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An exploratory study of biodiversity, ecological and extinction reporting among JSE-listed entities

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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

An exploratory study of biodiversity, ecological and extinction reporting among JSE-listed entities

A research report submitted by

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to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Commerce in Accountancy

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ABSTRACT

The purpose of this research is to explore the level of biodiversity, ecological and extinction reporting among 50 Top JSE-listed entities and the possible determinants of biodiversity, ecological and extinction reporting. This is important because unprecedented biodiversity loss is a major ecological and business risk affecting South African organisations. The thesis is grounded in an interpretive approach to collecting and analysing data and employs a mixed-methods approach. Qualitative content and thematic analysis were used to evaluate what content companies disclose in their integrated reports and to gauge the level of biodiversity, ecological and extinction reporting over the 2018 to 2020 reports. This was followed by the use of quantitative methods to test for associations between identified determinants and the level of reporting. The findings show that, overall, the level of disclosures have increased since 2018. Unfortunately, most of the disclosures are still vague, generic or focus on positive information. The findings also showed that there is a significant relationship between the type of industry and the level of biodiversity, ecological and extinction reporting. Interestingly, the study found that secondary listed JSE companies have a much higher level of biodiversity, ecological and extinction reporting. The research found that there is a significant relationship between the level of reporting and if the company has a biodiversity partnership or has disclosed the importance of biodiversity. Suggesting that companies are beginning to understand the need to protect biodiversity and prevent further biodiversity loss. This change in mindset is, unfortunately, occurring at a slow pace and more needs to be done by companies, stakeholders and society in general. This thesis is the first study to explore biodiversity, ecology and extinction elements concurrently. It is also the first South African study to explore biodiversity, ecological and extinction reporting across a range of industries.

KEYWORDS: Biodiversity, ecological, extinction, disclosures, South Africa, integrated report

DECLARATION

I, Dino Marco da Mata, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Commerce in Accountancy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: Dino Marco da Mata Signature: 

Signed at Primrose

On the 13 day of February 2022

DEDICATION

I dedicate this report to my Parents. You have both always supported me and encouraged me to be the best possible person I can be. I love you both dearly and everything I do is to make you proud. I can only hope that this report makes you proud of the son I have become (even if you do not understand what it is about). I would also like to dedicate this to my brothers and friends for their support help during this process. Finally, I would like to dedicate this report to my favourite person, Keke. Your presence in my life means the world to me and I appreciate all the support you have given me during this journey. From the time spent ranting about my struggles to weekends given up so I could work on this report and everything in between.

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1. INTRODUCTION

"What humans do over the next 50 years will determine the fate of all life on the planet" - Sir David Attenborough.

1.1. Context of study

In the past 50 years, there has been a greater loss of biodiversity than at any other time in human history (Convention on Biological Diversity (CBD), 2006; The Economics of Ecosystems and Biodiversity (TEEB), 2012). The scientific community agrees that Earth has entered its sixth period of mass extinction (Ceballos et al., 2017). At the centre of this loss of biodiversity is human activity. The CBD (2006) states that 15 of the 24 ecosystem services which contribute to human well-being are in decline. This has resulted in biodiversity loss being considered the fifth-highest global risk in likelihood of occurrence within the next decade (World Economic Forum, 2021). Biodiversity loss is also considered the fourth-highest global risk by impact (World Economic Forum, 2021) as the loss of biodiversity is a threat to the survival of the planet, economy and the quality of human life (CBD, 2006; Earthwatch Institute, 2002; Hassan et al., 2020; Jones, 2014; TEEB, 2008).

Biodiversity is essential for ecosystem functioning (CBD, 2006). Healthy ecosystems are critical for the survival of plant and animal species, genetic diversity and human well-being (CBD, 2006; Global Reporting Initiative (GRI), 2016). Biodiversity also contributes to economic development as it is the foundation for economic activity and contributes directly to local livelihoods (GRI, 2016; Jones, 2014; Jones & Solomon, 2013). Organisations depend on ecosystem services as they provide key input for business operations (Earthwatch Institute, 2002; TEEB, 2012). Examples of input include natural resources such as water and wood for manufacturing, pollination for agricultural activities, plants and animals for food production and habitats themselves for tourism industries and living in general (Earthwatch Institute, 2002; TEEB, 2012). The loss of biodiversity creates risks to organisations affecting access to natural resources, relations with stakeholders, access to capital markets and finance and the sound functioning of supply chains (Grabsch et al., 2012). Biodiversity also provides opportunities for organisations including new markets and products, investment opportunities or improved production (van Liempd & Busch, 2013).

1.2. Purpose of the study

This thesis investigates biodiversity, ecological, and extinction reporting based on the information contained within integrated reports of South African companies. Using an interpretively developed disclosure checklist, the level of biodiversity, ecological and extinction

disclosures is highlighted and coded. The results of applying this disclosure framework are used to gain insight into current reporting practices and assess determinants of biodiversity, ecological and extinction reporting[1].

1.3. Research problem

This research utilises a disclosure checklist to evaluate biodiversity, ecological and extinction reporting. The checklist is used to evaluate an organisation's biodiversity, ecological and extinction disclosures. The first research question (RQ) is:

RQ1: What are the levels of biodiversity, ecological and extinction reporting among South African listed companies based on information included in their integrated reports over the 2018 to 2020 years?

The second research question examines possible determinants of biodiversity, ecological and extinction reporting (based on the results from RQ1):

RQ2: What are the possible determinants of the levels of biodiversity, ecological and extinction reporting?

RQ2 is broken down into the following sub-questions:

RQ2.1: Is there a significant difference between the level of biodiversity, ecological and extinction reporting among different industries of South African listed companies?

RQ2.2: Is there a significant difference in the level of biodiversity, ecological and extinction reporting among the different integrated report content elements?

RQ2.3: Is there an association between the size of South African listed companies and the level of their biodiversity, ecological and extinction reporting?

RQ2.4: Is there a link between the level of biodiversity, ecological and extinction reporting and whether the South African companies have a primary or secondary listing on the JSE?

RQ2.5: Is there an association between the level of biodiversity, ecological and extinction reporting and whether the company has a biodiversity partnership?

[1] This thesis uses 'accounting', 'reporting' and 'disclosing' interchangeably. Evaluating the differences between accounting for and reporting on the environment is deferred for future research.

RQ2.6: Is there an association between the level of biodiversity, ecological and extinction reporting and whether South African listed companies reflect the importance of biodiversity?

For the purpose of this thesis, the 'level of disclosure' means: Whether the company has a disclosure which applies to one of the items in the disclosure checklist (see Table 7) and the level of detail of such disclosures (see Section 4.2). The research is concerned with the level of disclosures found in the integrated reports of South African listed companies (see Section 1.5).

1.4. Significance of the study

Given the importance of biodiversity for both humankind and businesses, academics have been evaluating the extent and quality of biodiversity-related reporting (including extinction and ecology) by companies globally (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Usher & Maroun, 2018; van Liempd & Busch, 2013). This body of research has focused mainly on either biodiversity, ecological or extinction reporting by companies, with no prior research evaluating the reporting of all three components concurrently. These elements cannot be viewed in isolation. Greater biodiversity contributes to ecosystem resilience which is vital to ecological communities withstanding change and stress (Atkins et al., 2022a; King et al., 2022; WWF, 2020). Biodiversity, ecosystems and their ecological communities are so finely integrated and balanced that extinction of a species or any ecological changes within a specific ecosystem causes biodiversity loss which greatly reduces the ability of that ecosystem and ecological community to withstand future changes (Atkins et al., 2022a; King et al., 2022; WWF, 2020). Often the ecological change is so drastic (for example land use change) that the ecosystem cannot recover which results in significant biodiversity loss and possible extinction of species (WWF, 2020). It is important to study these three elements together as they are integrated and influence one another. This thesis addresses this gap by combining the frameworks provided by Adler et al. (2018), Atkins and Maroun (2018), Grabsch et al. (2012), Global Reporting Initiative (GRI) (2020) and van Liempd and Busch (2013) to develop a comprehensive disclosure framework which incorporates biodiversity, ecological and extinction elements.

There has been limited prior research on the biodiversity, ecological and extinction reporting of JSE[2]-listed companies (Mansoor & Maroun, 2016; Usher & Maroun, 2018) and these

[2] Johannesburg Securities Exchange

studies have focused on select industries[3]. This thesis complements prior literature within a South African context by exploring the extent of biodiversity, ecological and extinction reporting of companies in a range of industries. Finally, South African regulations currently do not require companies to report on biodiversity, ecological and extinction matters. Given that biodiversity, ecological and extinction reporting is fairly new and specialised in nature, many accountants are not aware of this area of reporting. The thesis provides a practical contribution by making accountants aware of this specialised area of reporting and the current state of biodiversity, ecological and extinction reporting in South Africa.

1.5. Assumptions, limitations and delimitations

This thesis will explore only biodiversity, ecological and extinction reporting in the context of South African integrated reports (see Section 4.1). Only JSE listed companies will be studied as these companies are required to prepare annual integrated reports or provide reasons for not doing so (JSE, 2019). This delimitation exists because non-listed companies are inherently difficult to examine since they are not obliged to prepare an integrated report and only restricted information can be collected from these companies. Examining only South African entities controls for differences in regulatory systems, environmental contexts and cultural factors affecting the level of reporting. Testing for the effects of these factors on reporting is deferred for future research.

All biodiversity, ecological and extinction reporting information will be obtained from the integrated reports of companies but integrated reports are not the only source of information for stakeholders. The choice to limit the study to integrated reports is that the International Integrated Reporting Council (IIRC) (2021) suggest that these reports are the main form of communication with stakeholders and other forms of information may not represent a true reflection of the company's biodiversity views (Guthrie & Parker, 1989). Further motivation for using integrated reports is that they are the primary reports in South Africa as South African listed companies are required to produce annual integrated reports or provide reasons for not doing so (JSE, 2019). Additional evidence that integrated reports are the primary means of reporting in South Africa is that South African listed companies have been releasing integrated reports consistently since 2010/2011 (Roberts, 2017) and non-listed and non-profit organisations have voluntary adopted integrated reporting (Druckman, 2013; Roberts, 2017; Roberts et al., 2020).

[3] Mining, food producers and seafood industries

1.6. Definition of terms

- *Biodiversity* is defined as the variety of all living organisms on earth including the combination of diversity within species, their interactions with other diverse species and the interaction with ecosystems (National Research Council, 1999; CBD, 2006; Usher & Maroun, 2018).

- An *ecosystem* is the integrated community of living organisms and their non-living environment (The Earthwatch Institute, 2002). Ecosystems provide and support the essential needs for life, provide protection against natural disasters and form the foundations for cultural and spiritual advancements of humans (CBD, 2006). The components referred to above are described as 'ecosystem services' (CBD, 2006).

- *Ecology* refers to the relationships of living organisms with one another and their environments (Oxford English Dictionary, 2019).

Table 1: *List of acronyms*

Acronym	**Meaning**
ACCA	Association of Chartered Certified Accountants
BD Protocol	Biological Diversity Protocol
CBD	Convention on Biological Diversity
CVO	Chief Value Officer
EMAS	European Union's Eco-Management and Audit Scheme
ESG	Environmental, social and governance
GNF	Global Nature Fund
GRI	Global Reporting Initiative
IIRC	International Integrated Reporting Council
IR	Integrated report
IRF	Integrated Reporting Framework
IUCN	International Union for Conservation of Nature
JSE	Johannesburg Securities Exchange
JT	Jonckheere-Terpstra
LCF	Lake Constance Foundation
NCA	Natural Capital Accounting
NCP	Natural Capital Protocol
NGO	Non-Governmental Organisation
SANBI	South African National Biodiversity Institute
SDG	Sustainable Development Goals
SEEA-EEA	The System of Environmental-Economic Accounting Experimental Ecosystem Accounting
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
WWF	World Wildlife Fund for Nature

The remainder of this thesis is structured as follows. Section 2 provides a discussion of prior literature and current reporting frameworks regarding biodiversity reporting, ecological reporting and extinction accounting. The intention is to use the prior literature and frameworks to construct the disclosure framework used in the study. Section 3 derives the research questions. Section 4 discusses the methodology. Section 5 presents the results followed by a discussion and an analysis of the findings. Finally, Section 6 concludes and provides recommendations for future research.

2. LITERATURE REVIEW

2.1. Theoretical frameworks

A review of prior literature will discuss three core themes: (1) biodiversity accounting, (2) ecological accounting and (3) extinction accounting.

Biodiversity accounting

Concerns about biodiversity loss, together with the rise of the social and environmental reporting by entities, have influenced the development of biodiversity accounting and reporting (Jones & Solomon, 2013; Usher & Maroun, 2018). There still exists no single way to report on biodiversity (Büchling & Maroun, 2021). In attempting to account for biodiversity, Jones and Solomon (2013) propose three broad categories of problems which arise: (1) philosophical and scientific problems, (2) technical accounting problems and (3) accountability problems.

Philosophical and scientific problems arise from the broad scientific definition of biodiversity together with the selection of the philosophical paradigm which informs the preparation of the reports (Cuckston, 2013; Jones & Solomon, 2013; van Liempd & Busch, 2013). Technical accounting problems arise from questions of how to record biodiversity and whether it should be monetised (Cuckston, 2013; Freeman & Groom, 2013; Jones & Solomon, 2013). The problem is that current accounting is designed for financial calculations (profit/loss and equity) and does not capture organisations' impact on nature (Jones, 2003; Jones & Solomon, 2013). Problems of accounting practice refer to the actual extent to which organisations report on biodiversity (Grabsch et al., 2012; Jones & Solomon, 2013; Rimmel & Jonäll, 2013; van Liempd and Busch, 2013). Accountability problems arise from the need for biodiversity accounting to drive a positive behaviour change toward the conservation and preservation of biodiversity (Jones & Solomon, 2013; Rimmel & Jonäll, 2013; van Liempd & Busch, 2013).

Theoretical biodiversity reporting frameworks informed by prior literature include broad aspects dealing with the environment, namely, (1) a review of the state of biodiversity; (2) the case for protecting biodiversity; (3) development and implementation of biodiversity action plans and (4) post-implementation review (Adler et al., 2018; Büchling & Maroun, 2021; Grabsch et al., 2012; Jones, 2003; van Liempd & Busch, 2013). Table 2 provides examples of what a biodiversity report can contain.

Table 2: ***Biodiversity report content examples***

- Definition of biodiversity and its components.
- Reporting of any biodiversity-related mission statement.
- Existence of a biodiversity policy statement.
- States why protecting biodiversity important for the company and its stakeholders.
- Biodiversity information relating to specific sites.
- Report of flora and faunal wealth around its operating area.
- Information about specific species affected at the sites where the company operates.
- Disclosures of partnerships with biodiversity organisations or NGOs helping with biodiversity conservation.
- Disclosures of the feedback from stakeholders on biodiversity issues within the company.
- Biodiversity goals/targets for years to come.
- Discussion of biodiversity-related performance and achievement of targets.
- The amount spent on biodiversity conservation/ restoration.
- Reports and assesses biodiversity risk.
- Reported any specific incidents/accidents which impacted biodiversity.
- Information relating to biodiversity action plans.

Adapted from Adler et al. (2018), CBD (2018), Grabsch et al. (2012), GRI (2020) and van Liempd and Busch (2013).

The three core biodiversity themes cannot be seen in isolation. Biodiversity, ecosystems and their ecological communities are so finely integrated and balanced that extinction of a species or any ecological changes within a specific ecosystem causes biodiversity loss (Atkins et al., 2022a; King et al., 2022; WWF, 2020). Biodiversity accounting serves as the broader theme under which ecological and extinction accounting fall (Atkins et al., 2022a; Feger & Mermet, 2017). These three themes contribute to each other as ecological and extinction accounting focus on specific elements and build onto biodiversity accounting (Adler et al., 2018; Atkins & Maroun, 2018; Feger & Mermet, 2017).

Ecological accounting

Cuckston (2017) provides an alternate approach to biodiversity accounting, referred to as ecology-centred accounting. This is a move away from organisation-centred accounting which considers the risks and opportunities of biodiversity to the entity (Cuckston, 2017). Organisation-centred accounting does not consider the interconnectedness of humans and nature and puts the business first, before considering biodiversity (Cuckston, 2017). This results in organisations putting profit making before any environmental considerations. Ecology-centred accounting puts ecosystems at the centre while considering social factors to produce a socio-ecological system. It assigns an intrinsic value to biodiversity and considers the risks and opportunities of organisations to the ecosystem. This accounting approach aims to make this socio-ecosystem visible and understandable in ways which enable bringing biodiversity into decision-making to encourage behaviour that is conducive to conservation (Cuckston, 2017).

It is believed that accounting for ecology will aid organisations in assessing and managing their interdependencies with ecosystems (Cuckston, 2017; Feger & Mermet, 2017; Russell et al., 2017; Sullivan & Hannis, 2017). Ecological accounting is specifically concerned with the health of ecosystems within the broader theme of biodiversity accounting (Feger & Mermet, 2017). Feger and Mermet (2017) propose that ecologically centred information systems should be used by organisations to facilitate the management of biodiversity conservation. An example of an ecologically centred information system called 'InVEST' can produce maps, output quantities and monetary estimates of the ecosystem services from a specified area (Feger & Mermet, 2017). The purpose of the tool is to promote efficient ecosystem conservation by providing information which results in better landscape planning and management (Feger & Mermet, 2017).

Accounting for ecology aims to report on the changes in populations and the number of species within an ecosystem, the condition of the ecosystems and ecosystem services as a product of their interaction with human activities (Feger & Mermet, 2017). Biodiversity reports should include disclosures around the condition (health) of ecosystems affected by the organisation, flora and fauna essential for the healthy operation of the ecosystems, indigenous plants and animals which are no longer present and the presence of invasive species (Cuckston, 2017; Feger & Mermet, 2017). An example of an ecological account is provided in Table 3. Habitats should also be ranked according to their ecological condition to provide an enhanced understanding of changes in biodiversity (Jones, 2003).

Table 3: *Example of an ecological account*			
Natural asset category	**Opening stock (Rand Million)**	**Closing stock (Rand Million)**	**Explanation for change**
Agricultural biomass	15	32	Conditions caused low opening stock, contributing to a large increase in values observed; volatility caused by an increase in production costs and deviations from "normal" climatic conditions.
Fish	6	10	Fall in industry costs of production; rising fish quotas for certain species
Wood	2.4	3	Increase in stumpage price (price paid to buy standing timber); increase in volume removed.
Water	30	26.8	Higher built capital (physical infrastructure) depreciation costs; industry-wide price increases.
Minerals	3	5	Price driven changes, although accompanied by reductions in physical extraction associated with higher production costs.
Oil and Gas	100	30	High volatility in energy prices on a commodity market; rise in operating costs; falling prices causing a decline in revenues.
Energy resources (Wind, solar or water)	15	50	Rapid growth in a capacity related to investment and decreased production costs.
Adapted from Sullivan and Hannis (2017).			

Ecological accounting focuses on the health of and changes to ecosystems within the broader theme of biodiversity accounting (Feger & Mermet, 2017). Extinction accounting focuses specifically on loss of species and how this is driving further biodiversity loss and ecological changes (Adler et al., 2018; Atkins & Maroun, 2018; Cuckston, 2018; Weir, 2018).

Extinction accounting

The loss of species is driven by habitat loss, invasion by alien species, pollution, agriculture, and the unsustainable use of natural resources (Adler et al., 2018; Atkins & Maroun, 2018). All of which are a consequence of human activity. Species loss is driving a global effort to incorporate reporting on species and their habitats within corporate reporting (Weir, 2018). Examples of the organisations leading this global effort is found in Section 2.2. Extinction accounting is described as organisations reporting on and evaluating the absence of species (Atkins & Maroun, 2018, 2020). Atkins and Maroun (2018) believe that extinction accounting is the natural successor of biodiversity reporting and would better contribute to reducing further biodiversity loss. This is based on the notion that extinction accounting goes beyond merely raising awareness through describing the state of biodiversity but can also be used to prevent

extinction (Atkins & Maroun, 2018, 2020). Extinction accounting is an effort to show organisations and stakeholders the effects of their actions on species so that they can work together to conserve biodiversity (Adler et al., 2018; Atkins & Maroun, 2018; Atkins and Maroun, 2020; Buchling and Maroun, 2021; Cuckston, 2018; Weir, 2018).

Table 4 provides examples of what an extinction report may contain. These types of disclosures show that extinction accounting aims to be more than just a disclosure exercise (Atkins & Maroun, 2018; Weir, 2018). It attempts to recognise the importance of the current extinction crisis through understanding the prevention of species loss in terms of the triple bottom line and having a genuine concern about biodiversity loss (Atkins & Maroun, 2018; Weir, 2018). If companies and stakeholders have a genuine concern about biodiversity loss and the consequences of their actions on biodiversity, they would proactively limit their actions that contribute to biodiversity loss and contribute to biodiversity conservation/restoration.

Table 4: *Extinction report content examples*

- Provides a list of endangered plant and animal species whose habitats are affected by the company's activities.
- Incorporates images (photos or drawings) of threatened species.
- Reports operations with activities in IUCN protected areas.
- Reports on biodiversity or species loss due to its operations.
- Provision of education/training delivered on extinction accounting to all employees.
- Provide education on extinction initiatives to schools in future.
- Assesses whether the company's actions are effective in conserving biodiversity and preventing extinction.
- Pictorial evidence of successful and failed conservation is provided.
- Discussion of ways in which the company is working to prevent future liabilities related to harming endangered species.
- Report full details relating to any fines or ongoing claims relating to endangered species.
- Report actions/initiatives taken by the company to avoid harm to, and to prevent the extinction of, endangered plant and animal species.
- Assessments of species populations in areas affected by corporate operations.

Adapted from Adler et al. (2018) and Atkins and Maroun (2018).

There are reporting frameworks which incorporates several of the themes and content elements discussed above. The most widely adopted and comprehensive frameworks are discussed in Section 2.2.

2.2. Current reporting frameworks

The concerns regarding biodiversity loss, together with rise of the social and environmental reporting by entities, have influenced the development of biodiversity accounting and reporting (Jones & Solomon, 2013; Usher & Maroun, 2018). Biodiversity can be considered an extension of corporate social responsibility (Hassan et al., 2020). There is, however, no universally accepted framework for reporting on biodiversity (Jones, 2010; Mansoor & Maroun, 2016). Numerous frameworks and organisations have attempted to provide guidance on biodiversity reporting (Adler et al., 2018; Association of Chartered Certified Accountants (ACCA), 2016; Ecoact, 2020; GRI, 2020; IIRC, 2021). The most significant organisations and frameworks include the GRI, the CDP[4], the Integrated Reporting Framework, the United Nations (UN) Sustainable Development Goals (SDGs) and the European Union's Eco-Management and Audit Scheme (EMAS).[5] The requirements of these frameworks form part of the disclosure instrument used in this study and they will be discussed further below.

The GRI

The most comprehensive and recognised framework for understanding and communicating sustainability issues is the GRI. The GRI is an independent international organisation which provides a global common set of standards to help organisations communicate impact on sustainability (GRI, 2020). The GRI has a biodiversity specific standard in which it recommends that organisations report on four different biodiversity indicators (see Table 5) (Adler et al., 2018; Rimmel & Jonäll, 2013).

Table 5: *GRI biodiversity indicators*

Indicator	Explanation
GRI 304-1	Location and size of all land the organisation uses that has a high biodiversity value and is in/near protected areas.
GRI 304-2	Description of the impacts of business activities and products on biodiversity.
GRI 304-3	Habitats protected or restored by the organisation.
GRI 304-4	Number of International Union for Conservation of Nature (IUCN) Red List and conservation list species with habitats in areas affected by the organisation's operations.
Source: GRI (2020).	

[4] Formerly the Carbon Disclosure Project.

[5] The researcher acknowledges that ISO14000/14001 is also a significant framework. The researcher was, however, unable to obtain access to the framework for this study so the requirements of the framework were excluded from this study.

The CDP

The CDP is a non-profit organisation which collects, reports and discloses information on the environmental performance of organisations and cities (ACCA, 2016; Ecoact, 2020). The environmental performance is focused on greenhouse gas emissions, water security and forests (ACCA, 2016; Ecoact, 2020). CDP collects this information through questionnaires in which respondents disclose and provide evidence of their sustainability strategy (ACCA, 2016; Ecoact, 2020; Fialho et al., 2021). The information is not specific to biodiversity but forests and water security contribute to the sustainability of biodiversity and greenhouse gases lead to a loss of biodiversity (ACCA, 2016; Jones & Solomon, 2013). Stakeholders can access the information from the CDP and the information is useful for assessing the impact an organisation has on biodiversity as there is comparable information from similar organisations (ACCA, 2016; Ecoact, 2020).

The Integrated Reporting Framework (IRF)

The IRF encourages organisations to produce integrated reports which explain how an organisation creates value over time (IIRC, 2021). Integrated reports have eight content elements[6] where information about an organisation is included in the context of different capitals (IIRC, 2021). These capitals include financial, manufactured, intellectual, human, social and relationship and natural capital (IIRC, 2021). The capitals drive the value of an organisation and are changed by the organisation's activities (IIRC, 2021). While the IRF does not require an organisation to report on biodiversity, it does recommend that the organisation communicates how natural capital (including biodiversity) affects the value creation process (IIRC, 2021).

An organisation also needs to consider how natural capital and, in particular, biodiversity loss affects the other capitals. This allows the organisation to incorporate risks related to biodiversity loss into its business model and reporting framework (Atkins & Maroun, 2018). For example, BP has a biodiversity strategy which focuses on addressing biodiversity as an integral part of the company's business using environmental management systems throughout the lifecycle of activities and products (Earthwatch Institute, 2002).

[6] Organisational overview and external environment, governance, business model, risks and opportunities, strategy and resource allocation, performance, outlook and basis of preparation and presentation

SDGs

The SDGs are 17 sustainability goals (each with its own set of targets) which organisations can use to align their strategies to the UN Global Compact sustainability principles (Ecoact, 2020). Two of the goals address biodiversity loss directly but they do not provide reporting indicators (Adams, 2017; Ecoact, 2020). These two goals are outlined in Figure 1.

Adams (2017) discusses the incorporation of the SDGs within integrated reporting, stating that the SDGs are linked to the IRF capitals. Integrated thinking within the IRF helps contribute to the achievement of the SDGs and the integrated reports are used to communicate the responses to the risks and opportunities of sustainable development (Adams, 2017).

Figure 1: ***SDG 14 and 15***



Extracted from https://www.un.org/sustainabledevelopment/biodiversity/

EMAS

EMAS is an environmental management system based on third-party verification which explicitly requires reporting of biodiversity indicators (Lake Constance Foundation (LCF) & Global Nature Fund (GNF), 2016). The objective of EMAS is to promote continuous improvement in the environmental performance of organisations through the use of environmental management systems and the reporting of environmental performance (LCF & GNF, 2016). Although EMAS is specifically required to be used by companies in Europe, the guidelines provided by EMAS apply to all types of organisations and are recommended to any company which aims to integrate biodiversity into its reporting (LCF & GNF, 2016). LCF and GNF (2016) provide indicators to assist organisations with reporting biodiversity information related to different business aspects (outlined in Table 6).

Table 6: *EMAS biodiversity reporting guidelines*	
Indicator	**Explanation**
Strategy and management	It is the management of a business which results in continuous improvement in biodiversity performance. It is necessary to take a structured approach to preserving biodiversity.
Business premises and property	The EMAS Regulation explicitly requires reporting on land use as part of the key indicators of the EMAS environmental statement.
Supply chains	An organisation should adopt a life cycle perspective when describing aspects of supply chains which affect the environment. An organisation should not only describe the aspects with direct environmental impact but should also describe indirect aspects with a significant impact on the environment (if the organisation can reasonably influence these).
Raw materials	An organisation which describes its environmental impact by applying a life cycle perspective should also have a close look at the origin of its raw material.
Product development	Product development controls the complete life cycle of a product, together with its effects on biodiversity. There are numerous opportunities to control many environmental aspects relevant to biodiversity. For example, developing products using eco-friendly materials can reduce the initial impact on biodiversity compared to using more harmful materials and can decrease the subsequent negative impact the product has on biodiversity.
Transport and logistics	Transport processes are very energy- and resource-intensive. Negative effects such as the fragmentation of habitats have been ignored. The current level of mobility of goods, services, information and persons is not ecologically sustainable.
Marketing and communication	An important reason for communicating aspects of biodiversity is the potential effect which a wrongly used or disposed of product may have on biodiversity. There are numerous examples of this, most of which are because of negligence or a lack of information on the part of the consumer, resulting in negative effects.

Table 6: *EMAS biodiversity reporting guidelines*	
Involvement of stakeholders	Biodiversity is a complex field and the concepts of ecosystem services and natural capital do not simplify the challenge for businesses. A business may obtain technical support from research institutions, nature conservation authorities or nature conservation organisations when it comes to determining the relevance of biodiversity, defining targets and activities, and monitoring the business's development in this field.
Extracted from LCF and GNF (2016).	

The reporting frameworks discussed are focused with the disclosure of biodiversity, ecological and extinction information. There are concerns that disclosures alone do not provide useful information for facilitating biodiversity conservation (Russell et al., 2017). The failure to provide useful information arises from the lack of disclosures and/or biased disclosures. Section 2.3 discusses the valuation of biodiversity which is believed to be a better approach to facilitating biodiversity conservation (Atkins & Maroun, 2018; Cuckston, 2013; Russell et al., 2017).

2.3. Biodiversity valuation

It is argued that serious action to prevent biodiversity loss will only be achieved if it can be calculable and expressed in economic terms (Atkins & Maroun, 2018; Cuckston, 2018; Gray & Milne, 2018; Weir, 2018). Organisations are believed to only see extinction as a business risk, with the focus on the financial value of biodiversity loss (Atkins & Maroun, 2018). Organisations will, as a result, only prevent extinction if there is a financial rationale to do so and if there is a method to value species (Atkins & Maroun, 2018).

Certain organisations have published papers or frameworks which attempt to provide a method of valuing biodiversity (Endangered Wildlife Trust, 2020; Mission Économie De La Biodiversité & CDC Biodiversité, 2017; Natural Capital Coalition, 2016; TEEB, 2008, 2010, 2012). Valuing biodiversity refers to qualitative, quantitative and monetary measurements (Endangered Wildlife Trust, 2020; Natural Capital Coalition, 2016). Cuckston (2013) suggests that accounting for biodiversity can be organised into two broad approaches.

The first approach is to design a new form of accounting which can bring the interactions of humans and nature into a new accounting equation which will promote the stewardship of nature (Cuckston, 2013; Jones, 2010). An example of this is full-cost accounting (Freeman & Groom, 2013) which shows the cost of an organisation’s activities on nature or the value extracted from the ecosystem by the organisation (Cuckston, 2013). There remains no single

way to value biodiversity for this accounting approach (Cuckston, 2013; Freeman & Groom, 2013). Some valuation systems include the system proposed by TEEB (2008, 2010, 2012), System of Environmental-Economic Accounting Experimental Ecosystem Accounting (SEEA-EEA), Natural Capital Protocol (NCP) and the Biological Diversity Protocol (BD Protocol), and the natural inventory model proposed by Jones (2003) which helps to value natural assets.

TEEB (2008, 2010, 2012) developed a framework for valuing ecosystem services. The valuation represents the amount society may be willing to pay for the ecosystem service (TEEB, 2008, 2010, 2012). Mission Économie De La Biodiversité and CDC Biodiversité (2017) developed a methodology to calculate a quantitative biodiversity footprint showing the impact of the organisation's activities on ecosystems across the entire value chain.

The SEEA-EEA provides for a biodiversity account which shows the trends in plants and animals within specific ecosystem areas over time (UNEP-WCMC, 2015). This type of reporting represents a new trend in accounting called Natural Capital Accounting (NCA) (SANBI, 2021). NCA involves understanding, measuring and assigning values to ecosystem relationships (Cambridge Conservation Initiative, 2016). The best example of NCA is the NCP developed by the Natural Capital Coalition (Natural Capital Coalition, 2016). The protocol is a decision-making framework which helps organisations identify, measure and value their impacts and dependencies on natural capital (Natural Capital Coalition, 2016).

The most recent advancement in NCA is the development of the BD Protocol which is aligned with the NCP and provides a standardised approach of accounting for net impacts on ecosystems and species (Endangered Wildlife Trust, 2020). This helps organisations to integrate biodiversity data into their integrated reports and to inform stakeholders of measures to reduce their biodiversity impact. The BD Protocol enables organisations to develop a biodiversity impact inventory and a Statement of Biodiversity Position and Performance (Endangered Wildlife Trust, 2020). The BD Protocol is based on accounting and reporting principles to ensure that the information is a credible and unbiased representation of the organisation's biodiversity impacts (Endangered Wildlife Trust, 2020). The BD Protocol incorporates an accounting framework to measure net biodiversity impacts over time (Endangered Wildlife Trust, 2020). The Statement of Biodiversity Position shows the total impacts on biodiversity features and the Statement of Biodiversity Performance shows the net biodiversity impacts over the accounting period, with only impacts which have occurred or are likely to occur being recognised (Endangered Wildlife Trust, 2020). The BD Protocol also recommends disclosing biodiversity productivity/efficiency ratios and valuing the costs and benefits of biodiversity impacts (Endangered Wildlife Trust, 2020).

Jones (2003) developed a natural inventory model according to which an organisation must report to stakeholders the value of habitats, flora and fauna which the organisation has a responsibility to protect. The model consists of six levels of natural inventory classified according to level of detail, with level one being the lowest and level six being the highest (Jones, 2003). A higher level will have more extensive reported data. Level one provides an overview of the natural habitats and natural capital whereas level six provides a general inventory of the total population of flora and fauna (Jones, 2003). Given the complexities of valuing nature, Jones (2003) provides a five-point ecological grading scale to value the natural inventory (with 1 being a low ecological value and 5 being a high ecological value). Siddiqui (2013) found that the model has the potential to be used successfully in developing countries at the national level. Siddiqui (2013) successfully applied the model to create a natural inventory of the Sundarbans mangrove forest in Bangladesh, creating level one, two and five inventory accounts. Horner and Davidson (2021) found that the model can successfully be used account for corridor plantations with diverse wildlife.

The second approach is to incorporate biodiversity into accounting calculations in an attempt to change the behaviour of organisations (Cuckston, 2013). Freeman and Groom (2013) suggest using a positive but declining schedule of discount rates to evaluate projects. Freeman and Groom (2013) found that the standard discount rate approach undervalued projects that were sensitive to conservation, leading to incorrect choices. An additional method of incorporating biodiversity with accounting calculations is to construct a market in which an aspect of biodiversity is treated as a calculable good which can be traded (Cuckston, 2013). Some examples include transferable fishing quotas, carbon markets and, more recently, biodiversity offsetting (Cuckston, 2013; Tregidga, 2013). Tregidga (2013) performed a study of the biodiversity offset scheme in New Zealand. The goal of the scheme was to achieve no net loss of biodiversity (Tregidga, 2013). Tregidga (2013) questioned whether this approach is suitable for biodiversity conservation as the company studied claimed to have no net loss of biodiversity but failed to account for three threatened species affected by the company's operations. The failure to account for extinction risks renders the scheme a mechanism to justify or hide habitat or species destruction (Tregidga, 2013).

There are still objections to the monetisation of ecosystem services and biodiversity in general, as these ultimately remove the environment from environmental accounting (Feger & Mermet, 2017; Ferreira, 2017; Russell et al., 2017; Sullivan & Hannis, 2017). Valuing ecosystem services reduces the environment to lifeless inputs and outputs within a business model to pursue profitability (Ferreira, 2017; Russell et al., 2017). This results in there being no consideration given to the impact of human activity on ecosystems (Russell et al., 2017).

Sullivan and Hannis (2017) concluded that current practices of monetising ecosystem services are designed in a way which removes ethical considerations from decision making which possibly results in further ecological damage.

It is believed that no financial value can be placed on a living organism (Atkins & Maroun, 2018) and that there is a risk that species being seen as assets with economic benefits will lead to undesirable actions (Weir, 2018). One undesirable action described by Weir (2018) is that certain species will be preserved over others based on their economic value. Gray and Milne (2018) have an alternate view that profit-orientated organisations are incapable of ever preserving biodiversity as they are driven by financial performance.

Section 2.4 discusses the development of the disclosure checklist using elements and categories grounded in the academic literature and reporting frameworks discussed.

2.4. Development of the disclosure checklist

Following the approach used by Adler et al. (2018), Grabsch et al. (2012) and van Liempd and Busch (2013), a holistic view of biodiversity is adopted to analyse biodiversity, ecological and extinction reporting. Biodiversity, ecological and extinction reporting includes ecology, habitats, ecosystems, ecological systems, ecosystem services, conservation, protection, restoration, and information on species (Adler et al., 2018; Grabsch et al., 2012; van Liempd & Busch, 2013).

This thesis incorporates the disclosure themes developed by Grabsch et al. (2012): (1) scene-setting, (2) species related, (3) social engagement, (4) performance evaluation, (5) risk, (6) internal management and (7) external reports. These themes serve as the base for the disclosure checklist. Subsequently, an adapted framework was interpretively constructed using categories and elements grounded in the prior literature and the policy framework (Table 7). In addition to the themes developed by Grabsch et al. (2012), this thesis proposes an eighth theme ‘Valuation’ which refers to attempts by the organisation to value biodiversity (natural capital) as discussed in Section 2.3.

Scene-setting refers to the organisation’s definition of biodiversity and how they introduce reporting on biodiversity (Grabsch et al., 2012; Mansoor & Maroun, 2016). Species-related includes the number and type of species affected and efforts to conserve those species (Mansoor & Maroun, 2016; van Liempd & Busch, 2013). Social engagements include partnerships with NGOs, universities or government (Grabsch et al., 2012). They also include engagements with stakeholders on biodiversity issues (Grabsch et al., 2012; Mansoor &

Maroun, 2016). Performance evaluation encompasses the biodiversity targets set by organisations, the evaluation of their performance in line with those targets and the costs associated with those targets (Grabsch et al., 2012; Mansoor & Maroun, 2016; van Liempd & Busch, 2013). Organisations should also report on biodiversity risks and their assessment of these risks (Grabsch et al., 2012; van Liempd & Busch, 2013). Internal management refers to internal structures to ensure that action plans are successful, together with the value creation process (Grabsch et al., 2012; van Liempd & Busch, 2013). External reports refer to whether the organisation reports biodiversity with regard to an accepted reporting framework (Grabsch et al., 2012).

The subcategories and elements of the disclosure themes were interpretively developed from the existing literature and policy framework. The disclosure checklist was used as a thematic analysis tool, as discussed in Section 4, to evaluate the level of biodiversity, ecological and extinction reporting of South African listed companies (van Liempd & Busch, 2013).

Table 7: *Disclosure checklist*		
Scene-setting		
Definition	• The company defines biodiversity and its components.	• (Grabsch et al., 2012)
Mission statement	• Reporting of any biodiversity-related mission statement. • Existence of a biodiversity policy statement.	• (Grabsch et al., 2012) • (CBD, 2018)
Motivation	• Mention of the World Economic Forum's ranking of biodiversity risk. • The company provides ethical motivation to work with protecting biodiversity, protecting species and preventing extinction. • The company states why protecting biodiversity is important for the company and its stakeholders. • CEO/Chairperson letter refers to biodiversity.	• (World Economic Forum, 2021). • (van Liempd & Busch, 2013) • (CBD, 2018)
Species related		
Site-specific	• Reporting of biodiversity information relating to specific sites. • The company discloses specific habitats/ecosystems (land, marine, wetlands, rivers, etc.) affected.	• (GRI, 2020) • (Adler et al., 2018)
Specific species	• The company provides information about specific species affected at the sites where the company operates. • The company reports on potential risks/impacts on these specific species arising from the company's operations. • The company reports flora and faunal wealth around its operating area.	• (van Liempd & Busch, 2013) • (Atkins & Maroun, 2018) • (Adler et al., 2018)

Table 7: *Disclosure checklist*		
	• The company discloses which species are indigenous. • Company reports regular assessments of species populations in areas affected by corporate operations.	
IUCN Red list	• Mention of the IUCN Red List. • The company provides a list of endangered plant and animal species whose habitats are affected by the company's activities. • Incorporates images (photos or drawings) of threatened species. • The company reports biodiversity or species loss because of its operations. • The company reports operations with activities in IUCN protected areas.	• (Grabsch et al., 2012) • (GRI, 2020) • (Atkins & Maroun, 2018) • (Adler et al., 2018)
Surveys	• The company has included references to CDP questionnaires. • Reporting of biodiversity assessments/ surveys conducted.	• (ACCA, 2016) • (Adler et al., 2018)
Social engagement		
Partnerships	• Disclosures of partnerships with biodiversity organisations or NGOs helping with biodiversity conservation. • Company reports details of partnership engagements between wildlife/nature/ conservation organisations and the company which aim to address corporate impacts on endangered species. • Disclosures of which NGOs are working on biodiversity conservation in the areas where the company operates. • The company provided a donation which contributed to the conservation or protection of biodiversity. • The company participates in biodiversity associations to improve biodiversity practices in the community. • Collaborations with key advisors across professions and progress with ecologists, scientists, humanities scholars and other experts.	• (Adler et al., 2018) • (Atkins & Maroun, 2018) • (van Liempd & Busch, 2013) • (Russell et al., 2017)
Awards	• The company discloses awards or recognition received for biodiversity conservation or restoration.	• (Grabsch et al., 2012)
Stakeholder engagements	• The company reports steps taken for creating biodiversity awareness among its employees or in the community. • The company reports on the education/training of all employees delivered on extinction accounting to all employees. • Information provided about social media interaction regarding biodiversity.	• (Adler et al., 2018) • (Hassan et al., 2020) • (Usher & Maroun, 2018) • (Grabsch et al., 2012)

Table 7: *Disclosure checklist*		
	• Disclosures of the feedback from stakeholders on biodiversity issues within the company. • The company discusses the relationship between local communities and biodiversity at the sites where the company operates. • The company provides specific examples of stakeholder engagement. • Provide education on extinction initiatives to schools in future. • Update shareholders/stakeholders quarterly with progress and future actions.	• (van Liempd & Busch, 2013) • (CBD, 2018) • (Atkins & Maroun, 2018)
Performance evaluation		
Targets	• The company discloses biodiversity goals/targets for future years. • The company describes current biodiversity goals. • Reference to UN SDG 14 or 15 and respective targets. • Reference to CBD post-2020 framework goals. • Reports strategy for the future development and improvement of actions/initiatives.	• (Adler et al., 2018) • (Grabsch et al., 2012) • (Adams, 2017) • (CBD, 2020)
Performance	• Discussion of biodiversity-related performance and achievement of targets. • The company provides assessment and reflection on the outcome of partnerships and decisions taken about changes to initiatives going forward. • The company assesses whether the company's actions are effective in conserving biodiversity and preventing extinction. • Pictorial evidence of successful conservation is provided.	• (Grabsch et al., 2012) • (Atkins & Maroun, 2018)
Costs	• The company reports the amount spent on biodiversity conservation/ restoration. • The company discloses details and the value of any fines or claims relating to biodiversity loss or damage. • The company reports the potential liabilities relating to future possible fines/claims. • Includes a discussion of ways in which the company is working to prevent future liabilities related to harming endangered species.	• (Grabsch et al., 2012)
Risk		
Risk	• The company reports and assesses biodiversity risk. • The company describes business opportunities created by biodiversity. • The company uses tools to measure both positive and negative impacts of biodiversity. • The company identifies areas which require biodiversity action plans.	• (Grabsch et al., 2012) • (van Liempd & Busch, 2013) • (CBD, 2018)

Table 7: *Disclosure checklist*		
Risk management	• The company provides information relating to systems/processes developed to manage or mitigate biodiversity risk. • The company has researched methods to reduce its impact on biodiversity. • The company discloses the use of ecosystem services assessment tools such as InVEST.	• (Grabsch et al., 2012) • (Usher & Maroun, 2018) • (Feger & Mermet, 2017)
Incidents	• The company reported any specific incidents/accidents which impacted biodiversity. • The company provides pictorial evidence of incidents. • The company outlines a plan for the rehabilitation and restoration of areas affected by the incidents.	• (Grabsch et al., 2012) • (Atkins & Maroun, 2018) • (van Liempd & Busch, 2013)
Materiality	• The company classifies biodiversity as a material risk for the company. • The company provides materiality assessments on biodiversity issues.	• (IIRC, 2021) • (van Liempd & Busch, 2013)
Internal management		
Biodiversity action plans	• The company discloses information relating to biodiversity action plans. • The company reports biodiversity in top-level management plans and details management's approach to biodiversity. • The company provides details of land management or rehabilitation activities. • The company reports biodiversity projects undertaken to enhance biodiversity in and around the areas of operation. • The company provides details about its involvement in afforestation activities. • The company reports its involvement in the protection/conservation of "Ecological corridors" in and around areas of operation.	• (Grabsch et al., 2012) • (CBD, 2018) • (GRI, 2020) • (Adler et al., 2018)
Biodiversity officer	• A biodiversity officer is identified and his responsibilities are outlined. • The company identifies to whom the biodiversity officer reports.	• (Grabsch et al., 2012) • (van Liempd & Busch, 2013)
Products and value-chain	• Disclosures around the impact of the company's products and activities on biodiversity. • Information about whether the company's processes contribute to the mitigation, restoration or improvement of biodiversity. • The company details the importance of biodiversity as a natural capital in the value creation process. • Description of how natural capital and biodiversity loss affects the other capitals.	• (GRI, 2020) • (van Liempd & Busch, 2013) • (IIRC, 2021) • (Atkins & Maroun, 2018)

Table 7: *Disclosure checklist*		
External reports		
GRI, IRF and other frameworks	• The company reports on international conventions for biodiversity conservation and restoration. • Reference to GRI reporting, International Integrated Reporting Council (IIRC) framework or other relevant frameworks. • The company mentions that the Integrated Report is printed on recycled/sustainably sourced paper.	• (Adler et al., 2018) • (Grabsch et al., 2012)
Valuation		
Quantitative, Qualitative or Monetary measurement attempts	• The company performs a cost-benefit analysis for biodiversity projects. • The company partakes in a biodiversity offsetting scheme. • The company develops a natural inventory account. • The company refers to NCA or any biodiversity valuation frameworks. • The company provides biodiversity productivity or efficiency ratios.	• (van Liempd & Busch, 2013) • (Jones & Solomon, 2013) • (Endangered Wildlife Trust, 2020) • (Natural Capital Coalition, 2016) • (UNEP-WCMC, 2015).

3. DERIVATION OF RESEARCH QUESTIONS

van Liempd and Busch (2013) state that, in addition to the business rationale for organisations to report and manage their biodiversity impact, there also exists a moral obligation to report and manage their impact. Jones and Solomon (2013) believe that biodiversity reporting will influence organisations to take additional more effective actions to manage their biodiversity impact. van Liempd and Busch (2013) state that since organisations contribute to the loss of biodiversity, they should be part of the solution to preserve it. Adler et al. (2018) contribute to this idea by stating that organisations have ethical responsibilities towards the environment as they are stewards of natural resources.

Reporting on an organisation's impact on biodiversity and its efforts to protect and restore biodiversity will raise stakeholder awareness of its importance and promote positive change (Adler et al., 2018; Grabsch et al., 2012; Jones & Solomon, 2013; van Liempd and Busch, 2013). Jones and Solomon (2013) believe that reporting on biodiversity can inform society and enhance understanding of humans' role in biodiversity loss. Gaia and Jones (2017) look at biodiversity reporting through the lens of stakeholder theory, stating that stakeholders who are aware of biodiversity issues will avoid actions which contribute to biodiversity loss and will attempt to conserve biodiversity. Informing stakeholders on the impact of their activities on

biodiversity is necessary for the successful implementation of biodiversity conservation strategies (Gaia & Jones, 2017).

Prior studies have focused on the level of biodiversity reporting of companies in Britain and Germany (Grabsch et al., 2012), Denmark (van Liempd & Busch, 2013), South Africa (Mansoor & Maroun, 2016; Usher & Maroun, 2018), Sweden (Rimmel & Jonäll, 2013) as well as top Fortune Global companies (Adler et al., 2018; Hassan et al., 2020). The studies found that biodiversity disclosures are limited, vague and do not enable stakeholders to assess the company's impact on biodiversity (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Rimmel & Jonäll, 2013; Usher & Maroun, 2018; van Liempd & Busch, 2013). To outline the level of non-reporting, van Liempd and Busch (2013) found that more than 60 per cent of the companies did not report on biodiversity issues and almost 55 per cent did not mention the word 'biodiversity' nor other related phrases. On a positive note, Hassan et al. (2020), Mansoor and Maroun (2016), Rimmel and Jonäll (2013) and van Liempd and Busch (2013) found that biodiversity disclosures did increase over the years of the respective studies.

With the above in mind, the two primary research questions considered are:

RQ1: What are the levels of biodiversity, ecological and extinction reporting among South African listed companies based on information included in their integrated reports over the 2018 to 2020 years?

RQ2: What are the possible determinants of biodiversity, ecological and extinction reporting?

Overall, the findings of prior studies showed that disclosures were biased, used to manage impressions[7] (Grabsch et al., 2012) and focused on positive examples with limited negative impacts reported (Adler et al., 2018; Irshad et al., 2021; van Liempd & Busch, 2013). Companies disclosed mostly information about scene-setting and social engagement with very few companies discussing biodiversity in terms of performance, risk and internal management (Grabsch et al., 2012; Mansoor & Maroun, 2016; van Liempd & Busch, 2013). Previous studies also found that companies within industries with a high environmental impact are more likely to report on biodiversity issues (Adler et al., 2018; Grabsch et al., 2012; Hadro et al., 2022; Hassan et al., 2020). Adler et al. (2018), interestingly, found that companies in low impact industries reported more biodiversity disclosures than companies in medium impact industries. Previous South African studies have only looked at select industries so there is no evidence within a South African perspective for a range of industries.

[7] Impression management involves the processes by which management of an organisation controls how the organisation is perceived by others (Hassan et al., 2020; Irshad et al., 2021; Van Zijl et al., 2017).

RQ2.1: Is there a significant difference between the level of biodiversity, ecological and extinction reporting among different industries of South African listed companies?

Organisations need to consider the various types of stakeholders and their interests, which would lead to the use of different communication approaches (Feger & Mermet, 2017; Gaia & Jones, 2017). There exist four approaches to reporting biodiversity, namely, narratives about the organisation's management approach to biodiversity issues, financial information to explain the financial implications of a biodiversity-related event, disclosure of non-monetary information to explain how the organisation uses or impacts biodiversity, or the organisation uses information on natural capital externalities to show the external costs or benefits on society (Endangered Wildlife Trust, 2020). It is not clear exactly how this information is incorporated into integrated reports. The content elements of an integrated report are interconnected and intend to present information in a way which creates a holistic view of the dynamic and systemic interactions of the organization's activities and products (IIRC, 2021). What remains to be determined is if this principle applies to the accounting for and reporting on biodiversity.

RQ2.2: Is there a significant difference between the level of biodiversity, ecological and extinction reporting among the different integrated report content elements?

Prior literature suggests that larger companies disclose more environmental, social and governance (ESG) information (Ahmed & Courtis, 1999; Brammer & Pavelin, 2008; Drempetic et al., 2020; Gonenc & Scholtens, 2017; Jennifer Ho & Taylor, 2007). This is attributed to the fact that larger companies can afford to employ highly skilled individuals, can afford the increasing costs of voluntary disclosure and can afford sophisticated reporting systems (Ahmed & Courtis, 1999; Brammer & Pavelin, 2008; Jennifer Ho & Taylor, 2007). Larger companies also have more stakeholders and are more visible to the public, so large companies are under more pressure to disclose ESG information in order to gain legitimacy (Drempetic et al., 2020; Gonenc & Scholtens, 2017). This thesis examines the Top 50 JSE listed entities which provides the perfect opportunity to explore the following:

RQ2.3: Is there an association between the size of South African listed companies and the level of their biodiversity, ecological and extinction reporting?

The JSE has historically been at the forefront of promoting strong governance and disclosure by companies (JSE, 2015). This includes ESG aspects as South African listed companies are required to produce annual integrated reports or provide reasons for not doing so (JSE, 2019). The JSE listing requirements, however, provide that companies with a secondary listing on

the JSE are only required to comply with the listing requirements of the exchange where it has its primary listing (certain provisions of the JSE listing requirements are compulsory regardless of listing status) (JSE, 2019). A company with a secondary listing on the JSE might have a higher or lower level of biodiversity, ecological and extinction reporting, depending on the listing requirements of their primary exchange. To explore whether the JSE is still at the forefront of ESG reporting requirements it was decided to consider the following:

RQ2.4: Is there a link between the level of biodiversity, ecological and extinction reporting and whether the company has a primary or secondary listing on the JSE?

Feger and Mermet (2017) believe that effective conservation and restoration of ecosystems depend on more than one organisation. Weir (2018) supports this notion by suggesting that accounting for extinction requires collaboration across different professions. Adler et al. (2018) found that biodiversity disclosures among organisations with existing biodiversity partnerships were higher than organisations with no partnerships. With Atkins et al. (2022b) finding that the relationship between NGOs and companies has shifted from an adversarial one to one characterised by constructive dialogue, facilitation and mediation. The link between partnerships and the level of reporting has not, however, been tested extensively especially in the context of a developing economy.

RQ2.5: Is there an association between the level of biodiversity, ecological and extinction reporting and whether the company has a biodiversity partnership?

It has been noted that biodiversity reporting is often generic and provides only minimum disclosure on environmental impact (Adler et al., 2018; Atkins & Maroun, 2018; Gray & Milne, 2018; Mansoor & Maroun, 2016; Usher & Maroun, 2018; van Liempd & Busch, 2013; Weir, 2018). Weir (2018), further, argues that the current extinction reporting model may create false impressions even if there were a higher percentage of threatened species disclosures. This arises from the idea that increased species numbers are interpreted as success, however, no information relating to habitat conditions is provided (Weir, 2018). Adler et al. (2018) confirm this, finding that 67 per cent of the organisations did not report on habitats affected by their operations. Gray and Milne (2018) suggest that this is a result of the failure to report the root causes of extinction, namely human activity. Atkins and Maroun (2018) developed a disclosure framework from existing reporting frameworks (GRI and IRF) which can be used to account for extinction. The framework incorporates a value (deprival value) for species loss to show the impact on business so that profit organisations have an economic reason for preventing extinction (Atkins & Maroun, 2018). The framework uses a narrative approach with disclosures exceeding the minimum requirements of reporting frameworks, requiring the organisation to

consider information as deep as the ecosystem level (Atkins & Maroun, 2018). The aim of the framework is for organisations to care about biodiversity loss, introduce extinction prevention plans and report more comprehensive information (Atkins & Maroun, 2018).

RQ2.6: Is there an association between the level of biodiversity, ecological and extinction reporting and whether the company has disclosed the importance of biodiversity?

4. METHODOLOGY

The study is grounded in an interpretive approach to collecting and analysing data (Baker & Bettner, 1997). A mixed-methods approach was adopted according to a two-stage process to address RQ1 and RQ2. The first stage includes qualitative content and thematic analysis to evaluate what companies disclose in their integrated reports and to gauge the level of biodiversity, ecological and extinction reporting (Section 4.2 RQ1). The second stage (Section 4.2 RQ2) involves using quantitative methods to test for associations between identified determinants and the levels of biodiversity, ecological and extinction reporting.

4.1. Sample

The study is based on 50 Top JSE-listed companies by market capitalisation (as at 09/06/2021). The research examined the primary reports issued to stakeholders over the three years from 2018 to 2020. Separate sustainability reports, ESG checklists, interim results, investor presentations and companies' webpages were not included in the analysis[8]. The largest listed companies are included in this study to control for the possibility that a lack of resources or technical expertise, lack of financial analyst following or a lack of experience in applying the IRF may impact the report quality (Malola & Maroun, 2019; IIRC, 2021).

South African companies are selected because the country has a well-developed reporting environment (IOD, 2016; Maroun et al., 2014) and is one of the most biologically diverse countries in the world (The South African National Biodiversity Institute (SANBI), 2014). Additionally, South African listed companies are required to produce annual integrated reports or provide reasons for not doing so (JSE, 2019).

The relatively small sample is consistent with the fact that the objective of this study is not to extrapolate findings but to explore the level of biodiversity, ecological and extinction reporting in integrated reports of South African listed entities for a defined period. It is also comparable to similar studies (Adler et al., 2018; Grabsch et al., 2012; Mansoor & Maroun, 2016; Usher & Maroun, 2018; van Liempd & Busch, 2013).

[8] Integrated reports are the main form of communication with stakeholders (IIRC, 2021) and other forms of information might not represent a true reflection of the company's biodiversity views (Guthrie & Parker, 1989).

4.2. Data collection and analysis

The approach followed to collect and analyse data for the two research questions in this thesis is discussed in detail below.

Research question 1

Following a similar approach in previous studies (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Usher & Maroun, 2018), thematic content analysis is used to collect data to address RQ1. Content analysis was used because of its suitability for dealing with material that is not consistently formatted while highlighting trends and investigating both text and graphic disclosures (Krippendorff, 2013).

This thesis used a multiphase approach to collect and analyse data. Each report for each entity and financial year under review was broken down into key sections based on their content tables to gain a sense of content and structure (Malola & Maroun, 2019). Each section was further disaggregated into individual paragraphs which serve as the unit of analysis to avoid overlooking context and misinterpreting content. Any identified disclosures were coded and grouped according to the indicators outlined in the disclosure checklist (Table 7) (refer to Section 2.4 for a discussion of the checklist's construction). To ensure the complete collection of biodiversity, ecological and extinction related disclosures, keywords[9] were also searched to identify all disclosures.

The disclosures were then scored and recorded in a frequency table (according to one or more disclosure themes). All 81 items on the disclosure checklist have a score threshold of 0 to 3, resulting in a total potential score of 243 (81 x 3) per company per year. All repeat disclosures were counted and scored, however, only the highest score per disclosure item (Table 7) is used toward the total disclosure score per company. The scoring was adapted from Adler et al. (2018, p. 797) and Hassan et al. (2020, p. 6):

> 'A score of "0" was awarded for no disclosure at all. A score of "1" was awarded when the disclosure relating to a particular item was minimal, vague, and/or completely general. A score of "2" was awarded when disclosures contained objective, verifiable, and current data. A score of "3" was awarded when disclosure included all the ingredients of code "2," as well as providing specific information identifying the site/operating facility, affected species, and/or number of affected flora/fauna; a description of specific measures taken and/or amount of money spent; a discussion of trend information; and/or a linking of the data presented to a company strategy, aim performance measure, target, incident, or accident.'

[9] The primary words are: "Extinct," "extinction," "protection," "preservation," "wildlife," habitat," "species," "biodiversity," "forest," "ecosystem," "flora," "fauna," "endangered," "threatened," "vulnerable," "rehabilitation," "conservation," "marine," "ecology," "SDG," "ocean," and "IUCN."

An example of a disclosure which was scored a “1” is:

> ‘Our key environmental focus areas include ... water, waste, green building, biodiversity and disclosure. In each of these focus areas, we aim to understand our impact, create awareness and influence the right behaviours among our suppliers, employees and tenant base’ (Company 36 Integrated Report, 2020).

The disclosure only received a score of “1” as the information is vague and does not provide any details about how the company will understand its environmental impact or how the company will create environmental awareness.

The following two examples were scored a “2”:

> ‘Manage 83,402 hectares of land and 2,500 hectares are set aside for biodiversity offsets. Integrate mine closure planning with land rehabilitation, promoting biodiversity and conservation, and using our non-operational land to benefit the mine and surrounding communities’ (Company 21 Integrated Report, 2020).

> ‘… carbon neutral status: Planted 46 001 trees over 11 years offsetting almost 17 000 tons of CO2’ (Company 11 Integrated Report, 2019).

These two disclosures received a score of “2” as they provided specific biodiversity-related information which can be verified (land set aside for biodiversity offsets and trees planted). The reason why the disclosures did not receive a score of “3” is that they still lacked information on specific sites, habitats or species. For example, the first disclosure mentions that 2 500 hectares of land have been set aside for biodiversity offsets but there is no information about where this land is, what habitats are found on the land, nor the species affected by such biodiversity offsets. Similarly, the second disclosure mentions the specific number of trees planted but fails to state how many trees were planted in the current year, where the trees were planted, or what kind of trees were planted.

To contrast the difference between a disclosure score of “2” and “3”, an example of a score ”3” disclosure is provided below. Although the disclosure does not mention specific sites or species, it still achieved a score of “3” as the company describes the specific measures taken to help preserve and conserve biodiversity. The company also provides the ethical rationale behind taking the respective measures.

> ‘Protecting biodiversity is paramount… To ensure the wellbeing of our stakeholders, we understand that a healthy natural environment is critical. We conduct due diligence assessments … to ensure that we do not harm any vulnerable species or sensitive ecological systems on land we have earmarked for development. We also replace impermeable surfaces, bare ground and weed-infested areas with endemic plants, which have naturally adapted to the local environment, to ensure that our landscaping contributes positively to the preservation of biodiversity’ (Company 36 Integrated Report, 2020).

The codified data are presented using frequency tables and graphical plots to depict the level of biodiversity disclosures by the companies in each of the relevant years (Leedy & Ormrod, 2021). The number and percentage of biodiversity disclosures are categorised according to each theme (Table 7) and subsequently analysed for trends or patterns using descriptive statistics and graphical plots (Samkin et al., 2014). To further illustrate how biodiversity, ecological and extinction reporting is operationalised by companies, the thesis takes an approach similar to Adler et al. (2018) and Maroun and Atkins (2018) by providing specific examples of disclosures. These examples are analysed interpretively to highlight how the themes are operationalised by the sample of companies.

Descriptive statistics are applied to the data using methods such as the min, max, mean and standard deviation (Leedy & Ormrod, 2021). This is in keeping with the interpretive nature of the study and the small sample sizes which negate the use of inferential statistics (Grabsch et al., 2012; Mansoor & Maroun, 2016; Usher & Maroun, 2018).

Research question 2

The results of RQ1 are further analysed to address RQ2. The data generated from the coding process is classified as ordinal data (Leedy & Ormrod, 2021). The data is not normally distributed. Further analyses, therefore, entail the use of non-parametric tests to provide additional insights.

A Spearman correlation test is performed to evaluate possible correlations and interconnections between the biodiversity, ecological and extinction disclosure levels and the disclosure themes/grouping variables. The Spearman correlation test was run using all variables in Table 8. Kruskal-Wallis H, Jonckheere-Terpstra (JT) and Mann-Whittney U tests are also used to determine if biodiversity, ecological and extinction disclosure scores vary with the level of the grouping/independent variable (see Table 8) and the sign of any associations. The grouping variables are outlined in Table 8. The total aggregate disclosure score, number of disclosures and the total disclosure score per theme will serve as the dependent variables. Each will be considered separately.

Table 8: *Summary of variables to be used in the statistical analysis*	
Grouping variables	
Variables	**Assessment**
Year	Disclosure scores are aggregated according to each separate year (2018, 2019 and 2020).
Industry	Entities are assigned scores based on industry biodiversity risk: red zone (1); amber zone (2); green zone (3) (ranking according to F&C Asset Management (2004) and Adler et al. (2018)).
IR content element	Allocated according to organisational overview and external environment, governance, business model, risks and opportunities, strategy and resource allocation, performance, outlook and basis of preparation and presentation.
Size	Company size is measured by market capitalisation with companies grouped by quartile.
Primary or secondary listing on JSE	Entities are assigned a score of '1' for a primary listing and a '2' for a secondary listing.
Presence of a biodiversity partnership	Entities are assigned a score of '0' for no biodiversity partnerships and a score of '1' for the presence of a biodiversity partnership.
States the importance of biodiversity	Entities are assigned a score of '0' if they do not state why biodiversity is important and a score of '1' if they do state the importance of biodiversity.
Measures of the level of biodiversity disclosures	
Total biodiversity, ecological and extinction score per disclosure theme	Each of the disclosure items (see Table 7) has a score threshold of '0' to '3' (see Section 4.2). The highest score per disclosure item per company was aggregated to obtain a total disclosure score per disclosure theme for each company and year.
Total biodiversity, ecological and extinction score	The total disclosure score per theme (above) was aggregated to get a total aggregate disclosure score per company per year.
Number of disclosures	The number of biodiversity, ecological and extinction disclosures was counted for each company and year.

4.3. Validity and reliability of data

As this research follows a mixed methods approach, it must have validity and reliability in order for to provide legitimate results (Leedy and Ormrod, 2021). This is especially important as this research utilises a research instrument to collect and code the data (Leedy and Ormrod, 2021). This increases the risk that the construction of the research instrument is not complete nor accurate. The coding process is also inherently subjective, which further increases the need for validity and reliability. Reliability is the assurance that the research instrument will yield similar results when there has been no change in the item being assessed (Leedy and Ormrod, 2021). Validity is ensuring that the research findings are authentic and explanations are plausible (Lukka and Modell, 2010). The research instrument has validity if it measures what it is intending to measure (Lukka and Modell, 2010).

To ensure the validity and reliability of the data, the following steps have been taken:

- The disclosure checklist (Table 7) has been interpretively developed using current reporting frameworks as well as prior literature. To ensure accuracy and completeness, each of the elements included in the disclosure checklist has been grounded in the relevant prior research (Guthrie & Parker, 1989).
- The scores used in the coding have been adapted from two prior studies (Adler et al., 2018; Hassan et al., 2020). This reduces the possibility of inconsistencies with the prior literature and the effect of researcher bias.
- The research instrument was initially piloted with ten listed companies by the researcher to gain assurance with the process and resolve any uncertainties with the respective supervisor. The pilot sample was recorded by the researcher and a researcher assistant. This is to ensure that the coding is performed accurately and completely. The trial run resulted in the research instrument being changed through adding disclosure items that were identified as relevant while coding, combining disclosure items that were very similar to other disclosure items and adding the valuation disclosure theme. The pilot run also helped in determining which disclosures deserved a score of 2 or 3 allowing the coding of the final results to be more consistent.
- The instrument and preliminary results were accepted and presented at the Southern African Accounting Association conference held on 20 September 2021. The comments of the two anonymous reviewers and the conference participants were considered and applied before coding the final data for this thesis. The conference paper was subsequently published in the conference proceedings.
- The researcher acknowledges that the coding process followed is inherently subjective. The use of keywords (informed by prior literature and developed during the coding of data) reduces the risk of missing relevant disclosures. Total scores are compared to prior studies to assess the reasonableness of the coding process.
- Because of to the data being measured on an ordinal scale, non-parametric testing is applied. The results are generated using the frequency of the disclosures and the disclosure scores considered separately. As a sensitivity test, grouping variables are re-assessed where applicable. For example, the correlation test was reperformed using a Kendall's tau-b to ensure that the correlations identified during the Spearman's rho correlation test are reasonable (see Section 5.2). Where applicable, results are correlated using independent t-tests (parametric equivalents of the Mann Whitney U-tests) with a reduced alpha value to control for Type 1 errors[10].

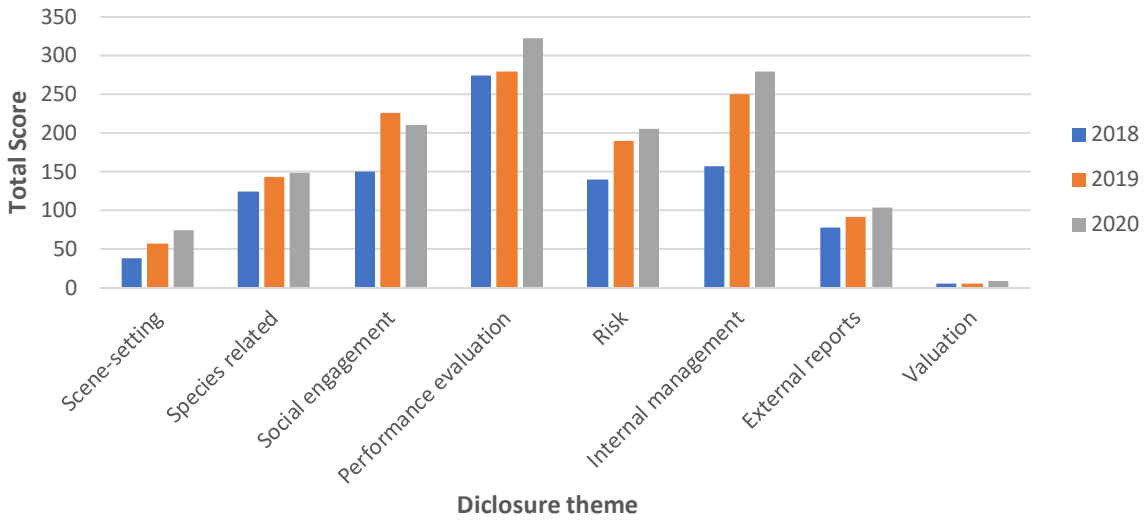
[10] A type 1 error refers to concluding that results are statistically significant when they came about purely by chance or unrelated factors.

5. RESULTS

5.1. Research question 1: Levels of biodiversity, ecological and extinction accounting

The total biodiversity, ecology and extinction disclosure scores per theme for the three years under review are presented in Figure 2.

Figure 2: *Total disclosure score per theme*



In total, there was a disclosure score of 1354 in 2020 compared to 969 in 2018. This represents a 40 per cent increase. The total disclosure score (Figure 2), as well as the average disclosure score (Table 9 below), increased for scene-setting, species related, performance evaluation, risk, internal management and external reports from in each subsequent year. The total and average disclosure score for the valuation theme did not change materially from 2018 to 2019 but subsequently increased in 2020. The total and average disclosure score for social engagements increased from 2018 to 2019 but subsequently decreased in 2020. This could be explained by the impact of Covid-19 on businesses (Atkins et al., 2020). The Covid-19 pandemic and the respective lockdowns may have prevented companies from actively engaging with stakeholders and working with NGOs or other biodiversity partners. A positive result was that several companies disclosed how the Covid-19 pandemic contributed to the company negatively impacting biodiversity. An example is a disclosure by Company 22 that highlights the effect that Covid-19 had on the water use (an ecosystem service) of the company:

> 'Total water consumption increased by 9.3% this year due to the impact of COVID-19, however, the extent of the impact was mitigated by best practices implemented across the Group' (Company 22 Integrated Report, 2020).

Table 9 presents the descriptive statistics using the total disclosure score per theme across the years 2018 to 2020.

Table 9: ***Descriptive statistics per disclosure theme***

Theme	2018				2019				2020			
	Min	Max	Mean	SD*	Min	Max	Mean	SD*	Min	Max	Mean	SD*
Scene-setting	0	5	1	1,48	0	7	1	1,60	0	12	2	2,49
Species related	0	27	3	5,23	0	20	3	4,27	0	18	3	4,31
Social engagement	0	20	3	5,23	0	23	5	6,25	0	21	4	5,71
Performance evaluation	0	21	5	4,81	0	18	6	4,63	0	18	6	4,81
Risk	0	20	3	4,36	0	20	4	4,84	0	21	4	5,16
Internal management	0	16	3	4,19	0	16	5	4,38	0	19	6	5,23
External reports	0	5	2	1,31	0	6	2	1,24	0	6	2	1,43
Valuation	0	2	0	0,36	0	3	0	0,51	0	3	0	0,63
Number of disclosures	1	17	5	3,72	1	17	6	3,96	1	24	7	4,66

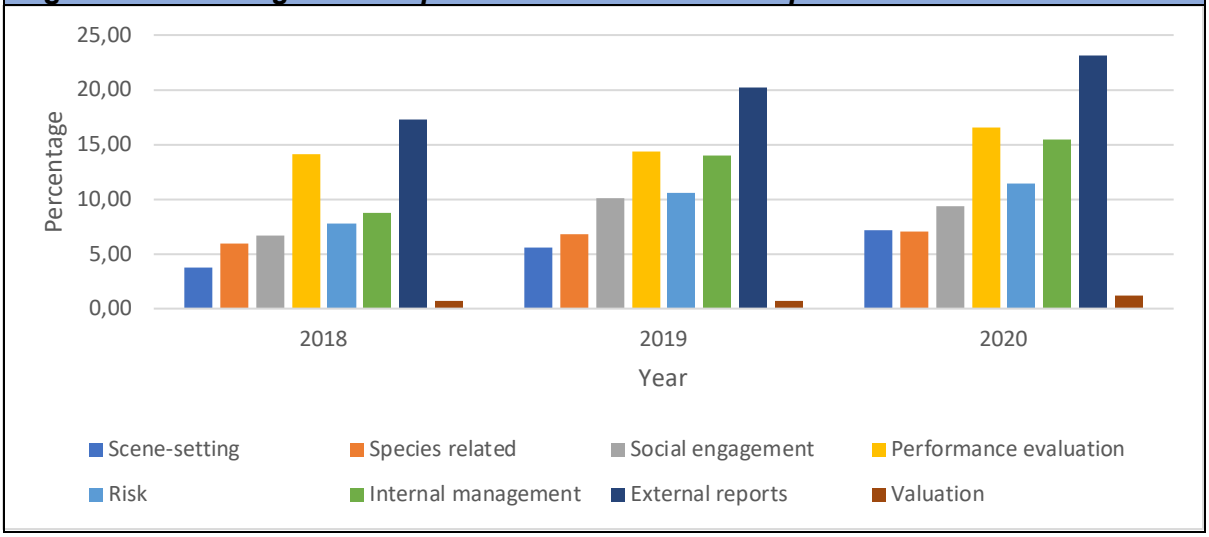
*Standard deviation

The results show that the maximum number of disclosures by a single company was 17 in both 2018 and 2019. The average number of disclosures across all companies, however, increased from 5 in 2018 to 6 in 2019. The maximum number of disclosures by a single company in 2020 was 24, which is an increase of 7 disclosures from 2019. Similarly, the average number of disclosures across all companies increased from 6 in 2019 to 7 in 2020. This represents a 40 per cent increase across the three years.

The overall increase in biodiversity, ecological and extinction reporting suggests that, as a whole, companies are realising the importance of biodiversity, ecological and extinction issues. Despite the general increase in disclosure scores, biodiversity, ecological and extinction reporting is still poor. All the themes had at least one company which did not disclose anything for the respective disclosure items in the theme. The results are consistent with prior studies which found that there was an increase in reporting but the level of biodiversity, ecological and extinction reporting was still poor (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Rimmel & Jonäll, 2013; Usher & Maroun, 2018; van Liempd & Busch, 2013).

Each disclosure theme comprises a different number of disclosure items, so the disclosure score per theme in Figure 2 may be distorted. Figure 3 shows the total disclosure score per theme as a percentage of the total possible score which could have been achieved per theme. This is a better reflection of the best-disclosed themes. The trends are similar to those seen in Figure 2.

Figure 3: *Percentage of total possible disclosure score per theme*



In 2020, the external reports theme had the highest percentage (23 per cent) which suggests that companies are making it evident to stakeholders that they are using the relevant reporting frameworks (external reports). External reports was the best-disclosed theme since almost all companies had at least one relevant disclosure. The level of detail of the disclosures, however, was low. The majority of the companies merely stated that they apply a relevant reporting framework (for example integrated reporting or the GRI standards) without any further details on how the frameworks are being applied. An example of a low detail external reports disclosure is:

> '… prepared the 2018 report (these chapters and website) using the Global Reporting Initiative's (GRI) Standards as a guide' (Company 1 Integrated Report, 2018).

This disclosure is very vague as the GRI has different standards which provide reporting guidelines across a range of sustainability topics. The company has not mentioned which GRI standards have been used and in what capacity the reporting guidelines have been used. Only stating that the company uses the GRI standards without further information does not allow stakeholders to assess accurately whether the company is using the biodiversity specific GRI standard to address and report all relevant biodiversity information.

To highlight the level of vague external reports disclosures, only two of the fifty companies (4 per cent) provided specific details on how they are applying the relevant frameworks. One example of a highly detailed disclosure, which was scored a "3" is:

> 'Our Biodiversity Conservation Practice guideline ensures that we integrate biodiversity conservation into all aspects of mine life … we subscribe to the International Council on Mining & Metals (ICMM) Position Statement on Mining and Protected Areas, which includes a commitment to respect protected areas and an undertaking not to explore or mine in World Heritage listed sites. Biodiversity considerations are incorporated into our integrated mine closure and progressive rehabilitation processes. Two examples indicating our commitment to biodiversity are…' (Company 16 Integrated Report, 2018).

This disclosure is valuable as the company not only mentions which guidelines are used (ICMM) and the general purpose of the guidelines but the company also states the reason for using the guidelines (to integrate biodiversity conservation into all the business). The company goes further to provide two examples (the respective examples were excluded from the disclosure for this thesis) of how the company is integrating biodiversity into the business, to illustrate the company's use of the guidelines. The detailed nature of the disclosure gives stakeholders confidence that biodiversity-specific issues are being addressed and reported by this company.

External reports were followed by performance evaluation (17 per cent) and internal management (16 per cent) as the best-disclosed themes. Although performance evaluation and internal management are two of the best-disclosed themes, only 6 of the 50 companies (12 per cent) provided any disclosure on incidents/accidents which negatively impacted biodiversity. This low percentage of negative impact disclosures suggests that most of the disclosures were biased and focused mainly on positive examples. Below is an example of a performance evaluation disclosure focused on positive information without any mention of the extent of the damage caused to the mined land.

> '… aims to return mined land to agricultural use, and support the re-establishment of native plant species using the latest reclamation methods. Growing Together started with employees from both companies working together to plant more than 4,000 trees at Dawson mine in March 2020 … They were joined by around 40 students from three local schools and Traditional Owners … planted various native eucalyptus species across a 90-hectare site where mining activities have ceased ... included a pilot of biodegradable COCOON® planting technology … which uses tree incubators made from wax-reinforced recycled carton, reduces the need for irrigation, requires 100 times less water than traditional methods, and has the potential to raise tree survival rates to at least 90%' (Company 5 Integrated Report, 2020).

The disclosure mentions that the company is trying to return the mined land to a suitable condition for agricultural use. This alludes to the fact that the land was previously damaged to the extent that plants could no longer grow there. The actual extent of damage and the resulting consequences have not been disclosed. The disclosure then provides a detailed account of the land rehabilitation efforts of the company. Overall, this is an example of a substantive disclosure with good and bad elements. The level in detail of the disclosure is an indication that the company takes biodiversity conservation seriously. The lack of detail regarding the negative impacts, however, may be an attempt by the company to manage impressions and avoid additional scrutiny by stakeholders (Van Zijl et al., 2017). Without detailed information on the damage caused to the land, stakeholders cannot assess if the rehabilitation actions taken by the company are sufficient. This might give stakeholders the false impression that all the negative impacts on biodiversity are sufficiently managed and corrected by the company.

In contrast, an example of an objective disclosure which mentions an incident (with a negative impact on biodiversity) as well as the company's response to the incident is:

> 'The incident was caused by an overflow of tailings slurry from the processing plant containing elevated levels of cyanide. This caused the death of four birds in a stagnant tailings pool within the plant area and the death of a cow outside the plant fence adjacent to the pool. Remedial actions were immediately put in place to deal with the incident. The tailings overflow was stopped, the pool was detoxified, the tails were pumped back into the plant, contaminated soil was removed and the faulty equipment replaced' (Company 4 Integrated Report, 2018).

The disclosure includes the incident which caused the biodiversity damage as well as the exact nature of the biodiversity damage (contamination of land, pollution of water and the death of four birds and a cow). The disclosure then provides details of the company's response to the incident and the actions taken to limit future damage. The disclosure makes it possible for stakeholders to evaluate whether the company's response is suitable for the extent of the damage caused. If stakeholders believe that the response is insufficient, they can place increased pressure on the company to do more. The disclosure shows that it is possible for companies to provide a detailed account of biodiversity or ecological damage and how this is being managed, in a manner which is conducive to the overall protection and conservation of biodiversity.

Additional evidence of the positive nature of biodiversity, ecological and extinction disclosures is that only 3 of the 50 companies (6 per cent) provided any sort of disclosure relating to specific fines/penalties linked to biodiversity loss or damage. Although a few companies

reported on fines related to biodiversity damage, the disclosures lacked detail and were still somewhat biased. For example, Company 5 disclosed details related to a fine but did not provide any additional details.

> 'In 2018, we recorded one Level 4 … and five Level 3 … environmental incidents … related to two separate pipeline spills that occurred at the Minas-Rio iron ore operation … The incidents at Minas-Rio resulted in fines being issued amounting to $50 million, some of which are being challenged, and the loss of 280 production days' (Company 5 Integrated Report, 2018).

The disclosure mentions that the company was fined $50 million for two environmental incidents. The disclosure, however, does not mention (1) the exact details of the spills, (2) what environmental damage was caused, (3) the actions taken by the company in response to the spills and (4) the specific reasons for the fine. The lack of detailed information, together with $50 million being a substantial amount (which suggests that the environmental damage caused was significant), may indicate that the company does not consider the prevention/correction of biodiversity damage as strategically important. The researcher does, however, acknowledge that as some of the fines were still under dispute the company may not have disclosed the specific detail as it could have legal ramifications and impact the outcome of the legal challenge.

The valuation theme reflected the lowest percentage (1 per cent)[11] followed by species-related and scene-setting (7 per cent). These results differ from prior studies which found that scene-setting and social engagement were disclosed most with performance evaluation, risk and internal management disclosed least. A promising result is that the percentage for all themes (except social engagements) increased over the three years. Social engagements increased from 2018 to 2019 but subsequently decreased in 2020. As discussed earlier, this may be attributable to the Covid-19 pandemic.

The total possible disclosure score percentage for the themes is relatively low, suggesting that the actual detail of the disclosures is lacking. All of the themes had a percentage below 25 per cent, which supports the results in Figure 2 and Table 9 that the level of biodiversity, ecological and extinction disclosures is poor. The results are consistent with prior studies and may suggest that disclosures are being used to manage impressions (Adler et al., 2018; Fialho et al., 2021; Grabsch et al., 2012; Irshad et al., 2021;van Liempd & Busch, 2013).

[11] Only 4 of the 50 companies provided a disclosure relevant to the valuation theme.

A surprising result is a low level of reporting for the scene-setting disclosure theme which is one of the worst-disclosed themes (see also Figure 2 and Table 9). Prior studies found scene-setting to be one of the better-disclosed themes (Grabsch et al., 2012; Mansoor & Maroun, 2016; van Liempd & Busch, 2013). The contrast in results is worrying as it may suggest that companies are reporting biodiversity, ecological and extinction information without actually knowing what they are reporting nor its importance. This is surprising given the mounting scientific evidence of the importance of biodiversity and ecosystems to both humans and businesses (CBD, 2006; Earthwatch Institute, 2002; Hassan et al., 2020; Jones, 2014; TEEB, 2008). Most of the scene-setting disclosures consisted of generic statements which only mention the word 'biodiversity' with no further details on the importance of biodiversity for the company or the company's approach to dealing with biodiversity, ecological and extinction issues. In addition, not a single company defined biodiversity or its related terms. An example of one such generic disclosure is:

> 'To be environmentally responsible, to mitigate and limit the impact on the environment of our mining activities and where possible to protect, restore and rehabilitate the land and biodiversity. We aim to reduce carbon emissions and related intensities, and to minimise water withdrawal' (Company 4 Integrated Report, 2020).

The company discloses that they will protect, restore and rehabilitate land and biodiversity but fail to state why land and biodiversity is important and needs to be protected and restored. By failing to state this information, it is uncertain whether the company understands the need to protect and restore biodiversity or if the company is only treating it as a disclosure exercise. The company does not mention how they will approach their aim of restoring and rehabilitating land and biodiversity so stakeholders will be unable to determine if the company has a suitable and effective approach to dealing with biodiversity issues. If stakeholders are unaware that the current approach is not effective, they will not place pressure on the company to improve the biodiversity practices.

There were, however, some companies which had a high level of scene-setting disclosures (see also Figure 4). In contrast to the above disclosure, below is an example of an excellent scene-setting disclosure which highlights the company's approach to managing biodiversity:

> '… is committed to driving a net gain in biodiversity through specialist assessment of the biotic and abiotic resources, driving clear, implementable, scientifically based action plans to drive resilience of ecosystems and integrated catchment management programmes. Our approach to responsible biodiversity management advocates for the minimal degradation of natural habitats, a net gain of biodiversity for existing operations and no net loss for new projects as well as the protection of species on land and in water…' (Company 43 Integrated Report, 2020).

What makes this disclosure better than the last is that the company provides a much higher level of detail. The previous disclosure mentioned the general biodiversity goal of the company (protect, restore and rehabilitate land and biodiversity), whereas this disclosure mentions specific biodiversity goals the company wishes to achieve (minimal degradation of habitats, a net biodiversity gain and the protection of species on land and in water). The more specific biodiversity goals indicate that the respective company has a better understanding of the biodiversity loss crisis and how the company can realistically contribute to its prevention. The disclosure also provides the specific manner in which the company will approach the goal of a net biodiversity gain. Having clear and achievable goals, together with a plan to achieve the goals, suggests that the company includes biodiversity, ecological and extinction information into decision-making processes. This is a vital step in the effort to protect and conserve biodiversity, as it is difficult for a company to improve its biodiversity performance without any consideration of such information (Adams & Frost, 2008; Adler et al., 2018; Atkins et al., 2017; Jones & Solomon, 2013).

To provide additional insights, changes in disclosure theme scores over time are tested using non-parametric Kruskal Wallis H-tests supported by a Jonckheere-Terpstra post-hoc test. Refer to Table 10.

Table 10: ***Results of non-parametric tests – year grouping variable***

Kruskal-Wallis test										
	Scene setting	Species related	Social engagement	Performance evaluation	Risk	Internal management	External reports	Valuation	Number of disclosures	Total Score
Kruskal-Wallis H	2,352	2,090	3,319	1,436	3,379	9,104	7,066	0,783	7,702	4,968
P-value (2-tailed)	0,308	0,352	0,190	0,488	0,185	0,011*	0,029*	0,676	0,021*	0,083
Jonckheere-Terpstra Testa										
Std. J-T Statistic	1,351	1,384	1,657	1,126	1,648	2,759	2,609	0,070	2,667	2,112
P-value. (2-tailed)	0,177	0,166	0,098	0,260	0,099	0,006**	0,009**	0,944	0,008**	0,035*
*Significant at the 5% level **Significant at the 1% level										

There is a statistically significant difference in the number of disclosures from 2018 to 2020 ($H=7.702$, $p<0.05$). A JT test showed that the number of disclosures increased from 2018 to 2020 ($JT=2.667$, $p<0,01$), with the total disclosure score also increasing from 2018 to 2020 ($JT=2.111$, $p<0,05$). As there was an insignificant difference in the total disclosure score across the years ($H=4.968$, $p>0.05$), this suggests that the total score increased due to the

number of disclosures increasing and not because the level of detail improved. There is also a statistically significant increase in the disclosure scores for internal management ($H=9.103$, $p<0.05$; $JT=2.758$, $p<0.01$) and external reports ($H=7.065$, $p<0.05$; $JT=2.608$, $p<0.01$) from 2018 to 2020. The internal management average disclosure score increased by 78 per cent from 2018 to 2020 (see Table 9), suggesting that the level of detail of such disclosures increased over the years. An example of an internal management disclosure which improved in detail from 2018 to 2019 is:

> '…our operations and the local community are experiencing water quality deterioration as result of upstream contamination, deforestation and key ecosystems losses. To respond, our Bavaria unit is partnering with TNC on a new local water fund to promote sustainable mining and agriculture… the German Ministry for the Environment awarded us a grant to scale up conservation efforts and protect the wetland, which serves as the source of water for the brewery and over two million people' (Company 1 Integrated Report, 2018).

This disclosure shows that in 2018, the company describes its general response to the water deterioration issue, which includes promoting sustainable mining and agricultural practices and scaling up the conservation of a wetland. The disclosure does not provide meaningful information on what wetland conservation efforts are and how the company's biodiversity partnership will promote sustainable mining and agricultural practices. The 2019 disclosure (below) provides a greater level of detail, as the company now states the manner in which they are protecting the wetland (through every bottle sold) and the results of their efforts (2.3 million square meters have been protected). Possible reasons for the increased level of detail can include increased pressure from stakeholders on the company to report more information or the company, itself, could have realised the need to report more detailed information.

> 'In Colombia, 70% of all drinking water comes from the páramos (wetland) ecosystems. To help protect these valuable spaces, we launched the water brand Zalva in October, with the promise to protect a square meter of wetland for every bottle purchased. To date, 2.3 million bottles have been sold, protecting 2.3 million square meters of natural land and resources' (Company 1 Integrated Report, 2019).

Next, the disclosures are analysed by company. Refer to Figure 4.

Figure 4: *Total disclosure score per company*

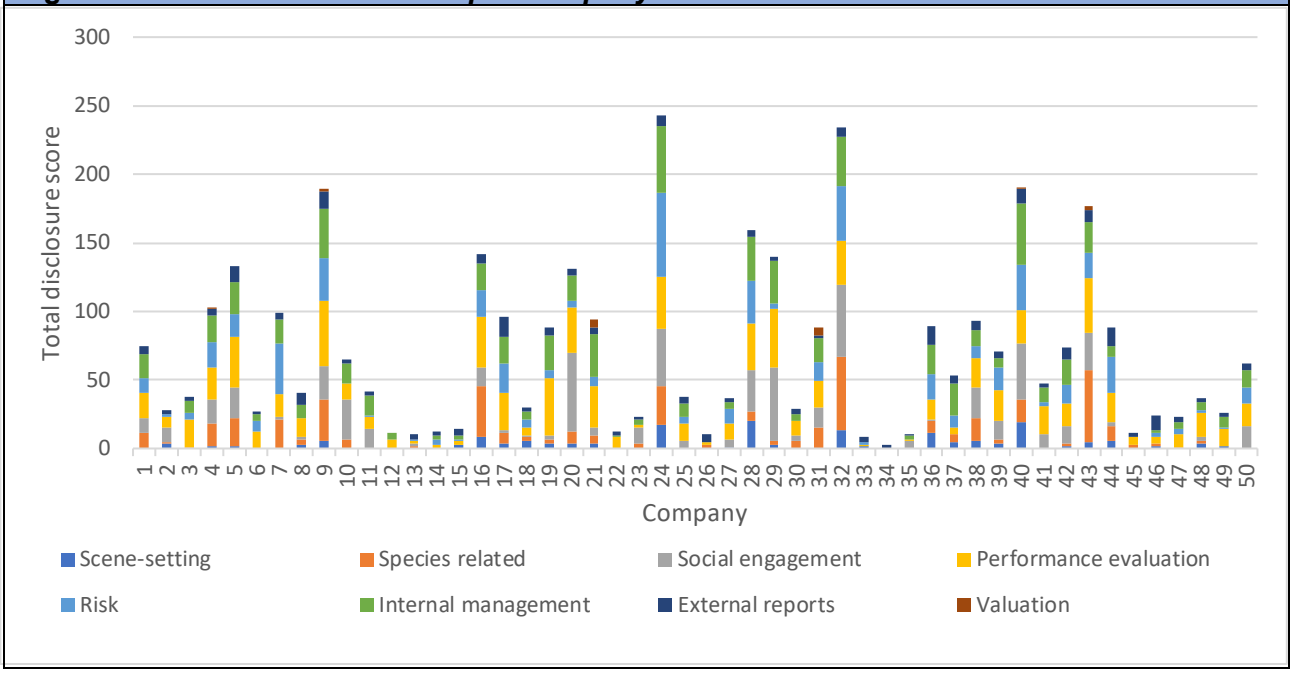


Figure 4 shows that Company 24 has the highest disclosure score (243) followed by Company 32 (234) and Company 40 (190). Among the lowest scoring were Company 34 (3), Company 33 (8) and Companies 13, 26 and 35 (10). Overall, the biodiversity, ecological and extinction reporting was poor considering the highest a company could score was 729 (243 x 3) over the three years. The results show that even among the highest-scoring companies, there was a lack of consistent reporting across all the disclosure themes. The disclosure themes that contribute the most to the total score are internal management, performance evaluation and risk. This is consistent with Figure 2 and Table 9 which show that these are the themes with the higher average scores.

It was noted that despite the risk theme contributing a significant portion to the total disclosure score per company, the actual level of detail of the risk disclosures was poor. This suggests that companies provide many risk disclosures but the disclosures are vague or generic, resulting in many disclosures receiving a score of "1". The concern is whether the companies truly understand the risk that they pose to biodiversity and the risk that biodiversity loss poses to the company itself. Majority of the companies failed to link how biodiversity loss is a risk to their business but rather stated how biodiversity loss is a risk in general. For example:

> 'Environmental risks dominate both the short-term and long-term risk outlooks of the 2020 World Economic Forum Global Risk Report, which cites biodiversity loss, climate action failure, extreme weather, human-made environmental disaster, natural disasters and water crises. These, in turn, will continue to have a knock-on impact on economies, productivity, property, infrastructure, food security, health and sustainable human settlements' (Company 2 Integrated Report, 2019).

The disclosure discusses how biodiversity loss is a type of environmental risk faced by companies. This type of disclosure indicates that the respective companies, firstly, do not understand the impact of biodiversity loss on their business and, secondly, do not understand the risk that they pose to future biodiversity loss. This lack of understanding is of concern as these companies fail to develop suitable and effective approaches to dealing with biodiversity, ecological and extinction matters. Figure 4 confirms this as the companies with a low risk disclosure score also had a low score for the internal management disclosure theme.

Some companies, however, did take an ecology-centred approach (Cuckston, 2017) and state how the company and their activities are a risk to further biodiversity loss. Unfortunately, most of these disclosures were also generic and did not explain exactly how the company's activities can contribute to further biodiversity loss. Below is an example in which the disclosure did mention a specific risk to biodiversity (soil contamination risk) but failed to explain how the risk arose and what exactly the risk entails. On a positive note, the disclosure did mention (very vaguely) that the company would perform remediation activities to address the risk.

> 'The soil contamination risk at the Boxtel site has been reassessed by an independent expert during the year with a significant reduction in the risk being the outcome. Minor remediation activities will be performed over the next year to address the residual risk remaining' (Company 7 Integrated Report, 2019).

Figure 4 also shows that social engagement disclosures contributed significantly to the overall score of companies which included social engagement disclosures. These companies also had generally higher biodiversity, ecological and extinction scores (see also Research Question 2.5 in Section 5.2). Interestingly, social engagement was one of the least disclosed themes, suggesting that when social engagement disclosures are present, they are generally very detailed. This is consistent with the results in Table 9 since the social engagement disclosures had the highest standard deviation (the most variation) in all three years. This suggests that companies either had very low social engagement disclosure scores (no disclosures) or very high social engagement disclosure scores (very detailed disclosures). To highlight the level of detail found in many social engagement disclosures, an example of an excellent disclosure is provided below.

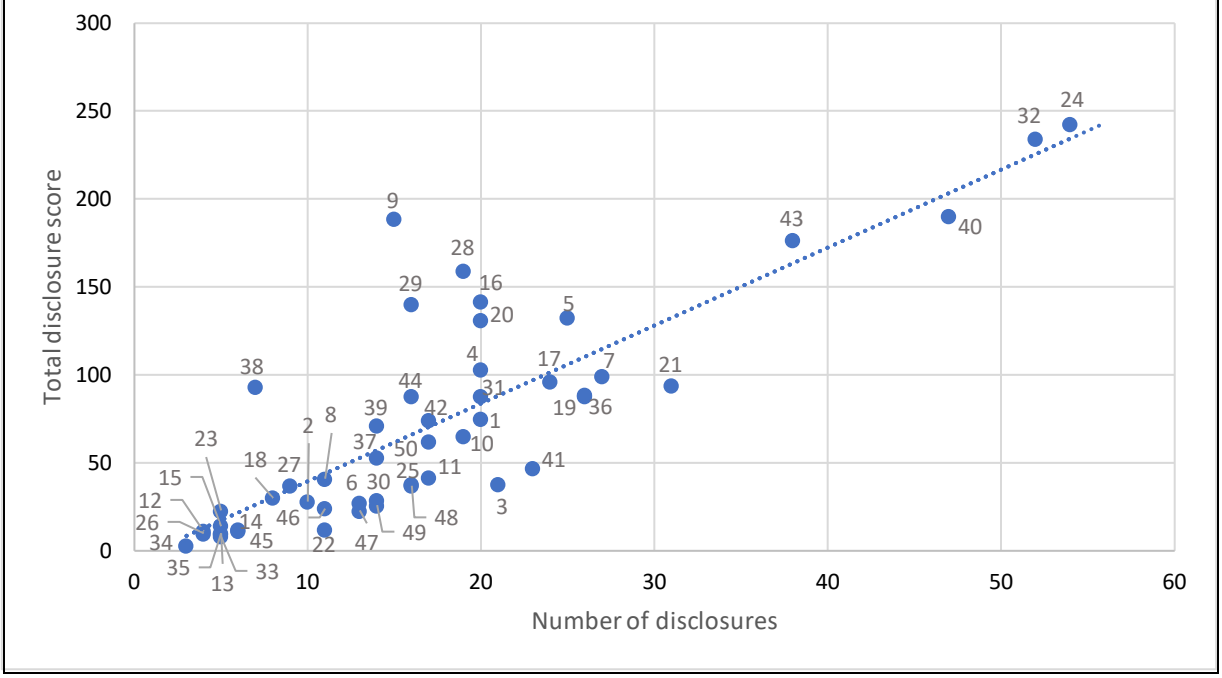
> 'Our Alien Vegetation Removal Programme at our mills in KwaZulu-Natal province in collaboration with the non-governmental organisation WESSA (Wildlife and Environmental Society of SA) … It involves the removal of alien vegetation on the land surrounding our mills … as weeds have been identified as one of the biggest threats to biodiversity. A total of 20 community members per mill are being trained and employed through the programme, with the goal of establishing viable businesses which would ultimately serve other customers' (Company 40 Integrated Report, 2018).

This disclosure is excellent as the company (1) mentioned the organisation with which the company has a partnership, (2) what this partnership entailed (removal of alien vegetation), the need for the partnership (weeds are a major threat to biodiversity and (4) the outcomes of such partnership (20 community members per mill are being employed and trained to perform the duties). Not all social engagement disclosures by companies achieved the same level of detail. The relevant disclosures, however, were neither vague nor generic, resulting in companies still scoring high in the social engagements theme. Such companies still discussed the specific social engagements they had and the objectives/outcomes of such engagements. For example, Company 10 provided a disclosure that mentions (1) that the company had a social enjoyment project with the community, (2) the reason for the project (to promote the importance of pollinators), (3) the project is for the benefit of a specific vulnerable species (the honeybee) and (4) the actions taken by the company to support the project.

> 'Follow the … Bee continues to create a buzz amongst schools and employees, as we promote the importance of our valuable pollinators … depots support local beekeepers across the country by regularly donating sugar to keep their bees thriving, creating bee-friendly gardens at the depots, as well as sponsoring or hosting local beehives' (Company 10 Integrated Report, 2019).

Figure 5 shows the total disclosure score compared to the number of disclosures per company. These results complement Figure 4.

Figure 5: *Total disclosure score and number of disclosures per company*



The highest scoring company (24) also had the highest number of disclosures. Similarly, the second and third highest scoring companies (32 and 40 respectively) had the second and third highest number of disclosures. This suggests that the total score is correlated with the number of disclosures. This is confirmed by the results in Table 12 (below). The total disclosure score has a strong positive correlation with the number of disclosures ($r=0.826$, $p<0.01$).

The total disclosure score and number of disclosures, however, do not have a perfect correlation. There are two possible reasons for this. First, companies provide many disclosures, but those disclosures were vague and generic. Resulting in a relatively low overall score. This can be seen with Company 21 which had the fifth greatest number of disclosures but achieved a far lower total score than some other companies with fewer disclosures. An example of a vague disclosure from Company 21 is provided below. The disclosure mentions that the company wants to achieve a net positive impact on biodiversity conservation. There are, however, no details provided on how the company plans to achieve a net positive impact nor is there any information on the goal for the current year.

> 'Our vision for carbon neutral mining by 2040: 50% reduction of freshwater use. 30% reduction in energy use and greenhouse gas (GHG) emissions (against 2016 baseline). Conservation of biodiversity by ensuring a net positive impact on conservation of biodiversity by 2030' (Company 21 Integrated Report, 2020).

Secondly, some companies provide many repeat disclosures within the same report, which are all counted but only the highest score per disclosure element (Table 7) is used toward the total score. Some companies even went so far as to repeat certain disclosures from 2018 to 2020. An example of a disclosure which was repeated is:

> '… recognises that many of its investments are dependent on a healthy and functioning ecosystem and that this system is increasingly under pressure from a quantity and quality perspective.… continuously analyses its impact on the environment, its response to changing environmental realities and the pursuit of new opportunities that might arise as a result of responsible environmental management' (Company 37 Integrated Report, 2018; 2019; 2020).

Discussion of results

There is a growing awareness of the biodiversity loss crisis and the subsequent threats to the survival of the planet, economy and the quality of human life (CBD, 2006; Earthwatch Institute, 2002; Hassan et al., 2020; Jones, 2014; TEEB, 2008; World Economic Forum, 2021). The result is that companies have both business and moral pressures to manage and report on

biodiversity, ecological and extinction information (Adler et al., 2018; van Liempd & Busch, 2013). It is believed that biodiversity, ecological and extinction reporting will influence organisations to not only take additional more effective actions to manage their biodiversity impact but will also inform stakeholders and enhance their understanding of human's role in biodiversity loss (Adler et al., 2018; Grabsch et al., 2012; Jones & Solomon, 2013; van Liempd and Busch, 2013). Stakeholders who are aware of biodiversity issues will avoid actions which contribute to biodiversity loss and will attempt to conserve biodiversity (Gaia & Jones, 2017). For example, many people are now conscious about their use of plastic because they are aware of the damage that plastic causes to the environment and biodiversity.

The results (Figure 2, Figure 3, Table 9 and Table 10) show that there is an overall increase in the level of biodiversity, ecological and extinction reporting of South African companies from 2018 to 2020. This is consistent with previous studies that also found a general increase in biodiversity reporting (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Rimmel & Jonäll, 2013; Usher & Maroun, 2018; van Liempd & Busch, 2013). This suggests that companies are aware of the biodiversity loss crisis and the need to report such information to stakeholders.

The results of the non-parametric tests (Table 10) show that there is a significant difference in the number of disclosures across the years but there was no significant difference in the total disclosure score across the years. This suggests that the overall increase in the level of biodiversity, ecological and extinction reporting is a result of an increase in the number of relevant disclosures rather than an increase in the quality of disclosures. This ultimately means that despite companies realising the importance of biodiversity, ecological and extinction issues, the reporting of such issues is still poor. This is consistent with previous studies which also found that biodiversity disclosures were limited, vague or generic (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Rimmel & Jonäll, 2013; Usher & Maroun, 2018; van Liempd & Busch, 2013).

The low level of biodiversity, ecological and extinction reporting has adverse effects on the greater effort to protect and conserve biodiversity. Firstly, the low level of detail in biodiversity, ecological and extinction disclosures can be interpreted as an indication that companies do not regard biodiversity, ecological and extinction issues as strategically relevant (Van Zijl et al., 2017). The strategic irrelevance of biodiversity, ecological and extinction issues, together with the low level of reporting, suggests that companies do not collect sufficient data on their biodiversity impacts (Adams & Frost, 2008; Van Zijl et al., 2017). While sufficient biodiversity, ecological and extinction data does not ensure that managers will incorporate biodiversity into

decisions, it can provide the basis for more informed decision-making (Adams & Frost, 2008; Cuckston, 2017). The inclusion of biodiversity, ecological and extinction information into decision-making processes is vital in the effort to conserve biodiversity, as it is difficult for a company to improve their biodiversity performance without any consideration of such information (Adams & Frost, 2008; Adler et al., 2018; Atkins et al., 2017; Jones & Solomon, 2013).

Secondly, the low level of biodiversity, ecological and extinction reporting limits the actions taken by stakeholders to protect and conserve biodiversity. Stakeholders who are not aware of their role in biodiversity loss will not avoid actions that contribute to biodiversity loss nor will they attempt to conserve biodiversity (Adler et al., 2018; Gaia & Jones, 2017; Grabsch et al., 2012; Jones & Solomon, 2013; van Liempd and Busch, 2013). For example, prior to the public education on the dangers of plastic use, many people did not limit their use of plastic as they were unaware of the damage plastic caused to the natural world. But following the education of the public, there has been a global effort to eliminate single use plastic. A related consequence of stakeholder unawareness is that companies maintain a relatively low level of disclosure in order to avoid additional attention and scrutiny from stakeholders (Irshad et al., 2021; Van Zijl et al., 2017). This additional attention will increase the pressure from stakeholders for the company not only to report increased levels of biodiversity, ecological and extinction reporting but to change their biodiversity practices (Van Zijl et al., 2017).

Not all the disclosure themes had a low level of biodiversity ecological and extinction reporting. Performance evaluation, internal management and social engagement disclosures all contained more detail (see Figure 2, Figure 3, Figure 4, Table 9 and Table 10). Although these disclosures were more detailed, the disclosures were biased, generally provided a historical review of performance and focused on positive information. This is consistent with the results of prior studies (Adler et al., 2018; Grabsch et al., 2012; van Liempd & Busch, 2013). The detailed and positive nature of such disclosures suggests that the disclosures are used to signal to stakeholders that the relevant risks are under control and have been incorporated into the relevant strategic considerations but, at the same time, avoiding additional attention and scrutiny from stakeholders (Van Zijl et al., 2017). It is accepted that the increased detail in certain disclosure themes could be explained by other factors, for example, business model, size or partnerships (these are considered in Section 5.2).

Additional evidence of possible impression management is that the external reports theme was the best-disclosed theme (Figure 3) but the actual level of detail for the disclosures was poor. The majority of the companies merely stated that they apply a relevant reporting

framework (for example integrated reporting or the GRI standards) without any further details on how the frameworks are being applied. This may be a form of impression management as companies are making it evident to stakeholders that they are using the relevant reporting frameworks (external reports) but without specific details on the application of such frameworks. Without such information, there is no guarantee that decision making and corporate reporting incorporate the frameworks (Atkins et al., 2017). Academics and stakeholders alike have raised this concern, as it has been noted that the frameworks are not being used to outline the relevance of biodiversity, ecological and extinction themes for business management, risk assessment and strategy development (Atkins et al., 2017; Van Zijl et al., 2017).

A surprising result was the poor performance in the scene-setting disclosure theme which was one of the worst-disclosed themes (see Figure 2, Figure 3, Figure 4, Table 9 and Table 10). The majority of scene-setting disclosures comprised of generic statements that only mention the word 'biodiversity' with no further details on the importance of biodiversity for the company nor the company's approach to dealing with biodiversity, ecological and extinction matters. This result is inconsistent with prior studies that found scene-setting to be one of the better-disclosed themes (Grabsch et al., 2012; Mansoor & Maroun, 2016; van Liempd & Busch, 2013). The low level of scene-setting disclosures is of concern as it may suggest that companies are reporting biodiversity, ecological and extinction information without actually knowing what they are reporting nor its importance. It may also be an additional indicator that companies do not regard biodiversity, ecological and extinction issues as strategically relevant (Van Zijl et al., 2017). This is surprising given the mounting scientific evidence of the importance of biodiversity and ecosystems to both humans and businesses (CBD, 2006; Earthwatch Institute, 2002; Hassan et al., 2020; Jones, 2014; TEEB, 2008). Understanding what biodiversity means to the organisation and how the company prioritises biodiversity, ecological and extinction matters is vital for: (1) the successful conservation and protection of biodiversity and (2) the company to make future profits without contributing to further biodiversity loss (Adler et al., 2018; Atkins & Maroun, 2018; Grabsch et al., 2012; Jones & Solomon, 2013; Van Zijl et al., 2017).

5.2. Research question 2: Reporting determinants

Table 11 presents the results of the non-parametric tests performed on possible determinants of ecological, biodiversity and extinction reporting. A Kruskal-Wallis test and a Jonckheere-Terpstra post-hoc test were used to test if there was a significant change in disclosure scores and number of disclosures when using industry (red, amber and green) market capitalisation (grouped into quartiles) and IR content element (organisational overview and external environment, governance, business model, risks and opportunities, strategy and resource allocation, performance, outlook and basis of preparation and presentation) as a grouping variable. In addition, a Mann-Whitney U-test, together with a Jonckheere-Terpstra post-hoc test, was performed to examine if there was a significant change in disclosure scores and number of disclosures when using listing (primary or secondary), biodiversity partnership (presence or no presence of a biodiversity partnership) and biodiversity importance (whether or not the company stated the importance of biodiversity) as grouping variables.

Table 11: *Results of non-parametric tests*												
	Industry		IR content element		Market capitalisation		Listing		Biodiversity partner		Biodiversity importance	
	H	JT	H	JT	H	JT	U	JT	U	JT	U	JT
Scene setting	9,636**	-2,728**	56,414**	-4,362**	4,720	0,398	1226,000**	2,576**	2117,000**	3,108**	165,000**	9,242**
Species related	14,512**	-3,878**	38,830**	-4,152**	5,414	0,444	1007,000**	3,487**	1227,500**	6,326**	986,000**	4,778**
Social engagement	10,342**	-3,175**	99,718**	-6,108**	1,739	-0,378	1326,500	1,931	26,000**	11,268**	1218,500**	3,803**
Performance evaluation	38,605**	-6,216**	273,036**	-1,461	15,673**	1,912	1013,500**	3,301**	1088,000**	6,562**	1253,500**	3,388**
Risk	27,289**	-5,129**	204,252**	-8,033**	4,847	0,323	1148,000**	2,725**	1478,000**	5,253**	741,500**	5,792**
Internal management	23,070**	-4,736**	178,515**	-9,693**	0,475	0,176	1288,000*	1,996*	1103,500**	6,549**	639,500**	6,133**
External reports	12,780**	-3,267**	409,918**	14,292**	8,705*	1,995*	805,000**	4,588**	2118,000**	2,930**	1151,000**	4,094**
Valuation	13,993**	-3,507**	14,086	-2,273*	7,882*	2,072*	1643,000	-0,648	2574,000*	2,464*	1966,000	0,584
Number of disclosures	39,202**	-6,335**	7,000	0,495	7,466	-0,345	1524,000	0,852	1382,000**	5,486**	1170,500**	3,762**
Total score	30,561**	-5,508**	7,000	-0,247	4,979	0,746	1073,500**	3,004**	644,000**	8,181**	739,500**	5,634**

H: Kruskal-Wallis H score. JT: Std. J-T Statistic. U: Mann-Whitney U score
*Significant at the 5% level
**Significant at the 1% level

Table 12 reports the correlation matrix for all the variables used in the study. A Spearman's rho correlation and Kendall's tau-b were used to examine the correlations between the variables.

Table 12: *Correlation matrix*

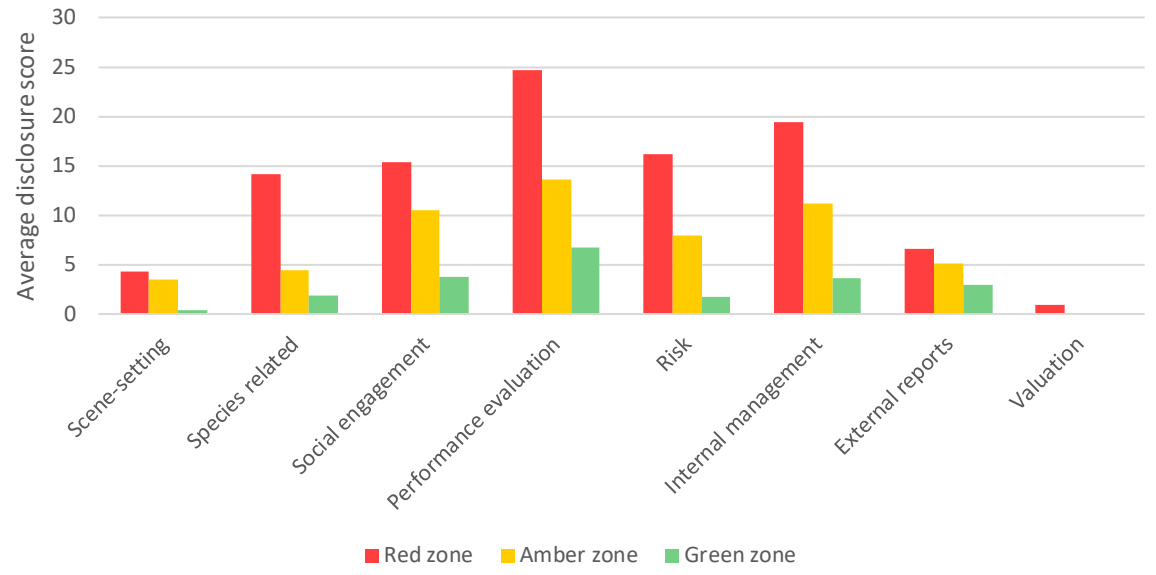
	Year	Listing	Industry	Biodiversity partnership	Market Cap	Biodiversity Importance	Scene setting	Species related	Social engagement	Performance evaluation	Risk	Internal management	External reports	Valuation	Number of disclosures	Total Score
Year	1,000	0,000	0,000	0,130	0,000	0,096	0,109	0,114	0,136	0,093	0,133	.224**	.211**	0,007	.218**	.172*
Listing	0,000	1,000	-0,107	.192*	.527**	.165*	.209**	.283**	0,157	.268**	.221**	.162*	.372**	-0,053	0,069	.244**
Industry	0,000	-0,102	1,000	-.228**	-0,005	-0,139	-.221**	-.308**	-.257**	-.504**	-.409**	-.381**	-.259**	-.285**	-.508**	-.441**
Biodiversity Partnership	0,122	.192*	-.218**	1,000	0,026	.208**	.252**	.513**	.914**	.532**	.426**	.531**	.238**	.200*	.445**	.664**
Market Capitalisation	0,000	.481**	-0,008	0,023	1,000	-0,094	0,032	0,043	-0,030	.170*	0,028	0,019	.165*	.169*	-0,030	0,066
Biodiversity importance	0,091	.165*	-0,133	.208*	-0,086	1,000	.750**	.388**	.308**	.275**	.470**	.498**	.332**	0,047	.305**	.457**
Scene setting	0,096	.194**	-.197**	.234**	0,027	.696**	1,000	.448**	.335**	.474**	.571**	.542**	.432**	0,080	.425**	.594**
Species related	0,095	.253**	-.269**	.458**	0,029	.346**	.381**	1,000	.587**	.588**	.596**	.606**	.499**	.287**	.571**	.749**
Social engagement	0,113	0,140	-.221**	.818**	-0,025	.276**	.277**	.474**	1,000	.617**	.503**	.655**	.277**	.222**	.536**	.780**
Performance evaluation	0,073	.227**	-.409**	.451**	0,120	.233**	.362**	.462**	.493**	1,000	.642**	.749**	.445**	.292**	.782**	.881**
Risk	0,110	.194**	-.349**	.373**	0,021	.412**	.485**	.485**	.410**	.498**	1,000	.705**	.501**	.209**	.664**	.795**
Internal management	.181**	.139*	-.316**	.456**	0,011	.427**	.443**	.468**	.534**	.602**	.577**	1,000	.462**	.290**	.783**	.898**
External reports	.183**	.341**	-.232**	.218**	.135*	.304**	.371**	.420**	.227**	.350**	.419**	.374**	1,000	0,104	.484**	.562**
Valuation	0,005	-0,052	-.270**	.198*	.152*	0,047	0,073	.253**	.195**	.244**	.181*	.245**	0,094	1,000	.302**	.298**
Number of disclosures	.174**	0,059	-.421**	.380**	-0,022	.261**	.348**	.459**	.420**	.637**	.531**	.638**	.390**	.253**	1,000	.826**
Total Score	.133*	.201**	-.353**	.548**	0,046	.378**	.476**	.601**	.619**	.724**	.648**	.754**	.444**	.243**	.683**	1,000

Spearman's rho correlations are reported above the diagonal. Kendall's tau-b is reported below the diagonal.
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Research question 2.1: Industry

Figure 6 shows the average disclosure score per theme across the industry types.

Figure 6: *Average disclosure scores across industries*



The red zone companies have highest average disclosure scores across all the disclosure themes. These companies are probably under greater pressure from stakeholders to minimise their environmental impact (Hassan et al., 2020). The red zone companies have an incentive to disclose a higher level of biodiversity, ecological and extinction information to legitimise themselves (Adler et al., 2018; Hadro et al., 2022; Hassan et al., 2020).

The companies in the red zone had 24 disclosures on average, with an average total score of 102. In contrast, the amber zone companies had an average of 13 disclosures, with an average total score of 56. These findings are consistent with prior studies which found that high-impact industries have a greater level of biodiversity, ecological and extinction reporting (Adler et al., 2018; Hassan et al., 2020; Rimmel & Jonäll, 2013).

Green zone companies had 9 disclosures on average, with an average total score of 21. Surprisingly, this is not consistent with previous studies which found that green zone companies disclose a higher level of biodiversity, ecological and extinction information than amber zone companies (Adler et al., 2018; Rimmel & Jonäll, 2013). A possible explanation for this is that the stakeholders of South African companies are not as concerned with the activities of lower-impact companies as they are with higher-impact companies. Despite it being easier for green zone companies to report biodiversity, ecological and extinction

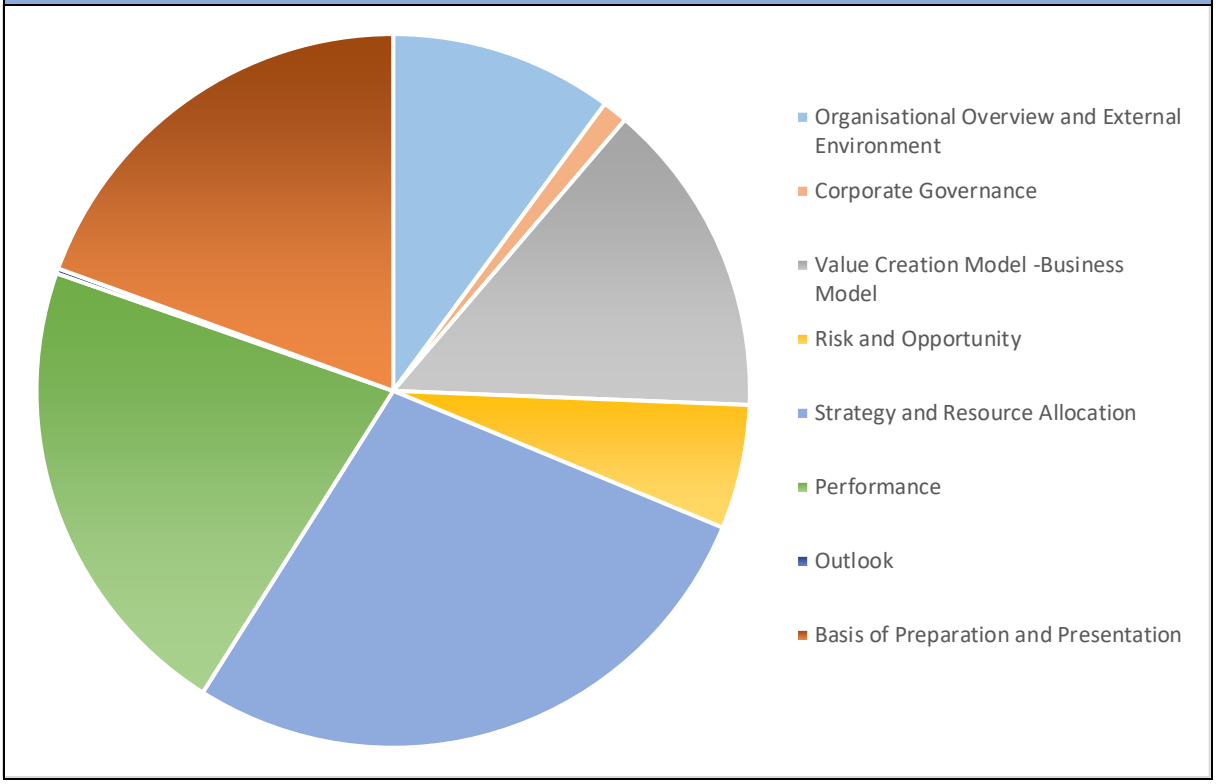
information without attracting negative attention, there remains no incentive for these companies to report such information because of the reduced focus and pressure place on these companies by stakeholders. The result is that green zone companies report a low level of biodiversity, ecological and extinction information to merely meet reporting guidelines.

The results of the correlation matrix show that all of the disclosure themes, as well as the number of disclosures and total disclosure score, have a weak negative correlation. The correlations are, though, significant at the 1% level (see Table 12). Of all independent variables, only the presence of a biodiversity partnership correlates with the type of industry ($r= -0.228$, $p<0.01$). The correlation is negative because the level of disclosure decreases as the industry changes from the red zone (1) to the green zone (3). The results of the Kruskal-Wallis and JT tests show that there are statistically significant decreases in the number of disclosures ($H=39.202$, $p<0.01$; $JT= -6.335$, $p<0.01$), total disclosure score ($H=30.561$, $p<0.01$; $JT= -5.508$, $p<0.01$) and the disclosure score per theme across the industry types as the industry changes from the red zone to green zone (see Table 11).

Research Question 2.2: Integrated reporting content elements

Figure 7 shows the location of biodiversity, ecological and extinction disclosures according to integrated reporting content elements.

Figure 7: *IR content element location of disclosures*



It is seen that companies disclose most under the strategy and resource allocation content element, with a total of 241 disclosures. Disclosures within the performance content element are the second highest (186) followed by the basis of preparation and presentation (169). This is similar to the results in Figure 3, as internal management, performance evaluation and external reports were the three best-disclosed themes.

Disclosures within the risks and opportunities content element, however, provide a grim result There was only a total of 49 disclosures which fall within the risk and opportunities content element. This is consistent with the results in Section 5.1, that the disclosures within the risk disclosure theme were among the most generic and vague. The value creation model content element contained 125 disclosures, suggesting that companies are more aware of biodiversity as a key input to the value creation of the business. This is still, however, a low number of disclosures given that biodiversity is important to all companies (Earthwatch Institute, 2002; TEEB, 2012). The outlook content element contained a total of 2 disclosures, which is less than 1 per cent of the total number of disclosures. This is low and it confirms the criticism that reports from companies generally provide backwards-looking information which fails to link biodiversity, ecological and extinction issues and the company's strategy (Atkins et al., 2017).

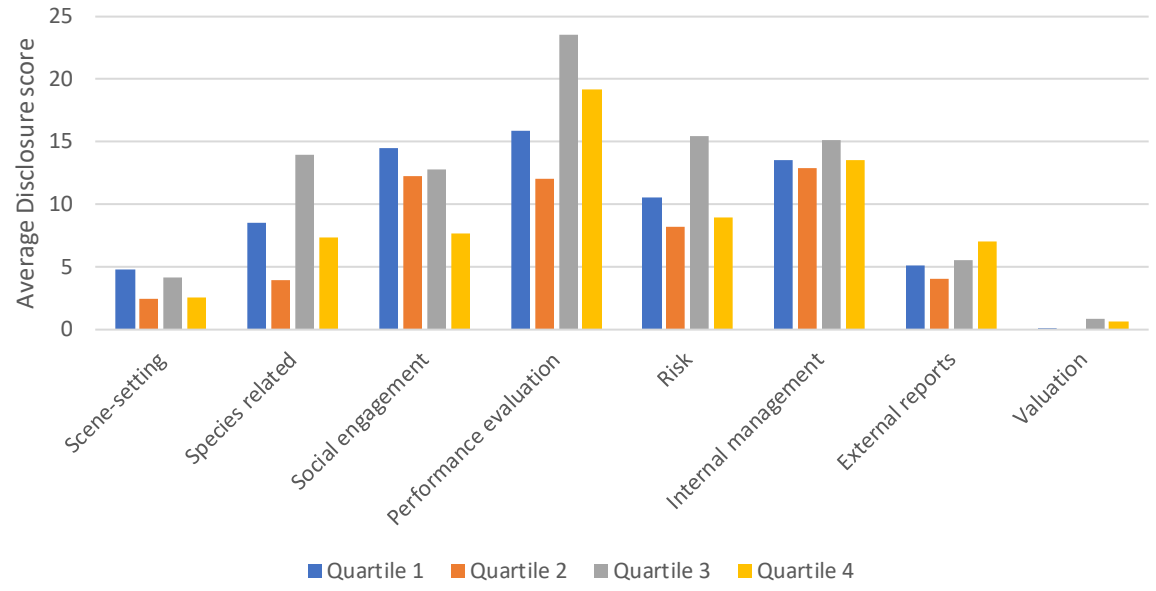
The overall findings suggest that companies are focused on reporting positive information, as the content elements which would contain negative information have fewer disclosures. This is consistent with the findings in Section 5.1 and supports the findings of Adler et al. (2018) and Hassan et al. (2020) that companies prefer reporting positive information as a form of impression management.

The Kruskal-Wallis and JT tests (see Table 11) show that the scores for scene-setting, species related, social engagement, performance evaluation, risk, internal management and external reports are all significantly different across the IR content elements ($p<0.01$). The valuation scores ($H=14.086$, $p>0.05$), total scores ($H=7.000$, $p>0.05$) and the number of disclosures ($H=7.000$, $p>0.05$) are all insignificant across the IR content elements.

Research Question 2.3: Company size

Figure 8 depicts the average disclosure scores of different sized companies (when grouped into quartiles.

Figure 8: *Average disclosure scores across companies of different sizes*



Quartile 1: Market capitalisation lower/equal to R57 260 million
Quartile 2: Market capitalisation between R57 260 million and R97 960 million
Quartile 3: Market capitalisation between R97 960 million and R197 480 million
Quartile 4: Market capitalisation greater than R197 480 million

The results of Figure 8 show that companies within the third quartile performed best in respect to biodiversity, ecological and extinction reporting. Companies within the third quartile had the highest average number of disclosures (21) with a total average disclosure score of 91. Quartile 3 companies also achieved the highest average disclosure score in the species related, performance evaluation, risk, internal management and valuation disclosure themes. The smallest companies within the study sample (companies within the first quartile) had an average of 20 disclosures which is one less than quartile 3 companies. The total average score (73) of quartile 1 companies, though, was 18 less than companies within quartile 3. Companies within the first quartile achieved the highest average disclosure score in the scene-setting and social engagement themes. The largest companies within the study sample (quartile 4 companies) achieved the highest average disclosure score for the external reports disclosure theme. These initial results suggest that there is no association between company size and biodiversity, ecological and extinction reporting so all companies (regardless of their size or financial resources available) should be able to achieve a high level of reporting.

When using market capitalisation as a measure of the size of a company, it is seen that there is a statistically significant difference in the performance evaluation disclosure scores across different sized companies ($H=15.673$, $p<0.01$). There also exists a weak positive correlation between the performance evaluation scores and the size of the company ($r=0.170$, $p<0.05$). The JT test, however, shows that there is an insignificant increase in the performance

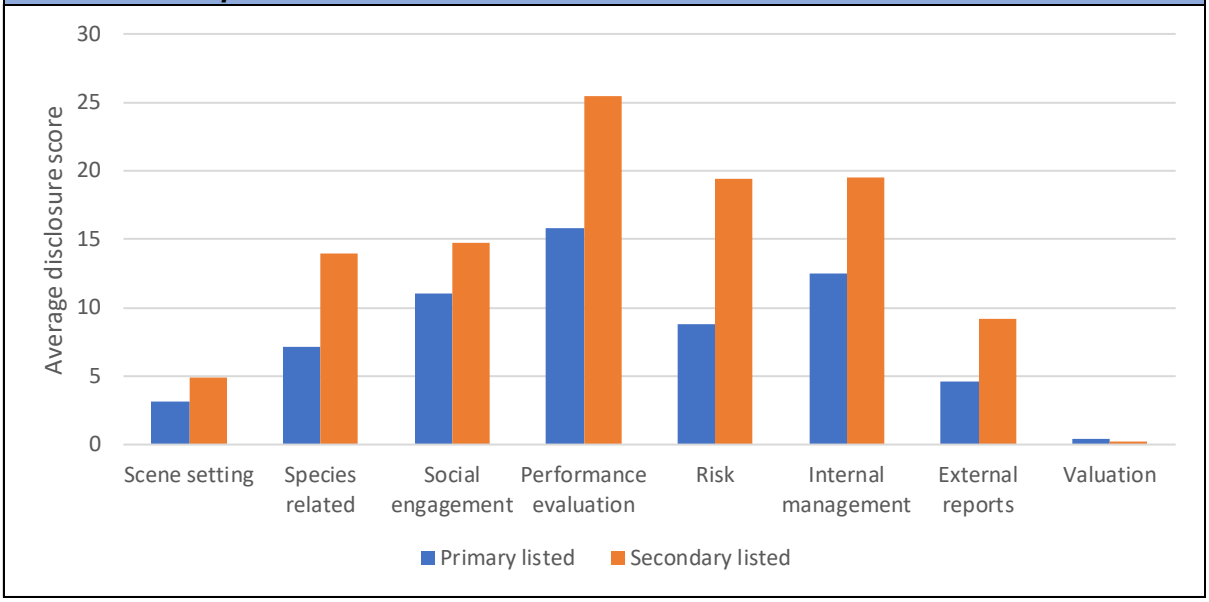
evaluation scores as the company size increases (JT=1.912, p>0.05). The Kruskal-Wallis and JT tests also show that there are statistically significant increases in the external reports (H=8.705, p<0.05; JT=1.995, p<0.05) and valuation (H=7.882, p<0.05; JT=2.072, p<0.05) disclosure scores across the different sizes of companies. There is a weak positive correlation between the external reports score (r=0.165, p<0.05) and company size. There is also a weak positive correlation between the valuation score (r=0.169, p<0.05) and the size of the company.

The above results suggest that although larger companies disclose more ESG information in general (Ahmed & Courtis, 1999; Brammer & Pavelin, 2008; Drempetic et al., 2020; Gonenc & Scholtens, 2017; Jennifer Ho & Taylor, 2007), this does not appear to be the case with biodiversity, ecological and extinction specific information. Only two of the eight themes increase significantly as the company size increases. The better performance of larger companies in the external reports and valuation themes may be explained by larger resource availability (Rossi & Luque-Vílchez, 2021). Larger companies can spend more money to implement more than one disclosure framework, increasing the external reports score. Large companies are also able to hire technical experts and have the cash resources required to value biodiversity, ecological and extinction information, increasing the valuation score.

Research Question 2.4: JSE Listing

Figure 9 depicts the average disclosure score for South African companies which are either primary or secondary listed on the JSE.

Figure 9: ***Average disclosure score across primary and secondary JSE listed companies***



Surprisingly, secondary listed companies have a higher average score in each of the themes except valuation. Secondary listed companies have an average total disclosure score of 108 compared to 63 for primary listed companies. On average, secondary listed companies had 20 disclosures compared to 17 for primary listed companies. The Mann Whitney U and JT tests (see Table 11) show that there is a statistically significant increase in the total disclosure score from primary to secondary listed companies ($U=1073.500$, $p<0.01$; $JT=3.004$, $p<001$). There was, however, an insignificant difference in the number of disclosures for secondary listed companies compared to primary listed companies ($U=1524.000$, $p>0.05$; $JT=0.852$, $p>0.05$). This suggests that the level of detail for secondary listed companies is better than primary listed companies.

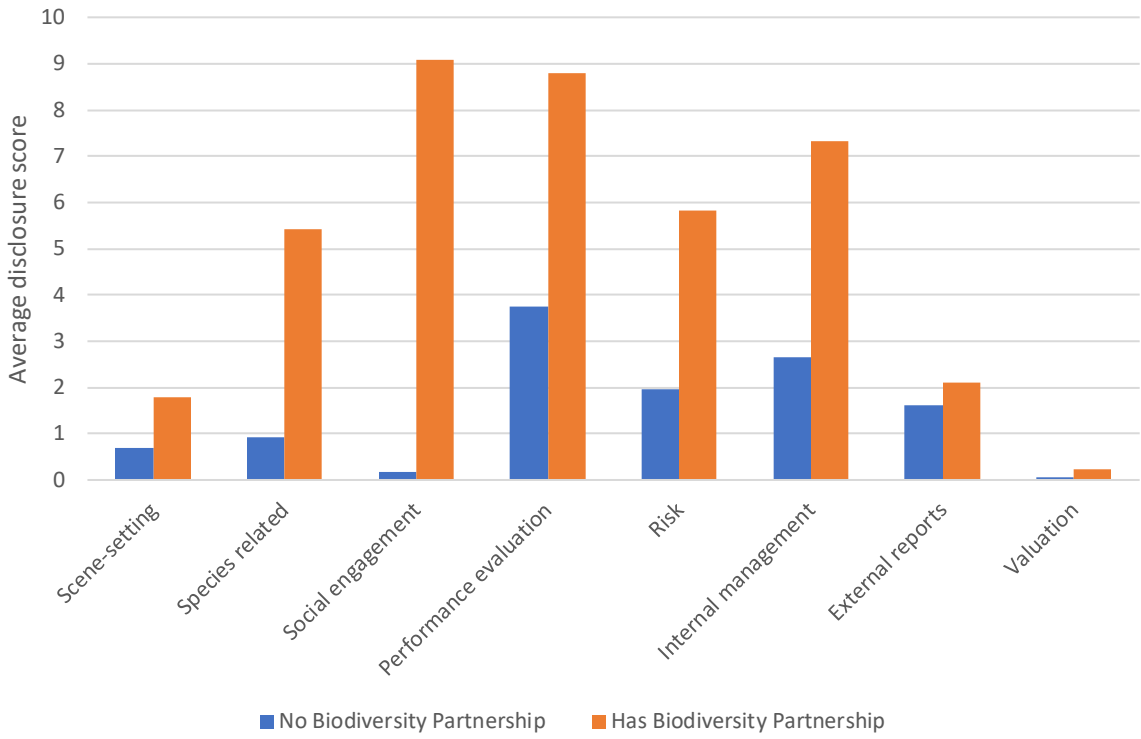
These results are surprising as the JSE has historically been at the forefront of promoting strong governance and disclosure by companies, including ESG information (JSE, 2015). The results suggest that the JSE has not kept up with the ESG reporting requirements of other countries. The majority of the JSE secondary listed companies have a primary listing in either the United Kingdom or Europe. This may explain why they have better biodiversity, ecological and extinction reporting as European companies are required to comply with EMAS regulations and other European Union Directives on reporting (Arif et al., 2022; Carungu et al., 2021; LCF & GNF, 2016; Papa et al., 2022). One such requirement is to publish an annual environmental statement (LCF & GNF, 2016). The statement should include information on the company's environmental impacts and their actions to reduce them (LCF & GNF, 2016). These reporting requirements are stricter than what the JSE currently has regarding biodiversity, ecological and extinction information suggesting that the JSE is lagging behind other countries with ESG reporting requirements. The JSE needs to update or change its current requirements to ensure that companies achieve a higher level of reporting (even if it means that companies are forced to do so through compliance with regulations).

Of all the disclosure themes, only social engagement and valuation did not have a statistically significant difference between primary and secondary listed companies ($p>0.05$). The results of the correlation matrix show similar results. Social engagements ($r=0.157$) and valuation ($r=-0.053$) scores did not have any significant relationship with the type of JSE listing ($p>0.05$). Scene-setting, species related, performance evaluation, risk and external reports all had a weak positive relationship with the type of JSE listing at the 1% level. Internal management had a weak positive correlation with JSE listing type at the 5% level ($r=0.162$). The correlations are positive as the scores increase as the JSE listing type goes from primary to secondary, which is consistent with the Mann Whitney U and JT tests (see Table 11).

Research Question 2.5: Biodiversity partnership

Figure 10 presents the average scores for companies with a biodiversity partnership compared to companies without a partnership.

Figure 10: ***Average disclosure score of companies with and without a biodiversity partnership***



Companies with a biodiversity partnership outperformed companies without a biodiversity partnership in every disclosure theme. Companies with a biodiversity partnership had an average of 8 disclosures which is double the number of disclosures by companies without a biodiversity partnership (4). The total average score of companies with a biodiversity partnership was 41 compared to 12 for companies without a biodiversity partnership. There is also a statistically significant increase in the total disclosure score ($U=644.000$, $p<0.01$; $JT=8.181$, $p<0.01$) and the number of disclosures ($U=1382.000$, $p<0.01$; $JT=5.486$, $p<0.01$) from companies without a biodiversity partnership to companies with a biodiversity partnership. It was noted that most common biodiversity partners were the World Wildlife Fund for Nature (WWF), Alliance for Water Stewardship and the Alliance to End Plastic Waste. Other notable partnerships were with the United for Wildlife Financial Taskforce, African Wildlife Foundation, the South African Department of Agriculture, Forestry and Fisheries and the Endangered Wildlife Trust. These partners are both local and international organisations which supports the evidence that preventing biodiversity loss requires global collaboration.

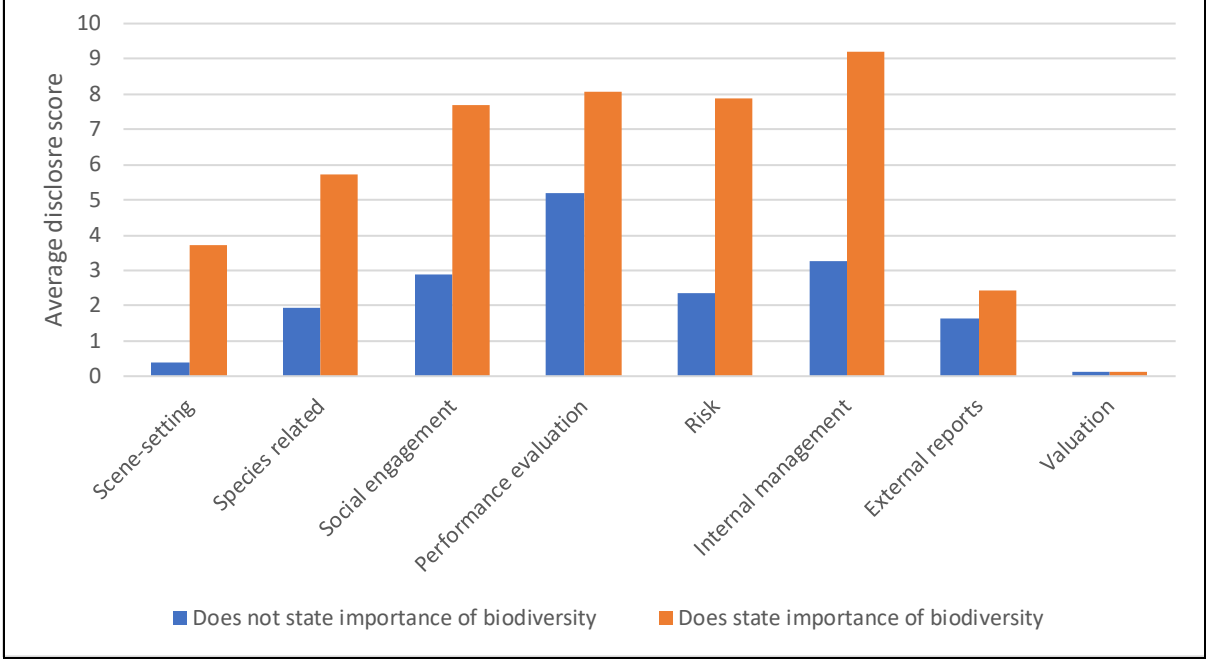
The results of the Mann Whitney U-test (see Table 11) show that at the 5% level, the valuation disclosure scores are significantly different between companies with and without biodiversity partnerships. The remaining disclosure theme scores are all significantly different between the two groups of companies at the 1% level. The correlation matrix (Table 12) shows that social engagement scores have a strong positive correlation ($r=0.914$, $p<0.01$) with whether or not a company has a biodiversity partnership. This makes sense, as most of the disclosure items within the social engagements theme deal with partnerships. It also suggests that the companies with a biodiversity partnership have better engagement with other stakeholders about biodiversity, ecological and extinction matters.

The results are consistent with prior studies (Adler et al., 2018; Hassan et al., 2020) and confirm the suggestions that effective biodiversity conservation, restoration of ecosystems and prevention of extinction depend on more than one organisation (Atkins et al., 2022b; Feger & Mermet, 2017; Weir, 2018).

Research Question 2.6: Importance of biodiversity

Figure 11 shows the average disclosure score per theme for companies which disclose the importance of biodiversity compared to companies that do not disclose the importance of biodiversity.

Figure 11: ***Average disclosure score of companies that do and do not disclose the importance of biodiversity***



Companies which state the importance of biodiversity have higher average scores (in all the disclosure themes) than companies which do not state the importance of biodiversity. Companies which state the importance of biodiversity have an average of 9 disclosures compared to an average of 5 for companies which do not state the importance of biodiversity.

The Mann Whitney U-test (see Table 11) shows that there is a statistically significant difference in the number of disclosures between companies which state and do not state the importance of biodiversity ($U=1170.500$, $p<0.01$). Companies which do not state the importance of biodiversity achieved an average total score of 18, compared to 45 for companies which state the importance of biodiversity. There is also a statistically significant difference in the total average score between these two groups of companies ($U=739.500$, $p<0.01$). The correlation matrix (Table 12) shows that both the total disclosure score and the number of disclosures have a weak positive relationship (at the 1% level) with whether or not the company states the importance of biodiversity. The Mann Whitney U-test results also show that the valuation disclosure scores are insignificant between companies which state the importance of biodiversity and those companies which do not ($U=1966,000$, $p>0.05$). The remaining disclosure theme scores are all significantly different between the two groups of companies at the 1% level. The correlation matrix shows that scene-setting scores have a strong positive correlation ($r=0.750$, $p<0.01$) with whether or not a company states the importance of biodiversity.

The results show that the companies which state the importance of biodiversity have a greater number of disclosures and have more detailed biodiversity, ecological and extinction disclosures than companies without a biodiversity importance statement. This complements the results of Figure 4 and Figure 5. The top 5 ranking companies all had a biodiversity importance disclosure in at least one of the three years, whereas all the bottom 5 companies did not have any biodiversity importance disclosure. Further, the companies with a biodiversity importance disclosure achieve significantly higher scores for the species related, performance evaluation, risk and internal management themes (see Figure 11 and Table 11). This suggests that companies which state the importance of biodiversity are not doing it merely for disclosure purposes but rather understand the importance of biodiversity and the need to preserve and conserve biodiversity. Such companies achieve the idea set out by Atkins and Maroun (2018) to actively take steps to understand and reduce their impact on biodiversity and not treat reporting as a disclosure exercise, through genuinely caring about biodiversity loss, introducing extinction prevention plans and reporting more comprehensive information.

6. CONCLUSION & RECOMMENDATIONS

The first objective of this thesis was to investigate the level of biodiversity, ecological, and extinction reporting based on information contained within integrated reports of 50 Top JSE-listed South African companies. The second objective was to investigate the possible determinants of biodiversity, ecological and extinction reporting.

There was an opportunity for this study as previous research focused mainly on either biodiversity, ecological or extinction reporting by companies, with no prior research evaluating the reporting of all three components concurrently (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Usher & Maroun, 2018; van Liempd & Busch, 2013). This thesis addressed this gap by interpretively developing an 81-item disclosure checklist which combines all three components. The newly developed disclosure checklist was used to explore the level of biodiversity, ecological and extinction disclosures and assess possible determinants of biodiversity, ecological and extinction reporting.

6.1. Main findings and concluding remarks

Research question 1: Levels of biodiversity, ecological and extinction accounting

The results show that biodiversity, ecological and extinction reporting by Top JSE-listed companies is limited with only a handful of companies providing any substantial biodiversity, ecological and extinction disclosures within their integrated reports. Despite the overall level of biodiversity, ecological and extinction reporting increasing from 2018 to 2020, the level of reporting is still low. The highest score for a company is 243 out of a possible total of 729 (33 per cent) over the three years. The results are consistent with prior studies which similarly found overall biodiversity reporting to be poor despite an increase in the overall level of biodiversity disclosures over the respective years of study (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020; Mansoor & Maroun, 2016; Rimmel & Jonäll, 2013; Usher & Maroun, 2018; van Liempd & Busch, 2013).

The results also had differences from prior studies. Previous studies found that very few companies discussed biodiversity in terms of the performance evaluation and internal management disclosure themes (Grabsch et al., 2012; Mansoor & Maroun, 2016; van Liempd & Busch, 2013). This thesis found that the performance evaluation and internal management themes were among the best-reported themes. Despite these disclosure themes containing a higher level of reporting compared to prior studies, the disclosures were biased, generally provided a historical review of performance and focused mainly on positive information. This

is consistent with the results of prior studies (Grabsch et al., 2012; Mansoor & Maroun, 2016; van Liempd & Busch, 2013).

Another result that is inconsistent with prior studies is that the scene-setting disclosure theme was one of the weakly disclosed themes. Prior studies, on the other hand, found that scene-setting is one of the better disclosed themes (Grabsch et al., 2012; Mansoor & Maroun, 2016; van Liempd & Busch, 2013). The low level of scene-setting disclosures is of concern given the importance of understanding what biodiversity means to the organisation and how the company prioritises biodiversity, ecological and extinction matters for the successful protection and conservation of biodiversity (Adler et al., 2018; Atkins & Maroun, 2018; Grabsch et al., 2012; Jones & Solomon, 2013; Van Zijl et al., 2017). It is acknowledged by the researcher that a possible reason for the difference in results is because of prior studies studying sustainability reports in addition to integrated reports. Sustainability reports contain primarily ESG information related to sustainability matters which would typically include more biodiversity, ecological and extinction information than integrated reports.

The detailed and positive nature of certain disclosure themes, together with the low level of reporting in other themes, raises the risk that management is using these disclosures to manage impressions (Atkins et al., 2017; Grabsch et al., 2012; Van Zijl et al., 2017). The better disclosed themes include positive detail which can be used to signal to stakeholders that the relevant biodiversity, ecological and extinction risks are under control and have been incorporated into the relevant strategic considerations (Van Zijl et al., 2017). Similarly, the other themes could contain a minimal level of biodiversity, ecological and extinction information to avoid additional attention and scrutiny from stakeholders (Van Zijl et al., 2017). This additional attention and scrutiny will ultimately increase the pressure from stakeholders for companies to better manage and report their biodiversity, ecological and extinction information.

Additional evidence of possible impression management is that the external reports theme was the best-disclosed theme but the actual level of detail for the disclosures was poor. The majority of the companies merely stated that they apply a relevant reporting framework without any further details on how the frameworks are being applied. This may be a form of impression management as companies are making it evident to stakeholders that they are using the relevant reporting frameworks (external reports) but without specific details on the application of such frameworks. Organisations still appear to be disclosing biodiversity, ecological and extinction information as a form of impression management. This confirms the fears of academics that the majority of companies seem to care about biodiversity preservation only

when it provides certain advantages in the form of enhanced reputation or when stakeholder pressure becomes too great.

Another result is that the valuation theme is the worst-disclosed theme. A possible explanation is that the valuation of biodiversity (in particular NCA) is a relatively new area of biodiversity reporting and companies have not had enough time to implement such frameworks. For example, the most recent advancement in NCA, the BD Protocol, was only officially completed during the 2020 financial year. Another possible reason for the slow adoption of biodiversity valuation is the concerns surrounding the valuation of biodiversity and ecology (Atkins et al., 2017). It is believed that no financial value can be placed on a living organism (Atkins & Maroun, 2018) and that there is a risk that species being seen as assets with economic benefits will lead to actions which will cause further biodiversity loss/extinction (Weir, 2018). One undesirable action is that certain species will be preserved over others, based on their economic value (Atkins et al., 2017; Gray & Milne, 2018). For example, the honeybee conservation received far greater attention and financial support than other less know insects that are equally as important to pollination activities.

Research question 2: Reporting determinants

Table 13 presents a summary of relationships among biodiversity, ecological and extinction disclosures and its determinant factors. The table indicates which variables have a significant/insignificant relationship with biodiversity, ecological and extinction reporting.

Table 13: ***Summary of relationships between biodiversity, ecological and extinction disclosures and its determinant factors***

	Industry	IR content element	Market capitalisation	Listing	Biodiversity partner	Biodiversity importance
Scene setting	✓	✓	×	✓	✓	✓
Species related	✓	✓	×	✓	✓	✓
Social engagement	✓	✓	×	×	✓	✓
Performance evaluation	✓	✓	✓	✓	✓	✓
Risk	✓	✓	×	✓	✓	✓
Internal management	✓	✓	×	✓	✓	✓
External reports	✓	✓	✓	✓	✓	✓
Valuation	✓	×	✓	×	✓	×
Number of disclosures	✓	×	×	×	✓	✓
Total score	✓	×	×	✓	✓	✓

: Significant at the 1% level
: Significant at the 5% level

The results complement the findings in Research Question 1 and are important as they provide evidence of the rationale and motivation for biodiversity, ecological and extinction reporting. Biodiversity, ecological and extinction reporting has a significant relationship with industry classification. This is consistent with academic literature which suggests that high biodiversity impact (red-zone) companies are under greater pressure from stakeholders to minimise their environmental impact and have an incentive to disclose a higher level of biodiversity, ecological and extinction information to legitimise themselves (Adler et al., 2018; Hadro et al., 2022; Hassan et al., 2020; Van Zijl et al., 2017). A result which is inconsistent with prior studies is that green zone companies had a lower level of reporting than amber-zone companies, with prior studies finding that green zone companies disclose a higher level of biodiversity, ecological and extinction information than amber zone companies[12] (Adler et al., 2018; Rimmel & Jonäll, 2013).

Another result is that biodiversity, ecological and extinction reporting, as a whole, has a significant relationship with the type of JSE listing. It was found that secondary listed companies outperformed primary listed companies. These results are surprising as the JSE has historically been at the forefront of promoting strong governance and disclosure by companies, including ESG information (JSE, 2015), suggesting that the JSE has not kept up with the ESG reporting requirements of other countries. The majority of the secondary listed companies have a primary listing in either the United Kingdom or Europe. This can explain why they have better biodiversity, ecological and extinction reporting, as European companies are required to comply with EMAS regulations and other European Directives, which includes a requirement to publish an annual environmental statement (Arif et al., 2022; Carungu et al., 2021; LCF & GNF, 2016; Papa et al., 2022).

The level of biodiversity, ecological and extinction reporting has a significant relationship with whether or not the company has stated why biodiversity is important. Companies which did state the importance of biodiversity significantly outperformed those companies which did not state the importance of biodiversity. This result is significant as it shows that companies are answering calls of academics for organisations to truly care about and understand the biodiversity loss crisis (Atkins et al., 2017; Atkins & Maroun, 2018; Büchling & Maroun, 2021). The results further show that the companies which mention the importance of biodiversity not only achieve better biodiversity, ecological and extinction reporting but are also involved in more biodiversity protection/conservation activities than their counterparts.

[12] The researcher acknowledges that this might be explained by differences in macro-economic environments of countries used in prior studies.

A positive result for the future of biodiversity, ecological and extinction reporting is that the level of biodiversity, ecological and extinction reporting has a significant relationship with whether or not the company has a biodiversity partnership. Companies which had a biodiversity partnership significantly outperformed those companies which did not have a partnership. This result is significant as it confirms the beliefs of academics that effective conservation and restoration of ecosystems depend on more than one organisation and collaboration across professions (Atkins et al., 2022b; Feger & Mermet, 2017; Weir, 2018).

The presence of biodiversity partnerships and the presence of biodiversity importance statements are particularly important as they show that companies are beginning to grow aware of the biodiversity loss crisis and the subsequent threats to the survival of the planet, economy and the quality of human life. Companies are, further, beginning to put biodiversity restoration and conservation activities before purely profit-making activities. This is a promising result as previous studies found that companies were self-interested entities that had no moral or ethical motives to care about biodiversity (Adler et al., 2018; Grabsch et al., 2012; Hassan et al., 2020). As positive as the results are, it should be noted that the number of companies that understand the importance of biodiversity is still very low.

6.2. Recommendations

More needs to be done by organisations in terms of biodiversity, ecological and extinction reporting. This thesis has found that the biodiversity, ecological and extinction reporting by South African companies is increasing, but at a slow pace and lacks the level of detail necessary to effectively contribute to the conservation and restoration of biodiversity and prevention of extinction. Most companies currently maintain a relatively low level of disclosure to avoid additional attention and scrutiny from stakeholders. Meaning that stakeholders never become aware of their role in biodiversity loss, thus never taking the necessary actions to prevent future biodiversity loss. The best way to make companies change their biodiversity practices and report increased levels of biodiversity, ecological and extinction information is through stakeholders placing pressure on companies to do so.

The first recommendation is to change the reliance which stakeholders have on organisations to educate and inform them on these biodiversity, ecological and extinction matters. Companies will not draw attention to issues which ultimately increase the pressure that stakeholders place on them. Every stakeholder (and human being) should take it upon themselves to learn about biodiversity and its importance to daily life. This way, stakeholders do not have to first wait for the company to care about biodiversity. Stakeholders can actively

pressure companies to change their current biodiversity practices and force the change which is required.

The results of this thesis show that organisations are beginning to accept the importance of biodiversity and are actively changing their biodiversity practices without any pressures. This shift in the mindset of organisations, however, is occurring at a slow pace. As a result, the second recommendation is that companies should recruit staff (in management and directorship positions) which have specific knowledge and experience in dealing with biodiversity, ecological and extinction matters. This will help organisations better implement strategies and management-level approaches to address their impact on biodiversity, ecology and extinction. Staff members with these specific skill sets will also be able to develop formal biodiversity reporting approaches which is an essential step in the long-term goal of saving the natural world. This thesis fully supports the calls for companies to recruit a Chief Value Officer (CVO) and/or a Chief Stakeholder Relations Officer with biodiversity-specific knowledge and experience (King & Atkins, 2016; Atkins et al., 2020). A CVO is described as a financial professional responsible for the financial statements, management of the IRF six capitals and maintaining stakeholders' relationships (King & Atkins, 2016). Similarly, the Chief Stakeholder Relations Officer can contribute significantly through managing the integration of biodiversity into internal control and risk management, as well as communicating with stakeholders on an ongoing basis to learn and understand their legitimate biodiversity, ecological and extinction needs, interests and expectations (Atkins et al., 2020).

Results found that secondary JSE-listed companies perform better than primary listed companies with biodiversity, ecological and extinction reporting. The third recommendation is that the JSE, in partnership with the government, should modernise its ESG reporting requirements. For the JSE to keep up with the ESG reporting requirements of other countries, changes need to be made. The JSE and the South African government could develop regulations similar to the EMAS regulations found in Europe. This could allow the JSE to mandate companies to report on information on environmental impacts and their actions to reduce them. Alternately, the JSE and the South African government could mandate the use of the BD Protocol by South African listed companies. What makes this suitable is that the BD Protocol is one of the most comprehensive NCA frameworks developed in South Africa by South African organisations (in partnership with companies and international organisations). The South African landscape and South African companies were also used in the development of the BD Protocol.

6.3. Areas for further research

This thesis has limitations in the form of a relatively small sample size and a dataset covering only three years. Studying a larger sample over more years is recommended for future research. The thesis considers six possible determinants of biodiversity, ecological and extinction reporting. Future studies can look at other factors which might affect biodiversity, ecological and extinction disclosures.

This thesis looked at the biodiversity, ecological and extinction reporting of only South African companies, across a range of industries. Given that this was the first study to explore biodiversity, ecological and extinction reporting concurrently, it is highly recommended that future studies utilise the comprehensive research instrument for studies in other countries. Alternately, future studies within a South African context could focus on a specific industry. This will allow the study to provide a much greater account of the level of reporting in specific industries within South Africa.

A further limitation was that only JSE-listed companies were studied. An area of possible future research could include exploring the biodiversity, ecological and extinction reporting of non-listed entities, state-owned enterprises or even biodiversity NGOs.

The biggest limitation of the study was that only information within integrated reports was considered. Given that there are many other forms of information for stakeholders which include biodiversity, ecological or extinction information, it is recommended that future research utilise the research instrument for determining the level of biodiversity, ecological and extinction reporting in the other forms of information. It may also be beneficial to get the views from market participants, employees of the organisation responsible for reporting, or other relevant stakeholders.

As the valuation of biodiversity (specifically NCA) is relatively new within the broad area of biodiversity accounting. It is highly advised that future studies expand on the valuation disclosure theme, to explore the level of biodiversity valuation performed by companies. This area of future research also allows for determining the rate of adoption of biodiversity valuation and NCA.

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