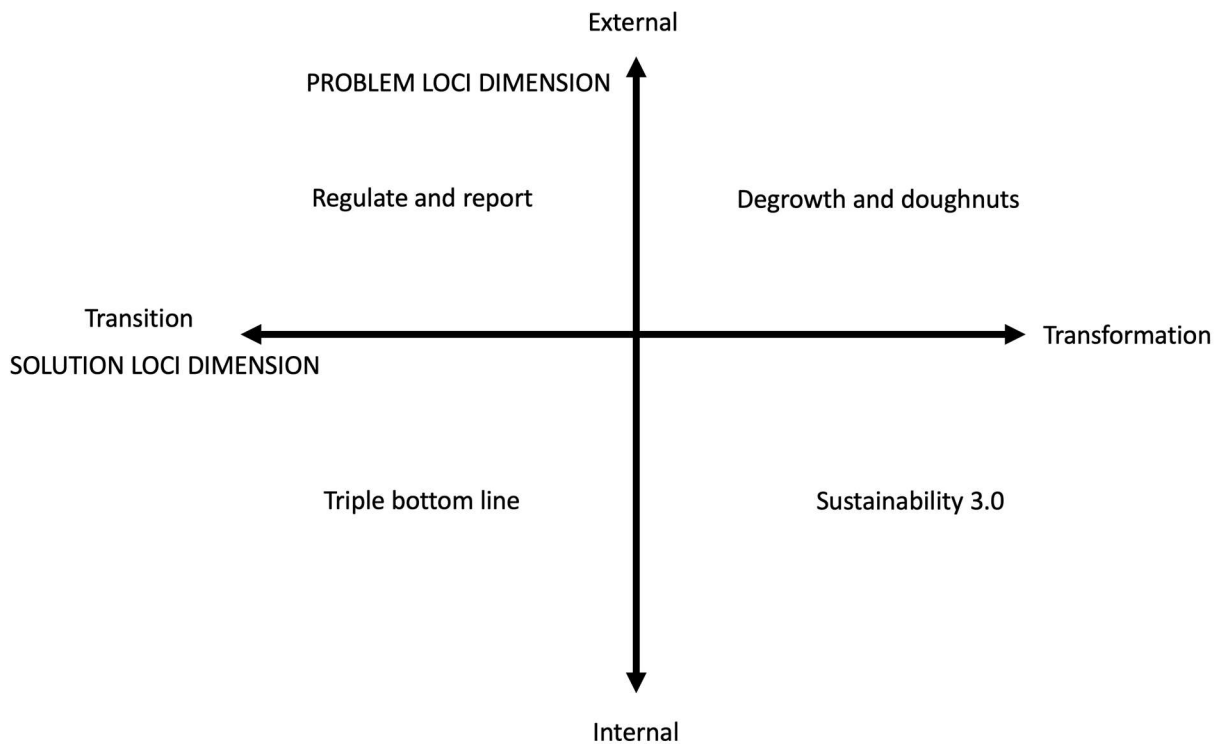
The second axis spans the possible loci of solutions. At the one end are the solutions relying on incremental transitions possible within the so-called green growth paradigm, where the fundamental belief is that the economic system itself is sound enough that the necessary changes can be instigated within it. The other end calls for more fundamental transformations and considers that the whole system needs an overhaul, i.e. the very fundamentals of business and firms a remaking. Maybe not surprisingly the articles we perused could be found predominantly on the transition end of this dimension, despite the growing number of transformative solutions proposed in the wider social and economic research streams.

On the other dimension of problem loci, it seems that the emphasis reflects the process through which the awareness of the biodiversity impacts of business has emerged: firms being predominantly focused on the running of the business as usual, it is up to the external forces to motivate change either through customer demand, investor expectation or legal regulations. Thus, also in this early phase of the development of this research streams the problems at the external interface of business seem easier to identify. Not surprisingly, the single most prominent discussion relates to reporting, either from the viewpoint of the differences between the reported actions and the actual impacts of firm actions, or from the viewpoint of the difficulty of accounting for the biodiversity impacts of the firms.

This leads us to our integrative canvas, depicted below (Figure 2), which constitutes of four quadrants onto which we map the publications and findings of our literature review.

In the first quadrant dubbed “Regulate and report”, the focus in on assessing the diverse methods of reporting demanded of firms, including the discussion of their verity, and the role of the regulations and expectations asserted on the firm from either laws, investors or customers. In this quadrant the ethos is transitional, underpinned by an assumption that as long as the external entities pose demands on the firms and follow up with their execution, the firms will gradually transition towards more biodiversity friendly practices. This quadrant includes nearly half, i.e. 16 papers of our focal sample.

Figure 2. Analytical canvas



In the second quadrant, titled “Degrowth and doughnuts”, the sustainability of the current economic system is more seriously doubted, and as a result, the role of firms as its part are in question. While this quadrant is heavily populated in the field ecological economics, so far there is a lacuna of discussion regarding what would this type of systemic level transformation in practice mean for the individual firm. This quadrant features only four papers of our focal sample.

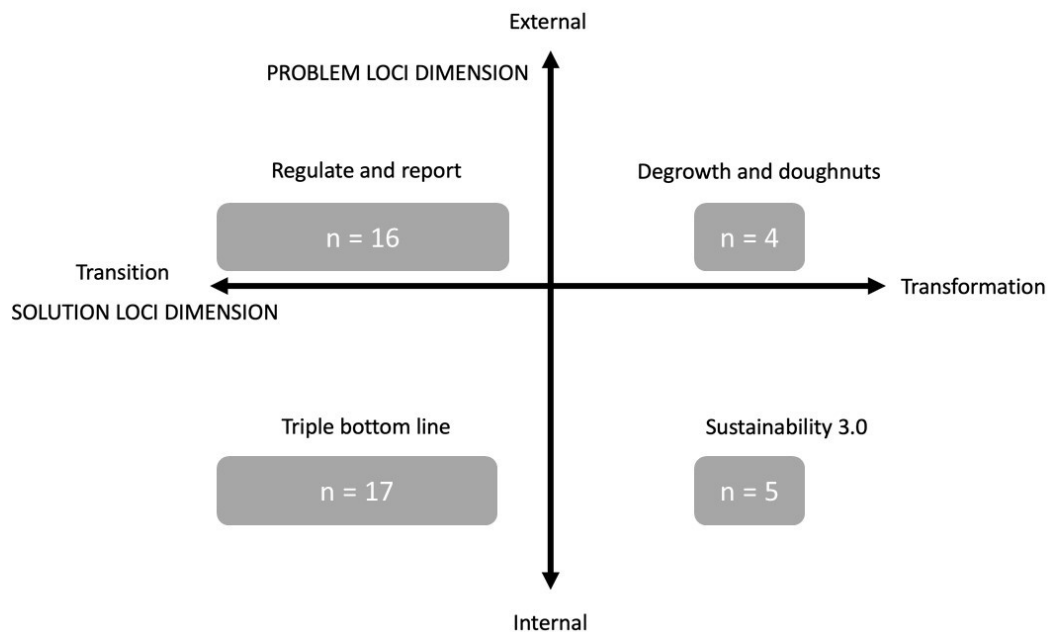
The third quadrant, termed “Triple bottom line”, is the most embedded in the contemporary practices, with the wealth of CSR literature to support its openings. In it, the benefits created by the firm must include positive outcomes to people and planet, instead of merely focusing on the financial profits. Underlying the triple bottom line thinking is the faith that the current economic system is fluid enough and the transitions effective enough

that including these new outcome aims has the necessary effect. This quadrant includes nearly half, i.e. 17 papers of our focal sample.

Finally, the fourth quadrant, “Sustainability 3.0.” is named after the proposition made by Dyllick and Muff (2015) where they assert that in the genuinely sustainable firm the whole overarching purpose of its existence has to be doing good for the environment or the humanity. This is a transformational approach as it flips around the goal and the instrument: instead of environment the instrument and the profit the goal, a genuinely sustainable firm should treat environment as the goal and profit as the instrument and create their business models from these assumptions. This quadrant features only five papers of our focal sample.

In guise of summary, Figure 3 concludes this state of the art to the reader. The majority of present research (33 papers out of 42) are focused on how companies can transition toward green growth, within the remits of the prevailing economic paradigm. Instead, only few papers (9 out of 42) are considering how transformative change can occur via business practices.

Figure 3. State of present biodiversity & business research



Conclusion and future research agenda

The main contribution of our paper is in offering a review of the current state of the art as regards research on biodiversity and business, across disciplines. Based on our critical review, we identify the following as directions for future research in order to enhance science-based knowledge and understanding on business and biodiversity.

1) More research is direly in need

To begin with, the small size of the research field of biodiversity and business is striking. While it says much about the global past interest in biodiversity, it is promising that article numbers are on the rise. Taking a critical stance, though this says much about the late awakening of business researchers toward the biodiversity crisis. Given the imminence and impact of the biodiversity crisis and the critical role of business activity in having created and continuously furthering the crisis (Dasgupta, 2019), our review is a call for much more research on how biodiversity can be tackled by businesses, across sectors and countries.

The biodiversity crisis is a planetary crisis (Rockström et al., 2015). Addressing such a crisis cannot be left to biologists, conservationists or sustainability scholars. It needs the attention of scholars, across disciplines. Notwithstanding, current research on business and biodiversity, remains too narrowly siloed in some disciplines, i.e. those related to responsible business, sustainability science or ecological economics. There is an urgent need for scholars from mainstream business and management disciplines to move beyond an interest in responsibility and climate change (Wright & Nyberg, 2017) to also adopt an interest in biodiversity. Until this occurs, much of their research might inadvertently hamper efforts to address the biodiversity crisis. Put bluntly, at a time of ecological crisis, the research foci of business and management scholars warrant serious critique. Going forward, given the complexity of the biodiversity crisis, interdisciplinary research is needed (Winn & Pogutz, 2013).

2) Need to mainstream biodiversity protection in business

Our second call for future research relates to the need to mainstream biodiversity understanding and knowledge in business. As current research results show, companies have been slow to address biodiversity protection, if at all. Quantitative survey-based or qualitative interview-based studies have been conducted, across countries, on companies' appetite in addressing the biodiversity crisis via their operations. These studies paint a bleak picture of companies' actual deeds toward preserving biodiversity. For example, biodiversity has been omitted from companies' environmental management and CSR strategies. Presently, companies thus lack agency toward tackling the biodiversity crisis. Pioneers and front-runners, though they exist, remain far and few.

As business practitioners remain, by and large, incapable of appreciating what biodiversity is, let alone defining it, they are hard placed as regards making a business case for it, measuring and appreciating how their company impacts on biodiversity loss, let alone identifying means of addressing the issue via their company's activity. In comparison with climate change, research and business response toward lagging are lagging. This is visible, for example, with respect to measuring a company's impact via footprint assessments.

Going forward, beyond more research, future research could focus on case- and action-research based approaches that enable working with practitioners in order to develop and share knowledge on biodiversity. Yet, there is a risk with funded research and/or development projects, in that they offer involved companies the illusion of engagement, while not committing them to addressing the problem on the long-term.

Similarly, research and interactional approaches that enable mainstreaming biodiversity knowledge and practices across business sectors are needed. In order to address the competence gap in business related to biodiversity, educational programs, be they massive online courses, targeted for specific executive audiences, or conducted as part of regular management programs, are needed. It appears that to date, as business and engineering schools have not educated their students vis-à-vis biodiversity, their alumni is poorly placed with respect to acknowledging the biodiversity crisis, let alone addressing it. This is why there are calls to recruit biodiversity professionals, such as biologists, ecologists or conservationists into consulting and business practice.

3) Future research regarding biodiversity reporting and measurement is in need

As regards biodiversity reporting and measurement, we suggest four avenues for future research. First, global studies on large business samples would give the general understanding on the level of biodiversity reporting. It would answer the research question how common is biodiversity reporting as sustainability reporting practice in various business sectors and geographical locations. Second, as loss of biodiversity is largely a land-use issue, we urge biodiversity reporting studies focusing on industries with direct link to the primary production. Examples of such industries are agriculture and related food sector, and forestry and related forest industries. Third, we echo Roberts et al.'s (2021) view on data diversity. Naturally, in reporting studies the main data are the various reports published by companies. However, this data should be supplemented with other data sources in order to get a wider understanding on the corporate reporting practices. For example, supplementing report content analysis with corporate representative interviews would highlight the reasoning on what has been reported and what not and why. Fourth, overall, the measurement of biodiversity effects needs to further understanding and research, so that it becomes as mainstream as carbon footprint measurements.

Taking a critical stance, though, it can be argued that if biodiversity is ill defined, then are all attempts to measure it illusions of control? Ought academics, instead, focus on appreciating the historical and ontological root causes of the biodiversity crisis, before considering means to solve it?

4) Need for economic, business and management frameworks

In order to support companies in biodiversity protection, supportive business models, management frameworks and tools are needed. Our review pointed to the few frameworks available, while in parallel, the prevailing mainstream management and business frameworks in use continue destroying biodiversity abound. If biodiversity is taken seriously, it would need to span a company's operations and management models, instead of being merely a line on the annual corporate responsibility report. To this end, a systemic overview of the presently recognized approaches toward sustainable business, as regards circular economy, regenerative organizing, nature-positive business, is in need.

Moreover, addressing the biodiversity crisis in business means appreciating and respecting nature, in its many forms. Despite companies' environmental management programs, biodiversity protection appears to have escaped serious business attention. To this end, our findings are a call for scholars and business practitioners to take concern for nature seriously, starting with appreciating it.

Beyond addressing the biodiversity crisis, such management frameworks need to consider how business can be conducted in a way that the ecological boundaries of the planet are respected (Rockström et al., 2015). There is need for holistic approaches and an understanding of how biodiversity conservation and addressing planetary boundaries affects organizational management, corporate strategy, business models and supply chains.

Taking a step further, addressing the biodiversity crisis also calls for understanding the root causes of why our present economic system systematically destroys the viability of life on this planet. Notwithstanding, alternative economic models, be it as regards degrowth, capitalism 2.0, conscious capitalism, or doughnut economics are not only needed, but they need to be increasingly discussed, synthesized and mainstreamed.

In summary, addressing the biodiversity crisis is a call for all scholars engaged with the study of economics, business and management to recognize the limits of the current models and paradigms and to develop approaches, frameworks and models that enable humankind to live in harmony with the natural environment. In so doing, the underlying assumptions guiding present business and consumption practice need to be unearthed and questioned, while alternative paths toward the future need to be framed. This calls for appreciating what is the type of transformative change that is needed for business and society to transform toward a biodiversity-respectful path.

5) Future research on agency and leadership are needed

If addressing the biodiversity crisis calls for transformative change, this means that such change requires leadership. Yet present research lacks an appreciation of how active agency and/or leadership can propel the change toward biodiversity-respectful business. Research is dominated by how external forces, such as regulation, drive corporate reactions toward the biodiversity crisis, instead of appreciating companies' intrinsic motivation to act to preserve the planet. Moreover, the active actors driving biodiversity-respectful transformations remain unidentified. Overall, companies' management of biodiversity focuses on measurement, numbers & reporting. Thus, agency is offered to numbers, instead of people as actors. This means ample opportunities for researchers going forward. We call for more research on how decision-makers' attention span could shift to include nature and biodiversity in their decision-making.

Prior research posits that biodiversity is conserved in collaboration with different stakeholders, across global supply chains. This means that biodiversity-respectful leadership is collaborative in its essence. All players, from the UN, to governments, firms, NGOs and local farmers need to take leadership toward tackling the biodiversity crisis. The future is jointly shaped by the action of us all.

6) Need for academic activism

This leads to the question as regards the role of the academic researcher. In addition to calling for more research on biodiversity and business, what other means do academics have at their disposal to making a difference? Beyond research designs and educational programs, academics can act as inspirers, catalysts toward different fora, be it decision-makers, institutional networks, professional bodies at local, national and international levels. Our review showed that addressing the biodiversity crisis is essentially a collaborative effort. To this end, different stakeholders, including political decision-makers would need to be included in research and educational projects and consortia. Going forward, we call upon scholars to be innovative and creative in considering how they can make a difference. Are publications, always more of them, the only way forward? It is time that academics also questioned their role in creating and addressing environmental crises.

References

- Altieri, M. A. (1999). The ecological role of biodiversity in agroecosystems. *Agriculture, Ecosystems and Environment*, 74(1–3), 19–31.
- Amel et al. 2017. Beyond the roots of human inaction: fostering collective effort toward ecosystem conservation. *Science*, 356(6335), 275-279.
- Anthony, S. J., & Morrison-Saunders, A. (2023). Analysing corporate forest disclosure: How does business value biodiversity?. *Business Strategy and the Environment*, 32(1), 624-638.
- Asselin, A., Rabaud, S., Catalan, C., Leveque, B., L'Haridon, J., Martz, P., & Neveux, G. (2020). Product Biodiversity Footprint—A novel approach to compare the impact of products on biodiversity combining Life Cycle Assessment and Ecology. *Journal of Cleaner Production*, 248, 1-10.
- Atupola, U., & Gunarathne, N. (2022). Institutional pressures for corporate biodiversity management practices in the plantation sector: Evidence from the tea industry in Sri Lanka. *Business Strategy and the Environment*, 1-16.
- Bartkowski, B., Lienhoop, N., & Hansjürgens, B. (2015). Capturing the complexity of biodiversity: A critical review of economic valuation studies of biological diversity. *Ecological Economics*, 113, 1-14.
- Benton, T. G., Bieg, C., Harwatt, H., Pudasaini, R., & Wellesley, L. (2021). *Food system impacts on biodiversity loss. Three levers for food system transformation in support of nature*. Chatham House, London.
- Blanco-Zaitegi G., Etxeberria I. A., Moneva J. M. 2022. Biodiversity accounting and reporting: A systematic literature review and bibliometric analysis. *Journal of Cleaner Production*, 371, 133677.
- Boiral, O., Heras-Saizarbitoria, I., & Brotherton, M. C. (2019). Improving corporate biodiversity management through employee involvement. *Business Strategy and the Environment*, 28(5), 688–698.
- Carroll, A. B., & Shabana, K. M. (2010). The business case for corporate social responsibility: A review of concepts, research and practice. *International Journal of Management Reviews*, 12(1), 85-105.
- Dasgupta, P. (2021). *The economics of biodiversity: The Dasgupta review*. HM Treasury, London.
- de Silva, G. C., Regan, E. C., Pollard, E. H. B., & Addison, P. F. E. (2019). The evolution of corporate net loss and net positive impact biodiversity commitments: Understanding appetite and addressing challenges. *Business Strategy and the Environment*, 28(7), 1481-1495.
- Etzion, D. (2007). Research on organizations and the natural environment, 1992–present: A review. *Journal of Management*, 33(1), 637–664.
- GRI. 2023. Global Reporting Initiative. Available <https://www.globalreporting.org/> Accessed 22th May 2023.
- Grigg, A. (2005). Biodiversity and the extractive industry: Innovative practices and remaining challenges. *Greener Management International*, (52), 63-76.
- Hassan, A. M., Roberts, L., & Atkins, J. (2020). Exploring factors relating to extinction disclosures: What motivates companies to report on biodiversity and species protection? *Business Strategy and the Environment*, 29(3), 1419-1436.
- Houdet, J., Trommetter, M., & Weber, J. (2012). Understanding changes in business strategies regarding biodiversity and ecosystem services. *Ecological Economics*, 73, 37-46.

- IPBES (2019). Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. IPBES Secretariat, Bonn, Germany. Accessed last on 05 November 2022.
- IBPES (2022). Biodiversity [Glossary]. <https://ipbes.net/glossary/biodiversity> Accessed last on 19 January 2023.
- Kassar, I., & Lasserre, P. (2004). Species preservation and biodiversity value: a real options approach. *Journal of Environmental Economics and Management*, 48(2), 857-879.
- Kennedy, S., Fuchs, M., van Ingen, W., & Schoenmaker, D. (2022). A resilience approach to corporate biodiversity impact measurement. *Business Strategy and the Environment*, 1-16.
- Leonard-Barton, D. (1990). A dual methodology for case studies: Synergistic use of a longitudinal single site with replicated multiple sites. *Organization Science*, 1(3), 248-266.
- McWilliams, A., & Siegel, D. S. (2011). Creating and capturing value: Strategic corporate social responsibility, resource-based theory, and sustainable competitive advantage. *Journal of Management*, 37(5), 1480-1495.
- Montgomery, C. A., Pollak, R. A., Freemark, K., & White, D. (1999). Pricing biodiversity. *Journal of Environmental Economics and Management*, 38(1), 1-19.
- Moreira, F. (2019). Love me, love me not: perceptions on the links between the energy sector and biodiversity conservation. *Energy Research & Social Science*, 51, 134-137.
- Panwar, R., Ober, H., & Pinkse, J. (2022). The uncomfortable relationship between business and biodiversity: Advancing research on business strategies for biodiversity protection. *Business Strategy and the Environment*, 1-17.
- Quarshie, A., Salmi, A., & Wu, Z. (2021). From equivocality to reflexivity in biodiversity protection. *Organization & Environment*, 34(4), 530-558.
- Reale, R., Magro, T. C., & Ribas, L. C. (2018). Measurement and analyses of biodiversity conservation actions of corporations listed in the Brazilian stock exchange's corporate sustainability index. *Journal of Cleaner Production*, 170, 14-24.
- Roberts, L., Hassan, A., Elamer, A., & Nandy, M. (2021). Biodiversity and extinction accounting for sustainable development: A systematic literature review and future research directions. *Business Strategy and the Environment*, 30(1), 705-720.
- Smith, T., Holmes, G., & Paavola, J. (2020). Social underpinnings of ecological knowledge: Business perceptions of biodiversity as social learning. *Organization & Environment*, 33(2), 175-194.
- Sobkowiak, M. (2023). The making of imperfect indicators for biodiversity: A case study of UK biodiversity performance measurement. *Business Strategy and the Environment*, 32(1), 336-352.
- Sunderland, T. C. H. (2011). Food security: Why is biodiversity important? *International Forestry Review*, 13(3), 265-274.
- Talbot, D., & Boiral, O. (2021). Public organizations and biodiversity disclosure: Saving face to meet a legal obligation? *Business Strategy and the Environment*, 30(5), 2571-2586.
- Verburg, R. W., & Osseweijer, F. (2019). A framework to estimate biodiversity loss and associated costs due to nitrogen emissions from single power plants. *Journal of Cleaner Production*, 1-14.
- Wagner, M. (2022). Business, biodiversity and ecosystem services: Evidence from large-scale survey data. *Business Strategy and the Environment*, 1-17.

- Westley, F., & Vredenburg, H. (1997). Interorganizational Collaboration and the Preservation of Global Biodiversity. *Organization Science*, 8, 381–403.
- Wilson, E. O. (1988). The current state of biological diversity. *Biodiversity*, 521(1), 3–18.
- Wilting, H. C., & van Oorschot, M. M. (2017). Quantifying biodiversity footprints of Dutch economic sectors: A global supply-chain analysis. *Journal of Cleaner Production*, 156, 194-202.
- Winn, M. I., & Pogutz, S. (2013). Business, ecosystems, and biodiversity: New horizons for management research. *Organization & Environment*, 26(2), 203-229.
- Wright, C., & Nyberg, D. (2017). An inconvenient truth: How organizations translate climate change into business as usual. *Academy of Management Journal*, 60(5), 1633–1661.