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Integrated extinction accounting and accountability: Building an Ark
Paper for the Special Issue of Accounting, Auditing & Accountability Journal on
Extinction Accounting & Accountability

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Structured Abstract

Purpose

We are currently experiencing what is often called the sixth period of mass extinction on planet Earth, caused undoubtedly by the impact of human activities and businesses on nature. In this paper we explore the potential for accounting and corporate accountability to contribute to extinction prevention. The paper adopts an interdisciplinary approach, weaving scientific evidence and theory into organisational disclosure and reporting in order to demonstrate linkages between extinction, business behaviour, accounting and accountability as well as to provide a basis for developing a framework for narrative disclosure on extinction prevention.

Design/methodology/approach

The paper is theoretical and interdisciplinary in approach, seeking to bring together scientific theories of extinction with a need for corporate and organizational accountability whilst recognizing philosophical concerns in the extant environmental accounting literature about accepting any business role and capitalist mechanisms in ecological matters. Our overarching framework derives from the concept of emancipatory accounting.

Findings and Practical implications

The outcome of the writing is to: present (a) an emancipatory ‘extinction accounting’ framework which can be embedded within integrated reports, and (b) a diagrammatic representation, in the form of an ‘ark’, of accounting and accountability mechanisms which, combined, can assist, we argue, in preventing extinction. We suggest that the emancipatory framework may also be applied to engagement meetings between the responsible investor community (and NGOs) and organizations on biodiversity and species protection.

Originality/value

This paper represents a comprehensive attempt to explore the emancipatory role of accounting in extinction prevention and also brings together the links in accounting and accountability mechanisms which, working together, can prevent species extinction.

Keywords

Extinction; accounting, accountability, ark, emancipatory accounting, IUCN, integrated reporting.

Paper type - Research

1. Introduction

Recognition of ecological crisis and the impending extinction of species on earth is not a revolutionary, 21st century concept by any stretch of the imagination. Economists have talked of ‘natural capital’ for many decades. For example, one book entitled, *Nature’s Price: The Economics of Mother Earth*, written in 1979, opens with the following statement:

“Nature is our capital. The interest it yields is all we may use. If we persistently encroach on that capital, we shall eventually go bankrupt.... But we are using up our natural capital all over the world instead of leaving it intact, so that not only is nature being wiped out but we are bringing the same fate upon ourselves” (van Dieren and Hummelinck, 1979, p.3).¹

Similarly, in 1978, in a speech to the Australian Conservation Foundation in Canberra, Prince Phillip provided an overview of what we now refer to as ‘integrated thinking’. This shows how almost fifty years ago there was awareness of links between business and extinction, as well as of the need to preserve natural capital:

“.... The conservation of the environment.... must be taken into account at all levels and in all departments of government and in the boardrooms of every industrial enterprise, It is no longer sufficient simply to quantify the elements of existence as in old-fashioned material economics; conservation means taking notice of the quality of existence as well. The problem is of course to give some value to that quality ... money spent on proper pollution control, urban and rural planning and the control of exploitation of wild stocks of plants and animals on land and in the seas, is the less expensive alternative in the long run” (HRH Prince Philip, 1978, p.12).

Indeed, writers have explored the potential outcome of ongoing environmental degradation and exploitation of natural resources for many decades (see, for example, Ehrlich’s (1969) dystopian prediction of ecological collapse). Carson’s seminal work, *Silent Spring*, had a tremendous impact on public attitudes and resulted in the banning of DDT (Carson, 1962). In the accounting literature there was recognition of an extinction crisis nearly 30 years ago:

“... a break in the ecological chain can happen for many reasons ... but it takes little imagination to see that once it has started, the process is irreversible and will, potentially, accelerate. The process of extinction is now rapid” (Gray, 1992, p.406).

Indeed, Gray (1990) explored various attempts to ‘green’ business during the 1970s/80s including the Pearce Report, commissioned by the UK’s Department of the Environment, and the launch of the Valdez Principles in the wake of the Exxon Valdez ecological crisis.² Yet, here we are, in the 21st century and the ecological situation continues to deteriorate.

¹ The book arose from a report into the value of nature, commissioned by the WWF.

² See also Pearce, Markandya and Barbier (1989); Derwent (1989) and CERES (1990) *The 1990 Ceres Guide to the Valdez Principles*, The Social Investment Forum, Boston, MA, USA.

This has prompted the realization that preservation of the natural world and the protection of species is no longer the reserve of deep greens, ecologists, ‘tree-huggers’ and conservationists. Active responsibility for saving the planet is now firmly in the hands of, inter alia, global businesses, governments, accountants, financiers and economists. As we argue below, material financial repercussions arise from the decline and loss of species: obvious ones such as the impact of pollinator decline, but also decline in less obvious, ‘unnoticeable’ species, because of their individual contribution to the ecosystem. A recent book, *The Chief Value Officer: Accountants Can Save the Planet*, outlines a discourse on how accounting, reporting and other corporate governance and accountability mechanisms can (and must) be orientated towards saving the environment and preventing extinction, or at least reducing deleterious impacts (King with Atkins, 2016).

The emancipatory potential for accounting to ‘save the planet’ has been raised in the academic accounting literature before yet there seems to have been little progression given the dire situation we currently find ourselves in. A seminal professional article, *The Accountant’s Task as Friend to the Earth*,³ explores a ‘possible innovative rôle’ for accountants in developing the (then) emergent concept of ‘green’ accounting but one which, “... must be approached with some care”, given the contradictory nature of bringing together financial business concerns and preservation of the natural environment.

Environmental accounting developments have not been emancipatory enough as we witness a world currently in the grip of a sixth period of mass species extinction. This is caused by a variety of factors arising from industrial activity and increasing human populations such as global warming, climate change, habitat loss, pollution, mono agriculture and use of agrochemicals. The Living Planet Report produced by the Worldwide Fund for Nature (WWF, 2016) provides horrifying statistics on the decline in wildlife populations over just a few decades.

This special issue of the *Accounting, Auditing & Accountability Journal*, explores the role of accounting and accountability mechanisms in potentially preventing extinction and slowing the current pace of species extinction. Submissions in the following areas were requested:

- theoretical and philosophical underpinnings of extinction accounting and accountability;
- corporate disclosures relating to species, by level of extinction risk, categorised as critically endangered, endangered, vulnerable, near threatened, of least concern, by the IUCN Red List, and the application of the GRI guidelines in relation to IUCN Red List species (specifically GRI 304-4);
- corporate disclosures on specific species (in annual reports, sustainability reports, integrated reports, corporate website disclosures);
- corporate partnerships with NGOs and lobby groups aimed at protecting species at risk of extinction and the role of NGOs in driving corporate accountability for species at risk of extinction;
- the educational role of companies in raising awareness of species at risk of extinction;

³ See, Gray (1990) which explores early experiments in environmental accounting as well as contemporaneous policy and political attempts to ‘green’ business.

- the role of responsible investment and sustainable finance in driving corporate accountability for species at risk of extinction (for example, collaborative engagement via the Principles of Responsible Investment (PRI));
- corporate initiatives aimed at protecting and conserving endangered species; and
- the process of corporate biodiversity auditing of species at risk of extinction.

Accounting for biodiversity has received little attention from the academic accounting community, especially when it comes to corporate accounting and accountability for specific species at risk of extinction. We received 10 submissions and four of these have been accepted and are included in this AAAJ special issue.

In our views, the papers in this AAAJ special issue point to the emergence of, and need for, a new form of accounting, or more specifically organizational narrative, hybrid disclosures, namely, Extinction Accounting and Accountability. This acknowledges a need to protect species at risk of extinction driven by recognition that, without urgent action by companies and other organisations, high profile species will be wiped out.

At this point, we acknowledge that extinction accounts at the level of local or national government (on the political level) or specific biomes (on the biological level) will play an important role in understanding the extent and specific causes of biodiversity loss, evaluating the impact of extinction of species and encouraging remedial action (Cuckston, 2017; Gaia and Jones, 2017). In the long-term, this ‘macro-level extinction accounting’ may become more important for promoting substantive change than the accounting at the level of an individual organization or industry⁴. This point is made by Russell et al. (2017) in a AAAJ special issue on ecological accounts. Nevertheless, in the short-term, extinction accounting requires pragmatism. Scientific, moral extensionist or deep ecological accounts of the risks posed by extinction need to be complemented by a method of accounting which engages those stakeholders (such as industries, business leaders, institutional investors and corporate consultants) who either dismiss the importance of preserving the environment or frame the wellbeing of the planet only in financial anthropocentric terms (see, Mitchell et al., 1997; Jones, 2010). For this reason, we develop our extinction accounting framework at the level of an individual corporation/organization. This must not be misunderstood as dismissing the importance of a deep ecological view of extinction. Instead, we assume that the technologies of accounting – which have been used to propagate capitalism – can be refocused to encourage companies to progress from a purely financial understanding of the environment to a more balanced perspective which incorporates elements of deep ecology (Jones, 2003; Gaia and Jones, 2017).

We use ‘progress’ to acknowledge that it is not easy to change firmly held financial or economic theories of the firm. At the same time, it is not impossible to educate the financial community and encourage a growing acceptance of environmental stewardship, moral extensionism and ecocentrism (Dillard and Reynolds, 2008; Atkins et al., 2015). For the critical reader, this may be overly optimistic but, in our view, there are already some early signs of accountancy’s emancipatory potential.

⁴ Special thanks to our two anonymous reviewers for raising this point and encouraging us to clarify the distinction between extinction accounts prepared at different levels.

Multinational companies are increasingly disclosing information relating to specific threatened species and their protection efforts (Atkins and Atkins, 2016). This may be motivated by the Global Reporting Initiative's (GRI) call for disclosures relating to the IUCN (International Union for the Conservation of Nature) Red List Species complemented by national and international conventions for protection of species (GRI, 2016). The efforts of non-governmental organizations (NGOs), such as the WWF, to establish partnerships with companies to protect species threatened by extinction are also raising corporate awareness of the need to act against species extinction. More broadly, there have been several recent efforts to provide frameworks for businesses to understand how they can incorporate risks relating to biodiversity loss and species decline into their business models and reporting frameworks. Most notably, the development and global spread of integrated reporting provides an integrated framework suitable for disclosing information on social and environmental impacts such as ecological issues (De Villiers et al., 2017). Similarly, the Natural Capital Protocol gives companies a means of interpreting the importance and materiality of natural capital. The United Nation's Sustainable Development Goals (SDGs), the United Nation's Convention on Biological Diversity's (CBD's) Aichi targets and the US Sustainability Accounting Standards Board initiative, all raise biodiversity as an issue for corporate disclosure (see, King with Atkins, 2016). The same is true of the most recent codes on corporate governance and responsible investment which call for environmental stewardship and the need to incorporate environmental-related risks in formal risk management systems and investment appraisal methods (see, for example, IOD, 2016).

Critical theorists have, however, challenged the extent to which different types of so-called non-financial reporting and codes of best practice can promote genuine changes in mindset and lead to a sustained positive impact on the environment (see, for example, Gray, 2006, 2010; Milne et al, 2013). We adopt a more engaging perspective. We feel that existing initiatives provide little specific guidance on how businesses can report on their extinction prevention efforts and the links between action, practice and reporting. If reporting frameworks can be consolidated and refined to deal with extinction of species in more detail, it is possible that companies and other organizations will use this enhanced system to identify extinction-related risks, introduce mitigation plans and report more comprehensively to stakeholders. In this context, one of the aims of this AAAJ special section is to assess the incidence and practice of 'extinction accounting' by global corporations and explore ways of improving the potential for accounting, corporate reporting and disclosures by organizations to be emancipatory and transformative. We also aim to explore a tentative framework for disclosing extinction prevention by companies and other organizations as well as the ways in which this framework may be applied and operationalized by responsible investors in their investee company engagement.

The remainder of this paper is organised as follows: Sections 2 to 4 explain the nature and extent of the risk of extinction of different species. Section 5 provides an outline of the accounting for biodiversity and introduces the emancipatory potential of accounting. Section 6 develops an extinction accounting framework and Section 7 examines how this framework can be applied as part of an emancipatory approach to accounting. Section 8 discusses the papers in this AAAJ special issue. Section 9 concludes.

2. The nature of extinction

The paths towards understanding the nature of extinction, as well as the paths towards acceptance of the phenomenon of extinction, have been far from straightforward. Indeed, the very existence of extinction as a phenomenon was not raised among the scientific community until 1796 by Jean-Léopold-Nicolas-Frédéric Cuvier,⁵ who worked as a lecturer at the Museum of Natural History in Paris. After studying the remains of a mastodon, he concluded that they must be those of a ‘lost species’. Until Cuvier’s research and ponderings, scientists had not thought nor dared to think of species disappearing, as it went against the grain of religious understandings. In a public lecture, Cuvier presented his “Mémoires sur les espèces d'éléphants vivants et fossiles”,⁶ where he said:

“What has become of these two enormous animals of which one no longer finds any [living] traces ... All these facts, consistent among themselves, and not opposed by any report, seem to me to prove the existence of a world previous to ours, destroyed by some kind of catastrophe” (published in Rudwick, 1997, pp.22-24).⁷

We feel it is, today, amazing to realise that people only ‘discovered’ and accepted extinction just over two hundred years ago. Brought up with pictures, TV documentaries, and toy figures of dinosaurs and visiting natural history museums full of fossils, it is hard to appreciate how ‘new’ our knowledge and understanding are of the natural world. The theory that dinosaurs were thrust into extinction following a meteor strike was only proposed in the 1970s (Allaby and Lovelock, 1985). It is even stranger when we first realise that extinction of species on a mass scale is not something which occurred in the past, at the end of the dinosaur age, but that mass extinction is happening now, in our modern world.

In addition to the relatively recent discovery of extinction, extinction itself is not a clear-cut concept. A species may be considered extinct in the wild but still live on in zoos and reserves. The decision of whether a species may be considered extinct can only be taken on the basis of research. It is almost impossible to declare a species definitively extinct as there may be a tiny population dwelling in a place as yet undiscovered by scientists. For example, botanists have recently discovered two Wentworth elms, previously believed to be extinct, in the garden at the Palace of Holyroodhouse near Edinburgh in Scotland (Samuels, 2016). It is now accepted that extinction is a natural part of life on planet earth. It has been estimated that all species eventually become extinct:

“We know that extinction is an utterly routine affair in nature with individual species rarely lasting more than a dozen million years. More than 95 per cent of those which have ever existed have departed into eternal night and only a tiny minority have left fossils for us to find, prise out and ponder” (Schoon, 1996, p. 18).

The ‘average’ species has been estimated to last between 5 and 10 million years (Lawton and May, 1995). Extinction, as a natural phenomenon, is a process rather than an event, with certain species

⁵ Known as Georges to his friends.

⁶ This Memoir on the Species of Elephants, both Living and Fossil, was read at the public session of the National Institute on 15 Germinal, Year IV [4 April 1796] by Georges Cuvier.

⁷ See also, Kolbert (2014)

‘reigning’ on earth for periods of time, only to be dislodged and replaced as environmental conditions alter:

“[S]ome kinds of plants and animals are dominant, proliferating new species and spreading over large parts of the world. Others are driven back until they become rare and threatened by extinction” (Wilson, 1992, p.5).

The background rate of extinction has been estimated to be around 1 extinction per million species per year. However, recent estimates suggest this is far lower, at 0.1 extinction per million species per year (De Vos et al., 2015). There is also the issue that we do not actually know the number of species living on the planet. The number of known species of organisms, including plants, animals and microorganisms was estimated to be 1.4 million towards the end of the 20th century (Wilson, 1992), although the researcher also commented:

“[A]nd how many species of organisms are there on earth? We don’t know, not even to the nearest order of magnitude. The number could be close to 10 million or as high as 100 million” (Wilson, 1992, p.124).

A scientific paper, “Mapping the Biosphere”, demonstrates the difficulties in estimating species numbers and also comments that a massive number of species would become extinct before they were even discovered (Wheeler et al., 2012). Indeed, extinction is now a critical problem facing the world’s biodiversity with the rate of species extinction possibly exceeding the rate of new species discovery and evidence of impending mass extinction (Wilson, 1992; Raven, 1997; Wheeler et al., 2012).

The role of the human species in causing and accelerating this trend is becoming ever clearer. At a global level, the IUCN produces a ‘Red List’⁸ which provides a classification of the ‘extent’ of extinction for species. The Red List was first published in 1964 as a Preliminary List of Rare Mammals and a List of Rare Birds and is today available as an online resource and documents thousands of species, classifying them according to their extinction risk. Over 79,800 species have been assessed to date for the IUCN Red List. In 2014, the IUCN made a commitment to have 160,000 wild species (of plants, animals and fungi) assessed by 2020. Figure 1 below presents a time chart of the IUCN’s main initiatives since its creation. Twenty years ago the rate of species extinction was deemed to be hundreds of thousands of times faster than the ‘natural’ extinction rate (Schoon, 1996). Established in 1964, the Red List has evolved to become the world’s most comprehensive information source on the global conservation status of animal, fungi and plant species. Cuckston (2018) provides a far richer, in-depth discussion of the Red List and its construction.

(Insert Figure 1 around here)

The latest Living Planet Report produced by the WWF states that wildlife populations have already declined on average by 58% between 1970 and 2012, and are predicted to fall by 67% by 2020 (WWF, 2016). This data comes from the Global Living Planet Index (LPI) which measures the populations of vertebrate species and assesses the average change in abundance over time. The LPI indicates an average annual decline of 2% in species populations. Worse findings are provided

⁸ Henceforth we refer to this simply as ‘The Red List’.

for freshwater species as the LPI indicates the abundance of freshwater species populations has fallen by 81% since 1970 (Cumberlidge et al., 2009; WWF, 2016). The LPI also provides distressing figures on marine species indicating a 26% decline since 1970. The IUCN website provides up to date statistics relating to species threatened with extinction. For example, it records that in 2014, 25% of all mammals were threatened with extinction, as well as 34% of conifer species, 41% of amphibians, 13% of birds. In stark contrast, the population of humans was 6.6 billion in 2007, an increase of half a billion from 2001, making us the widest distribution of any terrestrial mammal species on the planet. This begs the question, when will our ‘reign’ on the earth end? We return to this apparently unavoidable future event later in the paper and human extinction is the focus of Gray and Milne (2018) following this paper in the AAAJ special issue.

Despite the efforts of scientists and recorders around the world, the Red List can only be partial and can only represent the best of ‘our’ current knowledge on species. The Red List (IUCN, 2015) categorises species, for which adequate data has been collected, according to 7 categories, namely: extinct; extinct in the wild; critically endangered; endangered; vulnerable; threatened, and; of least concern. Table 1 provides a summary of the current state of listed species, drawn from the information included on the IUCN website (IUCN, 2015). Viewing the summary of the Red List long-term ‘project’ is sobering. The extent of extinction and species threatened with extinction is massive.

(Insert Table 1 about here)

We suggest that the long-term project conducted by the IUCN and the current form of the IUCN database can be thought of as a form of biodiversity audit on a massive, global scale. As well as our consideration of the ways in which companies report information relating to threatened species and our intention to develop an extinction accounting framework which could assist in extinction prevention, we also interpret the Red List itself as a form of environmental, biodiversity account produced by an external stakeholder, the IUCN.

3. Mass extinction: understanding the causes

There have been five previous mass extinctions on earth. These occurred at the following points of time: at the end of the Ordovician period; in the late Devonian period; at the end of the Permian period; at the end of the Triassic period and, lastly, at the end of the Cretaceous period which saw the death of the dinosaurs. Scientists have found that it takes tens of millions of years for a complete recovery in biodiversity following a mass extinction (Wilson, 1992). The current era of mass extinctions is different. Rather than being caused by external, environmental factors such as a meteoric collision or global warming/cooling, this extinction phase arises from the ecosystem itself, as:

“...we are now living in the middle of another such cataclysm which has a new and quite different cause. The absolute, unprecedented dominance of one species – us – is putting the existence of a large proportion of all other life in jeopardy” (Schoon, 1996, p.20, emphasis added).

Habitat loss, mono agriculture, global warming and climate change, invasions by alien species, pesticide and herbicide use, pollution, all results of human activities, are contributing to mass

extinction. Indeed, a salient cause of extinction is habitat loss, as we have witnessed decades of rainforest depletion, mono-agriculture on a massive, industrial scale and destruction of natural habitats by businesses, city development and just about all means imaginable. Scientists have developed models and theories to demonstrate a mathematical relationship between habitat size and the number of species supported: as habitat shrinks, species disappear in the local ecosystem. Island theory represents one approach to habitat loss which shows how habitats are effectively islands of biodiversity (see, for example, Shafer, 1990) which highlights the need to protect each one. Brownsimmer (2003) addressed the onset of current mass extinction, identifying business, capitalism and market forces as the cause and proposing democratic ecological socialism. Business and corporate activity are not generally seen as a potential part of the solution but we argue here that they can be, through accounting and accountability mechanisms.

In addition to the commonly accepted causes of mass extinction, there are additional scientific processes which contribute to the speed of extinction. Alleles are forms of gene carrying certain characteristics such as colour or negative traits which can cause a deformity, a mutation. In a large population, these alleles remain in balance. As soon as the population of a species contracts below a critical number, reproduction can lead to an imbalance in the characteristics, with negative alleles dominating, leading to vulnerability of the species and rendering extinction more likely:

“Small populations therefore accumulate deleterious mutations. Left unchecked, the effect of these fixed alleles is to reduce the reproductive capacity of a species, eventually to the point of extinction” (Whitlock, 2000, p.1855).

As we can see from the above discussion, a widely held belief that the world appears to be in the grips of mass extinction of species has circulated for several decades and by no means constitutes ‘breaking news’.

4. Biodiversity and the interconnectedness of species

When researching for our paper, the authors have given numerous presentations and had in depth conversations about extinction with friends, academic colleagues and practitioners from accounting and the investment industry. It has not been uncommon for someone to comment, ‘so what?’, ‘why does it matter if rhinoceros disappear?’, ‘who would miss insects?’ An especially poignant comment at a recent debate on the financial materiality of bee decline was along the lines that although a ‘trade off’ between feeding people and saving bees would not be welcome, it may be an inevitability if we are to ‘feed the world’⁹. These views demonstrate at best, a limited understanding of ecology and the ecosystem and at worst, apathetic ignorance. An understanding of how important each and every species is to the ecosystem requires a brief tour of ecology and biology. A species is commonly defined as:

“... a population whose members are able to interbreed freely under natural conditions” (Wilson, 1992, p.36).

⁹ This event was a roundtable on bee welfare organised by Hermes on 11th October 2016 and attended by responsible investors and companies producing pesticides believed by many to be a major cause of bee decline.

Further, a species is a 'closed gene pool' and is the end of millions, if not billions, of years of evolution. Darwin's theory of evolution via natural selection, or survival of the fittest, has been reinterpreted and to a large extent supported, through genetics in recent decades. Biodiversity, however, is seen as a by-product of evolution (Wilson, 1992). Evolution of species can occur in a linear fashion such that the number of species remains the same, in which case there would be no increase in biodiversity. Some hold beliefs in alternative paths to species proliferation such as the Creationist view, taking Genesis (the first book of the Bible) as a literal account of how biodiversity was created at one point in time. Taking an evolutionary perspective, there are other accepted forces which have led to the vast variety of species on earth. For example, intrinsic isolating mechanisms arise from events as simple as a river cutting through a species population such that over time the two separated groups may develop different mating calls or a preference for different habitats which prevents them from interbreeding and results in ultimately a separate species. This is one of many ways scientists believe biological diversity has evolved. Others include genetic drift, the 'founder effect', mutation and adaptive radiation (Wilson, 1992). Time also appears to be a crucial element:

“Great biological diversity takes long stretches of geological time and the accumulation of large reservoirs of unique genes. The richest ecosystems build slowly over millions of years” (Wilson, 1992, p.68).

However species were created, they are now disappearing. The interdependence of species within the ecosystem cannot be overestimated as:

“A great many species are critical for the functioning of ecosystem processes such as regulation and purification of water and air, climatic conditions, pollination and seed dispersal, and control of pests and diseases. And by affecting nutrient and water cycling systems and soil fertility, some species indirectly support the supply of food, fibre, fresh water and medicines” (WWF, 2016, p.50).

Some species, such as bees, have an obvious 'use' to the human race and their decline and for many bee species their impending extinction, are already presenting serious problems for world food production due to the depletion of pollination 'services'. However, why would species such as earwigs, cockroaches, scary spiders and other creepy crawlies be worth conserving? There is a simple answer. All species are interconnected within the planet's ecosystem and within their own, local habitats and ecosystems, such that we cannot begin to truly understand how the extinction of one species can affect the whole. The following chilling quote drives this message home:

“So important are insects and other land-dwelling arthropods that if all were to disappear, humanity probably would not last more than a few months. Most of the amphibians, reptiles, birds, and mammals would crash to extinction about the same time” (Wilson, 1992, p.125).

Insects are just one vital group of species upon which all others depend, along food chains and in ecosystems, as:

“... there are many individual species which have hundreds of other species completely dependent on their existence – because they provide food, shelter, sanctuary or some other crucial resource” (Schoon, 1996, p.17).

There are, it appears from research and experience, ‘keystone’ species, whose disappearance can have devastating effects on their local ecosystem. Examples of these include the sea otter, rhinoceros, elephant, driver ants and pollinators (Wilson, 1992). The infinite complexity of interconnectedness between species which constitute ecosystems cannot be overemphasized and, with current knowledge, is by no means understood:

“[T]he unpredictability of ecosystems is a consequence of the particularity of the species that compose them. Each species is an entity with a unique evolutionary history and set of genes, and so each species responds to the rest of the community in a special way ... [O]nly with a detailed knowledge of the life cycles and biology of large numbers of constituent species will it be possible to create principles and methods that can precisely chart the future of ecosystems in the face of the human onslaught” (Wilson, 1992, pp.169-170).

Ignorance is not a reason to delay action. These problems and complexities are as critically relevant to businesses, accountants and investors as they are to biologists, scientists and taxonomists. However, merely cataloguing, counting and recording species and extinctions per se is not an emancipatory approach and will not lead to extinction prevention.

5. Accounting for biodiversity, species and emancipatory accounting

What role can accounting play in extinction prevention? Accounting may arguably be viewed as a human construct designed such that a company (another human construct) can discharge accountability to humans. At first glance, accounting seems completely irrelevant to the rapid decline of flora and fauna on Planet Earth. There is a growing literature in the area of accounting for biodiversity, species accounting and biodiversity auditing. However, research into the practice of accounting for biodiversity reveals a form of reporting which is essentially anthropocentric, focused on species that people are interested in (rather than unpleasant species such as insects) and demonstrates little emancipatory potential (Jones and Solomon, 2013; Atkins, Gräbsch and Jones, 2014).

If biodiversity reporting is deficient in the corporate sector, disclosures in this area by public and third sectors are likely to be even less satisfactory given the comparable paucity of research into sustainability reporting in these sectors. The apparent slow progress of reporting by organisations across the public, voluntary and charity sectors; and an overriding focus on public relations and performance improvement rather than genuine sustainability goals (see, for example, Dickinson et al., 2005; Ball and Grubnic, 2007; Guthrie and Farneti, 2008; Farneti and Guthrie, 2009; Birney et al., 2010; Dumay et al., 2010). We suggest that extinction accounting is equally relevant and important to these sectors as to the corporate sector. It is only by a unified and concerted effort across all sectors, all organisations and all nations that extinctions may be prevented. Nevertheless, the scope of this paper is primarily on accounting by organisations in the private sector (i.e. by private sector companies) .

This is an inherent but necessary limitation. No single paper (or special issue) can deal with every dimension of an emerging extinction accounting framework. In addition, we chose to focus on company reporting and disclosure because of the need for encouraging a broader understanding of the impact of environmental degradation. The public sector is not subject to the same pressure to generate financial returns, maximise firm value and minimise business risk as the private sector. Establishing a broad duty of accountability to society and the planet is also more challenging in the private sector where specific environmental mandates are unestablished (GRI, 2013; Gaia and Jones, 2017). This runs the risk of over-emphasising the focus on the economic entity and conventional input-output models at the heart of economic theories of the firm (Russell et al., 2017). Nevertheless, it is at this level that the majority of unsustainable behaviour takes place and where the need for reform is most urgent (Gaia and Jones, 2017). Consequently, an extinction accounting framework designed to assist companies with conceptualising and reporting on extinction of species was, in our view, a logical place to start with the development of an emancipatory accounting schematic. Fortunately, one of the papers included in this special issue does address the public sector contributing substantially to our limited understanding of public sector extinction accounting (Weir, 2018).

Mindful of the criticism that prior environmental accounting research lacks a genuine ecological element (Russell et al., 2017), we reflected critically on the prior research on biodiversity reporting and accounting. In addition to being largely descriptive (Jones and Solomon, 2013; Mansoor and Maroun, 2016; Gaia and Jones, 2017), biodiversity accounting is problematic for furthering the agenda of species reporting and emancipatory accounting because:

“... it is not immediately understandable, sounds scientific and does not perhaps convey either the notion of accountability for species and wildlife, nor does it communicate the urgency of species extinction” (Jones and Solomon, 2013, p.683).

If extinction accounting is a natural evolution from accounting for biodiversity it should represent the heightening urgency of calling companies to account for their impact on nature and , if it evolves along a different trajectory, could result in a form of corporate reporting which is far more emancipatory. In other words, extinction accounting is differentiated from biodiversity accounting or reporting because, in addition to only describing the state of biodiversity and raising awareness, the accounting can be used to prevention extinction.

Part of the move towards ‘extinction accounting’ is to alter corporate attempts to report on their impact on, and efforts to conserve, ‘biodiversity’. There is no single approach for how this could be achieved and, as a result, companies are likely to draw on their existing experiences in financial, sustainability and integrated reporting. The result is that the extinction account might include quantified details on the number of species, locations affected and resources allocated to preventing extinction or mitigating adverse environmental effects (Jones, 2010; Jones and Solomon, 2013). This would be complemented by qualitative assessments of, for example, the reasons for wanting to tackle the risk of extinction, extinction polices and action plans (Atkins et al, 2015). Specific disclosures are likely to be informed by existing guidelines issued by, for example, the GRI and applicable codes on corporate governance and would probably be complemented by additional information which the organisation feels is relevant for understanding

the extinction account (see, Dumay & Guthrie 2017). Collectively, the organisation would seek to provide a comprehensive narrative (relying on qualitative and quantitative reporting and disclosure) which serves as an account of its understanding of extinction and its reactions to it.

The Sustainable Development Goals (SDG) of the UN already require organisations to ensure sustainable development and include SDGs relating to wildlife and nature (King with Atkins, 2016). Similarly, King with Atkins (2016) argue that integrated reporting represents a vehicle for reporting on these issues and also advocates the inclusion of a form of extinction accounting in integrated reports. There is already some evidence of the emergence of an early form of extinction accounting in these corporate reports as a paper exploring accounting for the rhinoceros discusses the extinction threat facing the species, especially within the African context, and analyses corporate disclosures by South African listed companies on their initiatives aimed at preventing rhinoceros extinction (Atkins et al., forthcoming). Also, a recent book focuses on the accounting and finance issues relating to bee decline (Atkins and Atkins, 2016). In both instances, the researchers find that companies rely on different types of reporting and disclosures (including a mix of qualitative and quantitative information) to construct their accounts of extinction and extinction prevention. However, attempts to consider accounting for specific species are still limited in the literature.

A slightly different approach includes a value perspective when reporting on extinction. The recent development of the Natural Capital Protocol (Natural Capital Coalition, 2016) is a good example. This provides businesses with a standardised framework to identify, measure, and value direct and indirect impacts and/or dependencies on natural capital. For this purpose, natural capital has been defined as the stock of renewable and nonrenewable natural resources that combine to yield a flow of benefits to people. The accounting literature abounds with concerns about attempting to place a ‘value’ on any aspect of nature¹⁰ (Gray, 1992; Russell et al., 2017). In particular, monetization of nature may over-simplify and under-value the relationship among living organisms and lead to unintended (and potentially damaging) behavior (ibid). Nevertheless, it may be possible to modify quantitative techniques and develop non-monetary frameworks which use ecological units of account for depicting extinction trends (see, Sullivan and Hannis, 2017). This could include, for example, ‘natural capital accounts’ which track number and types of species, areas under protection, changes in biodiversity and an index of how sensitive biodiversity areas are to extinction (for examples, see Jones, 1996; Cuckston, 2013; Khan, 2014).

So what is the difference between accounting for biodiversity and ‘extinction accounting’? Biodiversity reporting is descriptive and provides mainly generic information on species affected by an organisation’s operations. It is driven by codes of best practice (such as the GRI) and, in particular, on demonstrating that minimum disclosure recommendations have been met. Biodiversity reporting represents an emerging awareness of the need for broader and more detailed environmental reporting but an underlying compliance logic means that biodiversity is not an integral part of a company’s strategy, risk assessment and operational management.

We suggest that extinction accounting is evolving from biodiversity reporting. Extinction accounting sees biodiversity as more than just a disclosure element in a corporate report. The company attempts to understand the importance of preventing biodiversity loss in terms of the

¹⁰ A review of this body of literature is largely beyond the scope of this paper.

economic, social and environmental impact. In this way, extinction accounting is informed, to some extent, by an anthropocentric perspective. It is also characterised by elements of deep ecology because there should be a genuine concern about the loss of species and the impact this will have on purely social, moral and ecological grounds (see, Gaia and Jones, 2017; Russell et al., 2017). As such, extinction accounting represents a hybrid of both anthropocentric and deep ecological views of the environment. Its most defining feature is that, unlike biodiversity reporting, extinction accounting recognises the urgency of the extinction crisis we find ourselves in and, as a result, attempts to promote positive change. In this way, extinction accounting is emancipatory (or at least has the potential to be) whereas accounting for biodiversity certainly in its existing forms, is not.

The concept of emancipatory accounting has grown gradually and evolved within the academic accounting literature. The earliest explicit usage of the term ‘emancipatory accounting’ appears to be Tinker (1984; 1985). There have been attempts in the literature to explore accountability as an ‘emancipatory concept’ which could help to:

“... expose, enhance and develop social relationships through a re-examination and expansion of established rights to information” (Gray, 1992, p.413).

However, the most significant contribution to developing and understanding the concept of emancipatory accounting is found in the writings of Gallhofer and Haslam, who suggest:

“Accounting has the potential to be mobilized for the critical and emancipatory project. It can challenge current norms, traditions, ways of “doing things” and expose inequalities, injustices, oppression and exploitation. Through this, accounting can help engender change, contributing to the building of a more liberated, democratic and happier society” (Gallhofer and Haslam, 1996, p.25).

Applying the Gallhofer and Haslam (1996) perspective to the development of extinction accounting can, potentially, lead to an emancipatory outcome: extinction prevention. This is illustrated by considering a possible form of extinction accounting which is focused on how a company might apply an extinction accounting framework. Many forms of extinction account might be possible. For example, accounting at the level of local, national or international government could be used to take stock of the larger natural world and promote eco-justice (see, Dumay et al, 2010; Farneti and Guthrie, 2009). Similarly, different types of extinction accounting might be used to identify vulnerable species and develop normative policies which seek to improve corporate standards and regulate the functioning of the capital market (ibid). In this early stage of the extinction accounting ‘journey’, we limit the scope of our illustration to a form of extinction accounting performed by corporations. We appreciate that in this emerging reporting environment, reaching definitive conclusions is impossible. The framework presented below is offered to demonstrate how existing reporting principles can be used to construct an account of extinction and provide a basis for the cooperative research program to explore the specific characteristics of the accounting in more detail.

6. An extinction accounting framework

This section provides a tentative definition of ‘extinction accounting’ followed by a review of what we refer to as ‘extinction narratives’. We then outline a normative framework which may be used to construct an extinction account.

A tentative definition of ‘extinction accounting’: on the absence of nature

‘Extinction accounting’ may be described as ‘an attempt by companies to report on and evaluate the **absence** of **specific** species’.

In this paper, we continue to adopt a ‘within system’, approach, consistent with a tradition in the existing literature, which rests on an acceptance that:

“... as accounting helps to construct the world ... and influences decisions and expresses accountability ... then accounting designed with environmentalism in mind can change these things” (Gray, 1992, p.410).

In other words, rather than having to completely reconceptualise accounting, it is possible to construct an emancipatory framework which draws on prior research on ecological accounting and remains consistent, to at least some extent, with orthodox forms of accounting (see, for example, Cooper et al., 2005; Copper et al., 2005; Gray, 1997; 2009). The calculative essence at the heart of contemporary accounting systems must, however, be carefully considered. As explained in Section 5, attempts to place a financial value on nature, in any way, have been hotly contested especially because this contradicts beliefs and assumptions among deep green theorists (Gray, 1992). Indeed, for these groups,

“... ecological and social issues are seen as beyond economic calculus altogether and a role for accounting and accountants in such matters is rejected outright (Byrch et al., 2015, p.672).

We adopt a more pragmatic approach. We do not attempt to create a single financial measure of extinction risk or loss. As suggested by the prior research, this is likely to oversimplify complex biological relations and result in an incomplete account of the risk and consequences of extinction of species and lead to incorrect decisions or unintended consequences. For example, Gray (1990, p. 66) warns of the possible:

“... danger that will result if we either start to take the results of cost-benefit analysis seriously or if we start to produce ‘social accounts’, ‘social balance sheets’, ‘social profit and loss accounts’ which depend on the financial valuation of non-market phenomena”.

Furthermore, a later paper by Gray focuses on the deleterious role of hegemonic financial reporting within the capitalist system in destroying nature and the environment:

“The march of a financial market-driven, financial reporting-enabled international capitalism leaves in its wake a planet barely able to continue supporting life” (Gray, 2006, p.797).

Such concerns illustrate the substantial challenge of crystallising a disclosure framework which accounts for species without diminishing their intrinsic value and ignoring their incalculable contribution to the ecosystem. Indeed, early attempts to account for social issues in corporate reports were not hugely successful. The early case of ‘integrated’ reporting by management consultants Clark C. Abt in the USA in the 1970s is an excellent example. They attempted to fuse social and financial accounting within the profit and loss account and balance sheet. Reflections on this experiment concluded that:

“[T]he impression gained from the Abt experiment was that, whilst much could be done, the resultant numbers were so confusing as to verge on the meaningless” (Gray and Bebbington, 2001, p.264).

Similarly, any attempt to place an exact financial value on a species could only be meaningless. This is not, however, to say that broad financial estimates cannot be used as an initial part of an extinction accounting framework. To make an impact and promote change, the extinction accounting framework must capture stakeholders’ attention. Using only a deep ecological case is unlikely to resonate with company managers and institutional investors who are trained in and socialised according to financial and economic doctrines. As a result, extinction accounting initially framing extinction according to the financial context with which these individuals are most comfortable. Mindful of the warnings of Gray (1990; 1992; 2006), the aim is not to present extinction as a type of cost versus benefit analysis or measure of total comprehensive income which might oversimplify the anthropocentric and deep ecological issues. To this end, the extinction accounting framework focuses on the deprival value associated with the loss of plant and animal species.

Valuing the loss of a species provides an ‘upside down’ or reverse approach to valuing nature which also captures the urgent need to prevent extinction. It represents an attempt to ‘value’ the absence of nature. In other words, how much is at stake from the extinction of a species? How much does extinction cost businesses? What corporate financial value is at risk because of possible extinctions? This analysis is performed initially according to an anthropocentric framework, focusing on the financial and operational risks and implications associated with a loss of species. This allows companies to contextualise the enormity of the threat posed by extinction even if, at this stage, the purely ecological/scientific case is unclear.

As seen from Section 4, every species contributes to the ecosystem in some way, often in a way we do not necessarily understand. It is impossible to extract a definitive value at risk from the loss of, for example, sand flies, or maybugs. However, scientists can estimate broadly the loss of ecosystem services as a whole. The aim is not to attribute this cost to a single company or line item in the financial statements. It is the immensity of species loss which we are aiming to demonstrate.

For example, ecosystem services have received increasing attention from the United Nations’ Millennium Ecosystem Assessment (MEA), the UN Environment Programme initiative, and the

Economics of Ecosystems and Biodiversity (TEEB) (TEEB Foundations, 2010 a; b). There have been attempts to ‘value’ all of the ‘services’ provided by the ecosystem, where the term ‘ecosystem services’ refers to the ‘services’ provided to the human race by the ecosystem and includes four textbook ‘types: provisioning services, regulatory services, supporting services and cultural services. Constanza (1997) estimated that ecosystem services worldwide are annually worth approximately \$33 trillion, almost twice the global GNP at an estimated \$18 trillion. The immense complexity of ‘valuing’ ecosystem services is beyond the scope of our paper but Constanza et al’s (2014) estimation concludes that changes in global land use between 1997 and 2011 have resulted in a loss of ecosystem services of between \$4.3 and \$20.2 trillion per year (Constanza et al., 2014). The authors estimated total global ecosystem services in 2011 to be \$125 trillion per year or \$145 trillion per year, using slightly different measures. These figures are alarming but the paper stresses that the estimates are conservative. As Constanza et al. (2014) emphasise it is not the estimate per se which is important it is rather the point made by the estimate, in that it assists in raising awareness of the size of ecosystem services compared to the magnitude of services arising from ‘human-built’ capital, as well as affecting worldviews about the ecosystem. However, such valuation of ecosystem services is utterly anthropocentric being solely concerned with the value of the ecosystem to the human race, indeed to the ‘service’ of the human race. This approach has been criticized as ‘commodification’ of nature (Constanza, 2006; McCauley, 2006). Chaisson (2002) suggests that attempts to estimate the global value of ecosystem services are meaningless, as the loss of all ecosystem services would result in the end of all human life, implying that the value of ecosystem services is actually infinite, which brings us back to the notion of corporation’s needing to account on their efforts to protect each and every species affected by their operations.

As we cannot understand the contribution of each endangered species to the functioning of the ecosystem as a whole, as seen from discussion of the scientific literature above, the loss of one species could be represented by a pro rata proportion of \$145 trillion dollars a year, or could equal a substantial amount, if not all, of \$145 trillion, if it is found to be a keynote species. If we focus on just one keynote species, or ‘ecosystem service’, namely pollination, the financial impacts of bee loss and bee decline are staggering. The global economic value of pollination was estimated at US\$217 billion in 2008 (Benjamin and McCullum, 2009). Stathers (2016) suggests that estimates of the impact of pollinator decline globally average around £130 billion per year. Again, these estimates are not seeking an exact figure but rather demonstrating the massive contribution made by pollinator species to the ecosystem as a whole and to its continued functioning (Atkins and Atkins, 2016).

As discussed, deep green ecologists have opposed the valuation of species and nature on the basis that no financial value can be assigned to a living creature or to a species. Deep green ecologists also resist commodification of nature. Whilst we have empathy with this perspective it is not going to assist in encouraging business to take a lead in preventing species extinction. The business world is, unfortunately, only likely to deal with extinction risk as a business risk which focuses on the potential loss of financial value. It is, in our view, idealistic to assume that a single business or organisation can be encouraged to act on extinction prevention without a clear financial rationale and without tools to ‘cost’ species into their models and strategy. Even if an exact ‘number’ cannot be placed on a species, an assumption that each species contributes a substantially significant value as a whole can be made. This leads to reporting on corporate impacts on the species and forces

companies to attend to extinction prevention for a simple reason: no ecosystem...no business activities.

It must be reiterated that we are not attempting to value species in any 'exact' way but suggesting that it is important to provide an indication (even if this is initially limited to a financial dimension) of the enormity of species loss and its impact on business and society. A detailed extinction account does not stop with a broad financial estimate of the deprival value of an ecosystem and related ecosystem services. This is used to provide context and must be complemented with a structured narrative on extinction, the outlines of which we explain below.

Extinction narratives: The content of hybrid extinction disclosures

An introduction to the concept of extinction accounting was presented in Atkins et al. (forthcoming) which builds on applicable GRI guidelines. We develop this further in Table 2, incorporating other forms of representation.

Insert Table 2 here

As illustrated in Table 2, our framework identifies seven stages of disclosure/reporting. Stage one represents the current GRI principles for what we define as 'extinction accounting' and further stages develop the emancipatory potential of extinction accounting. We choose to focus on 'disclosure' rather than reporting given the emphasis in recent literature on the role of disclosure in revealing information that was previously secret or unknown rather than providing a detailed periodic account of an organisation's financial condition activities and prospects (see, Dumay, 2016; Dumay and Guthrie, 2017). Table 2 seeks to provide some guidance on prospective content of disclosures, whether narrative, estimating financial, or pictorial.

A company providing an extinction account needs to disclose the species affected by its operations and provide an explanation of the link between its activities and the risk of extinction. The accountant can include a mix of qualitative and quantitative information on, for example, the number of species, population sizes, affected areas and the costs of any fines or environmental damage already caused. This narrative is designed to explain extinction as a business risk, material for stakeholders with the result that there is a link between extinction and the existing corporate governance frameworks which can be mobilised to try and address the risk of extinction.

A report by KPMG (2016) raises some concerns about companies' ability or willingness to identify key environmental or social issues (such as climate change, access to water and migration) as business risks deserving of the attention of boards of directors. Analogous to the risk of extinction of species, it appears that companies struggle to make the link between environmental problems being raised by the scientific community and the implication for their business models and ability to continue as going concerns. There is, however some evidence of this trend reversing. For example, Atkins and Atkins (2016) find that organisations are beginning to understand and articulate bee extinction, not just as a biological concern, but as something which has significant implications for business models, consumer behaviour and the quality of modern life. Similarly, findings from Atkins et al. (forthcoming) show how the loss of the rhinoceros is being framed as moral tragedy which companies feel obligated to address as part of a sustainable business model,

suggesting that despite financial imperatives, when a high profile animal is threatened, other motives come into play.

An aspect of this part of the extinction accounting narrative, which we feel deserves specific attention, is the risk of legal liability. In exploring the financial impacts of species decline and extinction, we consider the legal approaches to biodiversity protection and potential fines which business can attract if they fail to protect endangered species. Environmental law and legislation protecting endangered species must, if effective, have financial implications for those who do not comply, providing additional financial incentives for business to prevent extinction and protect species.

As explained earlier, extinction accounting should be emancipatory. Reporting on specific species and legal/regulatory framework is important but this needs to be complemented by an acknowledgment of the risk of extinction supported by detailed reporting on actions, partnerships and initiatives designed to mitigate risks and a review of performance against targets on a continuous basis. The framework is not prescriptive on how this should be disclosed. A company would probably rely on a qualitative assessment to contextualise and explain its reaction to extinction and provide quantified financial and non-financial measures to demonstrate its successes and challenges in reversing extinction trends. It is likely that organisations would rely on guidance provided in existing frameworks (such as those issued by the GRI) to inform their extinction narrative complemented by additional disclosures where necessary to ensure that the extinction account is complete and clearly understood.

Finally, Table 2 recognises the importance of extinction accounting for driving organisational change. For example, the company should explain how it has modified its strategy, risk assessment and operational plans. The company should also reflect on its extinction narrative (including actual performance versus established goals) and consider how to change its business model and processes in order to mitigate extinction risk. In this way, extinction becomes an integral part of the value creation process and something which – as discussed in more detail below – can be tackled using integrated reporting and an integrated thinking philosophy.

In this way, our framework goes further than GRI and also provides a more articulated means of disclosing corporate/organisational efforts to preserve species than currently exists in the emerging (and often competing) reporting frameworks. Concerns have been raised about the genuine contribution made by the GRI principles to sustainable development and the motivations underlying GRI, with suggestions that:

“... these guidelines in practice have been identified as being inward looking, and for being used for other agendas such as to promote ‘public relations’” (Dumay et al., 2010, p.532).

Similarly, Milne and Gray (2013) argue that the GRI have been criticised for an apparent reluctance to define ‘sustainability’ and related concepts leading to concerns that companies may be perceived as acting sustainably simply by GRI compliance. Indeed, Milne (2013) suggests that the GRI reporting principles are essentially impotent in driving organisations to become sustainable, instead reinforcing ‘business as usual’. We suggest that for ‘extinction accounting’ to

contribute effectively to extinction prevention, organisational disclosures must far exceed the minimum reporting standards set by GRI, as these are not progressive or transformational in their current form. As a result, in Section 7, we provide an emancipatory accounting and accountability framework which, while drawing on current accounting and accountability frameworks, is emancipatory in nature

7. Exploring and extending an emancipatory framework for extinction accounting and accountability

Our extinction accounting and accountability framework uses the GRI (2016) and IIRC (2013) as a basis. Both the GRI and IIRC have developed guidance for reporting on financial and ‘non-financial’ measures. These are the result of extensive multi-stakeholder engagement and have already been integrated as part of the contemporary corporate reporting discourse (Dumay et al., 2010). As such, they provide a legitimate base for an extinction accounting framework which can be readily understood by corporates and is more likely to be accepted and applied than radical alternatives. The reporting guidelines can be complemented with additional reporting or disclosure of both qualitative and quantitative information to provide a hybridised account of extinction prevention efforts.

This approach is consistent with Dumay et al. (2010) who recommend that organisations develop their own sustainability disclosures as opposed to indicators/measures based on generic guidelines such as GRI as these narratives will have more relevance to the organisation. They suggest that perhaps GRI could be adapted to adopt a more narrative approach. Such narratives may reflect the notion of ‘self-accounts’ (Roslender and Fincham, 2004). This narrative approach is applied in our extinction accounting framework, as a greater focus on narrative disclosure which is intricately connected to the organisation’s activities and their efforts to prevent extinction is more relevant to stakeholders and more likely to be transformative. Any financial figures which can be incorporated into the narrative, such as fines for environmental damages or loose estimates for the financial impact of species loss to the ecosystem, can only enhance the narrative. Such hybridity gives readers a richer and more comprehensive image.

In addition to organisation-level disclosures on extinction prevention, it is also important for organisations to consider the impact and effect of their extinction prevention activities at ecosystem level. In other words, their extinction account should include a broader environmental and ecosystem assessment rather than focus only on their own sphere of direct influence (see, for example, Gray, 2006; Milne et al, 2009; Dumay et al., 2010). Unless narrative extinction disclosures by organisations consider the impact of their activities at ecosystem level the result will be a ‘sustainable’ organisation within an unsustainable ecosystem (Dumay et al., 2010). Extinction accounting, primarily in the form of self-reflective narrative disclosure on the organization’s attempt to prevent extinction fits with recommendations in the early literature for a form of essentially narrative reporting of practices which are seeking to have an impact at an ecosystem, rather than merely an organisational, level.

The outline of our extinction accounting and accountability framework is presented in Figure 2 as an ark^{11 12}. The framework is characterised by a series of elements which are discussed in turn below: (1) a proactive and progressive emancipatory accounting; (2) integrated thinking; (3) a moral and/or business imperative for preventing extinction; (4) motivations; (5) drivers, and; (6) outcomes.

1: A proactive and progressive emancipatory accounting

As introduced above, an emancipatory extinction accounting framework is different from conventional sustainability or biodiversity reporting which is often limited to disclosing environmental, social and governance (ESG) considerations due to compliance pressures or as part of an impression management exercise (Solomon et al., 2013; Tregidga et al., 2014; Mansoor and Maroun, 2016). Extinction accounting needs to be transformative and, for this reason, our model requires companies to be proactive in how they manage extinction risk. According to Alrazi et al. (2015) and Melnyk et al. (2003), ‘proactivity’ (B) requires active stakeholder engagement (B1), appropriate management systems to monitor and drive environmental performance (B2) and supporting accounting infrastructure (B3). Applying this to extinction accounting, companies need to consider, *inter alia*, the following: What are stakeholders’ legitimate expectations regarding the organisation’s responsibility to identify and manage extinction risks?; Practically, what policies, plans and actions can the company introduce to address these needs and reverse extinction trends?; What specific management interventions, systems, controls and policies need to be developed and implemented to drive extinction-reversal plans?; How should performance be measured and what data does the accounting system need to collect to monitor progress against budgets/plans?

2: Integrated thinking

Extinction accounting is more likely to produce the desired outcomes when extinction is understood at the operational and strategic level (see, Jones and Solomon, 2013; IOD, 2016) and as part of an integrated thinking approach to business management (see, IIRC, 2013). To illustrate this, we use the six capitals referred to by the IIRC to demonstrate the interconnection between extinction, different dimensions of the reporting entity (C) and proactivity (B). We illustrate the contextualisation of extinction in two contexts. In the first case, the species which the organisation focuses on contributes directly to the organisation’s business model. In the second instance, a particular species is not an integral part of the business model.

3: Extinction as a business imperative

In many cases, the link between extinction, and the different capitals can be established. A salient example is the risk of pollinator extinction which, for the food industry, would have catastrophic consequences for production and supply of agricultural produce (manufactured capital) and the profitability of producers and retailers (financial capital). Companies need to manage this risk by reviewing the environmental impact (natural capital) of existing farming methods, including the use of pesticides, and how new technologies (intellectual capital) and existing knowledge,

¹¹ This contains some elements from the environmental reporting models recommended by Melnyk et al. (2003), Alrazi et al. (2015), de Villiers et al. (2016).

¹² The ark imagery derives from a story within the Bible and the Quran, where all creatures on earth were saved from the ‘Great Flood’ by being taken into an ark. Using the Ark imagery as a basis for discussing ecological issues and species conservation is not novel per se (Robbins, 1970; Prickett, 1974; Humphreys, 1990) but is new to accounting and finance, as far as we know. Interestingly, Gray and Milne (2018) identify the story of the Great Flood as one of the only ‘accounts’ human near extinction throughout history.

expertise and experience of its employees (human capital) can be mobilised to mitigate the threat to long-term sustainability. Implementation of resulting strategic plans requires the development of clearly defined action plans, the use of performance measurement techniques to track progress at each capital level and the expansion of the conventional accounting system to provide the appropriate data (see, Jones, 2010; Atkins et al., 2016; Maroun, 2016).

Applying the hybrid disclosures from Table 2, an extinction account could include details on the different species of pollinators found in the geographical locations in which the company operates, changes in populations and statistics on chemicals being used. The company would provide a detailed explanation of the role played by these insects in the context of the organisation's business model and an explanation of the value of pollinator services. This could include estimated values of the cost of substituting for the pollination performed by bees (and other insects), the impact on the type, quantity and quality of produce if pollinators go extinct and details on magnitude and time frame of the risks associated with pollinator decline. We feel that this hybrid disclosure provides an emancipatory narrative establishing the pollinator extinction as a business risk, relevant for stakeholders and the organisation's value creation process. In keeping with the transformative potential of an extinction accounting framework, the company would include details on the specific policies developed and the current and planned actions which are or will be used to mitigate extinction risks. This could include, for example, qualitative information on partnerships formed with NGOs, research centres and farmers to change agricultural practices and quantified details on chemical usage, statistics on the health of bee populations and the costs incurred on different initiatives/projects. A detailed assessment of progress on key extinction prevention initiatives, challenges encountered and planned changes to business processes and strategies should be included to provide a forward-looking account of extinction.

4: Extinction as a moral imperative

In other instances, the business case for extinction accounting is indirect. The plight of South Africa's rhinoceros is an excellent example. Rhino poaching does not impact the business model of the local food industry in the same way as the loss of the honey bee but the implications of extinction are still material and can be better understood using the six capitals as a framework. In this instance, natural capital is not used directly in the food producers' and retailers' production process but the Rhino is one of South Africa's iconic 'Big 5'¹³ and a core part of the country's culture, heritage and ecotourism. The animal is also a keystone species within its ecosystem and its extinction could have unanticipated consequences (Wilson, 1992). Consequently, there are broad scientific and moral reasons for protecting the species. At the level of social capital, it is important to realise that local companies are juristic persons and, as such, enjoy the rights enshrined in South Africa's Constitution. But rights do not come without responsibilities (Esser and Du Plessis, 2007). As a member of society, companies owe a duty to society to act in a fair, transparent and responsible manner (IOD, 2016; King, 2016) which includes making a reasonable contribution to the State's efforts to curb rhino poaching.

Preliminary research highlights that several South African companies are answering the call to participate in the effort to save the rhinoceros (Atkins et al., forthcoming). This includes financial contributions to anti-poaching units and animal rescue groups, investment in technology being used to police South Africa's wilderness areas, different training initiatives and a massive

¹³ The other members of the Big 5 are the lion, leopard, buffalo and elephant.

campaign to make individuals aware of the threat of extinction and secure their support (ibid). These investments in financial, manufactured, intellectual and human capital show a deep commitment to protecting the rhino and highlight the need for innovative accounting solutions. Where extinction is a moral imperative (rather than a direct operational issue) the approach outlined in Table 2 can still be applied to inform the content of an extinction account. Examples of possible disclosures include: the number of animals lost due to poaching, total expenditure on direct anti-poaching projects, investments in community training and research contributions to projects aimed at curbing poaching trends. The aim is to explain why rhino conservation is an important issue for the organisation, explain the problem of rhino poaching and provide context on what the organisation is doing to contribute to saving the species. To avoid reporting becoming an impression management exercise, these details need to be supported by specific information on conservation policies, sponsored projects, firm-led initiatives and self-reflection. The annual or integrated report should make a clear connection between anti-extinction policies and actions and the broader CSR strategy. This should include a detailed assessment of conservation results against strategic outcomes and the changes which the organisation plans to drive to achieve or expand its conservation goals.

5: The moral versus business imperative

The bee and rhino examples provided above could be seen as two opposing perspectives on extinction accounting. The prior environmental and ecological literature represents a tension between those espousing a deep ecology perspective and stress the intrinsic value of nature and those who seek to assign financial value to the ecosystem, as embodied in the Natural Capital Protocol (Cuckston, 2017; Russell et al., 2017). The proposed model seeks a middle ground. A hybrid disclosure framework combines both perspectives by including the financial/operational implication of extinction with elements of the moral and ecological case for preventing loss of species (see, Khan, 2014; Gaia and Jones, 2017). This can be achieved practically by using the narrative/pictorial format and structure outlined in Table 2.

6: Motivations

The examples presented above highlight different motivations for extinction accounting which draw on both an anthropocentric and deep ecological paradigm. In our view, this will often involve concern about the natural world and a sense of moral/ethical commitment to preventing species extinction. Where these species are a part of the cultural or social fabric, a sense of preservation of heritage will also inform anti-extinction proactivity and reporting. This is inconsistent with a large body of academic work which argues that non-financial accounting and reporting are about managing the hegemonic threat posed by the sustainability movement rather than driving genuine reform (see, for example, Milne and Patten, 2002; Solomon et al., 2013; Tregidga et al., 2014; Atkins et al., 2015c). We do not disagree with these views and recognise that many companies will frequently adopt a reporting framework superficially or as part of an impression management exercise. However, assuming that this is always the case is overly critical. Accounting can be used to construct new fields of visibility (Hopwood, 1987), drive compliance with regulation and societal expectations (Brennan and Merkl-Davies, 2014; van Zijl and Maroun, 2016) and promote positive change (Dillard and Reynolds, 2008; Atkins et al., 2015a). We also acknowledge the emancipatory potential of accounting and reporting (Gallhofer and Haslam, 2003; 2017; Gallhofer et al., 2015). We include the business case for preventing extinction as a valid motivation for driving an extinction accounting framework. Where a business case is apparent, the integrated

report (or equivalent) needs to explain the business rationale and the link between proactivity and the six capitals to provide an account of how extinction risk is managed.

7: Drivers

Our framework identifies several drivers of extinction accounting which are closely linked to companies' motivations for reporting on extinction (as a result, we show double connectors between the drivers and motivators of extinction accounting). The first are coercive pressures (A1) already identified by the sustainability and environmental reporting literature (see, for example, O'Donovan, 2002; de Villiers et al., 2017). The threats posed by climate change, habitat destruction and mass extinction are well documented and no longer regarded as the exclusive domain of the scientific fraternity (Jones and Solomon, 2013). Public pressure to reduce greenhouse gas emissions, use natural resources responsibly and accept accountability for biodiversity impacts (Rimmel and Jonäll, 2013; Gray et al., 2014) is, in our view, resulting in growing coercive pressures to develop more refined accounting and management systems which are capable of reporting on and reducing adverse environmental impacts. Coverage of environmental issues (including extinction events) by the media (Brown and Deegan, 1998; Cho and Patten, 2007), regulatory developments (Mansoor and Maroun, 2016) and the demands of a responsible investor community (IOD, 2011; Atkins and Maroun, 2015) add to the pressure for high quality environmental reporting (which we see as including extinction accounting). Indeed, the role of the responsible investment community is growing significantly with financial institutions prioritising discussions on ESG issues, such as climate change, in their meetings with investee companies (Solomon and Darby, 2005; Solomon and Solomon, 2006; Solomon et al., 2011; Solomon et al., 2013; Biehl and Atkins, 2015; Heron, 2016; Stathers, 2016; Thamotheram and Stewart, 2016). In the context of bee and pollinator decline, Heron (2016, p.142) emphasises the privileged position investors find themselves in and the emancipatory potential their role provides:

“Using the corporate access enjoyed by institutional investors, fund managers raising the topic at board level may escalate the topic up the agenda, especially if done in collaboration with other investors with significant combined assets under management and hierarchy on the share register”.

Biodiversity and now extinction (pollinators being a case in point) are increasingly foci for responsible investor engagement. We acknowledge the crucial role that institutional investors can play in driving extinction prevention and also extinction accounting, as part of the overall 'ark' of extinction accounting and accountability.

The traditional adversarial relationship between NGOs and corporates forms part of coercive pressures to report on sustainability issues (Brennan and Merkl-Davies, 2014). However, in our extinction accounting framework we draw on new evidence of a more dialogic relationship, interpreted as a 'counselling' or consultancy role played by NGOs, environmental activists, the scientific community and other stakeholders (A2). More specifically, these organisations have a detailed understanding of environmental issues, the systems which need to be put in place to reverse extinction trends and how best to measure and report on natural capital. As a result, effective partnerships with NGOs and activists can inform the scope of the extinction report, the underling management systems and accounting infrastructure (Atkins, Atkins and Maroun, 2016).

Similarly, institutions such as the GRI, the UN and the IIRC have already issued guidance on the type of non-financial information which could be included in integrated or sustainability reports (A3). This is complemented by technical reports which are focused specifically on identifying threatened species and habitats (A4). These guidelines and scientific reports help to inform companies' assessment of extinction risk and how relevant information should be collected, monitored and acted on by an organisation.

8: Outcomes of extinction accounting

Scientific data and economics have a role to play in the extinction accounting framework but these are not the only considerations. As indicated above, extinction accounting is informed by scientific findings, the organisation's business case and underlying social and moral imperatives with the result that it is understood as socially constructed. In turn, the primary outcome of the extinction accounting framework is legitimacy (D). For this purpose, legitimacy is not the result of ceremonial adoption of a new accounting discourse or symbolic displays of sustainability (see, Meyer and Rowan, 1977; Gray, 2010). We define legitimacy more narrowly. It is the product of an organisation being genuinely responsive to the threats posed by extinction and using procedurally rigorous methods for informing a strategic plan which is acted on and reported to stakeholders in order to reverse extinction trends. Recognising the fact that there are economic and social/moral considerations, we present legitimacy as a product of an anthropocentric (D1) and deep ecological (D2) stance on extinction.

Anthropocentrically, extinction accounting can lead to efficiency gains, new innovations and higher levels of competitiveness. For example, companies developing new technologies to deal with declines in pollinators will enjoy an obvious business advantages over their peers. Similarly, investments in anti-rhino poaching can have alternate applications. Technology developed for drones to police South Africa's national parks, for instance, can be modified and used to track inventory in large warehouses, carry out stock counts more efficiently and provide an effective method of surveillance for valuable assets. It is also possible for companies to use extinction accounting as a method of differentiating themselves (see, Porter and van der Linda, 1995; Mansoor and Maroun, 2016). Where an organisation is committed to reversing extinction trends, this can be used to signal that the company is socially responsible and genuinely aligned with societal concerns and, as a result, worthy of support. Collectively, the end result of effective extinction accounting is reduced business risk and improved sustainability.

Outcomes at the deep ecological level concentrate on the sense of accomplishment/commitment associated with rising to the moral duty to address the risk of extinction. The company secures legitimacy, not on operational or financial grounds, but because it has lived up to the expectation that it ought to be a good corporate citizen (see, Atkins et al., 2015a; IOD, 2016). The fact that the company has participated in preventing the loss of a species which has an intrinsic right to exist equal to that of human beings is, in itself, a valuable outcome and source of legitimacy which ensures long-term sustainability.

Overall, Table 2 and Figure 2 provide a tentative framework for corporate disclosure of extinction prevention efforts. This hybrid disclosure will consist of qualitative and quantitative information which, collectively, provides an extinction narrative incorporating the elements discussed

throughout this paper. Basing this accounting framework on the GRI and IIRC's principles allows the narrative elements to be incorporated into an organisation's integrated report.

Lastly, in Table 3, we provide a tentative framework for responsible investor engagement on extinction prevention, which could form the basis of discussions between investee companies and responsible investors. The framework is presented in the style of questions which could be asked by the investor in a meeting. Similar concepts for responsible investor engagement on pollinator decline may be found in Atkins and Atkins (2016). We also describe this engagement framework as emancipatory as the aim of any species engagement will be to prevent extinction and the questions need to be oriented around organisational change and behavioural transformation, rather than merely sharing of information. The framework could also potentially be useful for NGOs holding discussions with companies or other organisations on extinction-related issues.

Insert Table 3 about here

In summary, the combination of responsible investor engagement on extinction, with extinction accounting using the hybrid disclosure framework presented above, with the accountability mechanisms included in the Ark provide a robust and powerful framework for preventing species extinction

8. Other contributions in this AAAJ special section

Four papers are included in this AAAJ special issue. They differ substantially in approach, method and focus although they are all motivated by concern, discomfort and despair at the current state of our planet. Arising from similar motivating attitudes each paper approaches the concept of 'extinction account' from a contrasting and novel perspective.

Gray and Milne's (2018) paper, "Perhaps the dodo should have accounted for human beings? Accounts of humanity and (its) extinction", provides a counter account, counter-narrative of extinction which seeks to consider not only the symptoms relating to species extinction but also the causes, and especially the root cause: the human race. Accounts of nature need, in their view, to include humans not as external to nature, but as part of nature – and the part which is the origin of extinctions, habitat loss, environmental degradation, climate change. Desperately sad ongoing events with devastating effects on 'our' planet are not external problems to be addressed and solved by humans but are instead internal to, and the result of, the economic and capitalist system which is, allegedly, attempting to address them. The potential for business accounts and sustainability reports to explain that 'we are nature' rather than list the ways in which they are attempting to conserve, preserve and protect a 'nature' separate from themselves is crucial to any future forms of accounting and accountability.

Sustainability, protecting 'nature' as an asset for future generations is rendered irrelevant in a dystopian world where such 'future generations' are actually unlikely to exist: which brings the authors to consider what accounts of nature 'should' look like. The whole natural capital accounting project is strongly anthropocentric, viewing 'natural' capital, which is of course all species on earth, as a resource for 'us' to use, becomes totally obscured when 'us' and 'them' are viewed as one. This essay takes us away from a world where any human with an interest in ecology,

species extinction and biodiversity preservation is a ‘tree hugger’ to humans ‘hugging trees’ to prevent themselves from being carried into self-extinction by the flood of extinctions created by their own activities, businesses, consumption, exploitation, hubris and arrogance.

The authors do not offer any framework for an accounting which incorporates human as well as non-human species extinction. However, they leave us with a blank sheet beckoning researchers to explore the potential ways in which organisations, governments, NGOs, local communities, may bring humanity humbly into accounting as an equal, threatened party, maybe even more vulnerable in the face of mass extinction than many of our other, equally important and significant species. Maybe the cockroach, or some deep sea slug, should be replaced in environmental accounting as a species that should be revered, as a species whose survival may be crucial to all other species, or species which will survive long after the human race has been reduced to a small collection of hairy, smelly, semi-naked, shuffling creatures, wearing rusty Rolexes, dragging Bentley steering wheels on tattered Chanel silk scarves, stifling cries, whilst watching the rest of nature recovering in peace?

Gray and Milne (2018) highlight the potency of combining utopian and dystopian imaginings in order to provide accounts which may, in our view, have the potential to be more emancipatory, as they acknowledge forthcoming (near) human extinction, incorporate it into ‘accounting’ and realign human activities towards a completely different goal, a million miles away from the goal pursued by the world at present.

The next paper included in this AAJ special issue is quantitative but also seeks to offer interpretation and critical reflection, and provides an assessment of practice rather than being a theoretical/explorative essay. Adler et al’s (2018) paper, “Biodiversity and threatened species reporting by the top Fortune Global companies”, provides a comprehensive review of biodiversity conservation strategies around the world as well as a critical discussion of the academic literature on accounting for biodiversity. The authors analyse an extensive sample of data from Fortune Global 500 companies spanning 23 countries, on biodiversity and species. The authors then assess disclosures against an index previously developed in Adler et al. (2017) and analyse the findings in a range of ways including: an interpretive discussion of the disclosures; analysis of interview data and; a regression analysis to reveal relationships between the disclosures and corporate characteristics. The paper reports an overall lack of reporting on biodiversity. Almost 70% of companies in the sample disclosed nothing about habitats affected by their operations or on initiatives to protect habitats. This demonstrates an apparent ignorance, or ‘ignoring’, of what is causing biodiversity loss. This finding resonates with Gray and Milne (2018) as it highlights the lack of any recognition in accounts that we need to deal with causes as well as symptoms and a lack of awareness and understanding of why this happening, primarily the human role in extinction. Similarly, Adler et al. (2018)’s finding that there was an almost complete absence of disclosing corporate impacts on ecosystems, wetlands, or marine biodiversity again emphasises this lack of recognition of the enormity of the human extinction cause and the interconnectedness of species. An interesting finding is the relevance of partnerships with nature organisations/NGOs to disclosures, with those companies demonstrating such partnerships being associated with significantly more disclosures. This emphasises the need for partnership, for collaboration and co-operation if there is to be the type of change, as expressed in our Ark framework.

The third paper by Cuckston (2018) entitled, ‘Making extinction calculable’, examines the role of the Red List as a calculative device in achieving biodiversity conservation and in preventing species extinction. The paper provides a thorough discussion of the mechanics of the Red List and explanations of all the terms used, which per se contributes to the prior literature, as the list is frequently referred to in the literature but rarely explained, with Cuckston (2018) concluding that “[T]his extinction risk classification outcome is thus a huge simplification of a mass of entangled information”. By bringing together the history, development and construction of the Red List, with theory from the ‘social studies of finance literature’, Cuckston (2018) provides a powerful argument for the force provided by the Red List. The paper adopts a novel approach to interpreting the Red List by considering the construction of the List according to Callon’s (1998) three problems of achieving calculability, and shows how the List is being used by conservation organisations and activists to ‘construct new agencements’. One important aspect of this paper is the use of the word ‘qualculation’ in altering the understanding of calculation from one imbued entirely with quantitative calculation to an action which integrates quantitative calculation with qualitative judgement in order to provide an outcome incorporating both qualitative and quantitative elements. Indeed, the notions of accounting as a productive force which ‘manipulates’ reality resonate with the concept of accounting as a potentially emancipatory, transformative and progressive force. Thus, Cuckston’s (2018) interpretation of the Red List is viewed as an emancipatory ‘account’ or ‘audit’ of extinction which, when employed in the ‘right way’ can prevent extinctions.

Last is the paper by Weir (2018) entitled, “The purposes, promises and compromises of extinction accounting in the UK public sector”. There is a dearth of research into biodiversity and nature accounting in the public sector, when compared to listed company research, and a salient contribution of this paper is to highlight efforts by the UK public sector in implementing extinction accounting practices. The paper assesses the use of extinction accounting at a local level by analysing UK local council practice in accounting, and in mitigating against species loss and promoting species recovery. Differing again from the other three papers in this special issue, Weir (2018) adopts semi-structured interview method with UK council representatives to explore extinction accounting practice in this relatively neglected area. The analysis of interviews provides rich data on extinction monitoring and reporting practices, performance measurement issues, accounting planning and decision-making and the emergence of trade-offs. An interesting finding is the important role played in species ‘auditing’ by ‘non-employees’, generally volunteer members of wildlife and nature groups, reflecting the observations made by Christian (2015) in relation to local community engagement in wildlife protection and the need for ‘community’ accounts of nature.

Findings show how efforts to prevent further extinctions are dependent on the goodwill of interested parties rather than on centrally driven, well-financed initiatives. The lack of financial investment in species protection is further borne out by Weir’s finding that budgets imply trade-offs between species, a ‘performance management logic’ and that basically there is not ‘enough money’ to prevent extinction properly! This is summed up in the words:

“[B]y ignoring species risk-status in favour of cost effectiveness ... a dangerous precedent may be set in which declension is courted for fund management sake; in

short, this may create a notion that species loss is tolerable if adequately, and financially, compensated for.”

We wish to point out that there is substantial overlap in the various extinction-related discussion, statistics and literature contained within the special issues papers. Each paper stands in its own right as well as being part of an issue which may be read as a whole and have therefore left these, at times repetitive, elements intact. As we can see from the above discussion, the papers also vary immensely in approach, method and theoretical framing. Each paper tells the extinction story in its own way.

9. Conclusion and reflections

Human beings are newcomers in geological terms. Hominids emerged approximately 2 million years ago and modern humans have only inhabited the earth for a few thousand years. Yet, in this short period of time we have become the primary driver of a sixth mass extinction event (Ceballos et al., 2017). Is it possible to reverse this trend? For some readers our attempt to provide an extinction accounting and accountability framework may be interpreted as one of many efforts to support and strengthen the hegemonic position of financial reporting within the capitalist system (Gray 2006). We, however, see the framework from a different perspective: one of attempting to enhance an accounting system of which we are an integral part and harness its emancipatory potential in order to mitigate the loss of species. This entails making use of aspects of modern accounting to frame our extinction accounting model, something which may be seen as a limitation by deep ecologists advocating a paradigm shift in corporate reporting. We agree that radical change is, ultimately, required if we are going to prevent a major loss of species. We are also aware of the need for pragmatism. Deep ecology is unlikely to convince modern organisations to dispense with well-entrenched ideologies. As a result, grounding the extinction accounting framework in existing accounting practices and systems ensures that that it resonates with practitioners and has, at least, some chance of being adopted and applied. This is especially true when it comes to using an anthropocentric view of nature to frame the impact of an absence of ecosystem services. On one hand, attempting to assign a monetary value to nature poses a number of technical and moral challenges. On the other, the academic community needs to appreciate that companies and investors are unable to consider the environment from a non-financial or non-economic perspective. By highlighting the costs of a loss of biodiversity, the extinction accounting model is able to make an initial case for preventing extinction and using this to drive a more comprehensive analysis of and reporting on extinction of species. This can draw on both anthropocentric and deep ecological perspectives on nature. Extinction accounting does not resolve the tensions between these two paradigms; it seeks balanced pragmatism. Arguing for companies to disregard the need to generate financial returns for shareholders is idealism in the extreme. At the same time, not encouraging companies to realise that there are ecological and moral grounds to protect biodiversity is short-sighted. The extinction accounting framework recognises this by using a narrative reporting format to address both anthropocentric and deep ecological aspects of biodiversity loss. This is done by using an existing integrated reporting approach to formalise a multi-dimensional view on extinction of species. The Ark seeks the art of compromise as a solution. Our approach may be seen as false utopianism but if all such attempts fail we will be faced with a dystopian future where business, finance and accounting cease to exist and the ability for humans to deliver radical change may be rendered impotent.

Our paper has an interdisciplinary focus, drawing on the scientific literature to highlight links between species and the ecological and financial consequences associated with extinction. We attempt to build a business imperative and moral case for preventing extinction grounded in this ecology and prior accounting research. Our model is, however, inherently normative. This paper stops short of outlining the methods which can be used to identify key findings in interdisciplinary research and interpret these in the context of informing developments in the corporate reporting/business management context, something which would be a useful area for future research. The operationalisation of the proposed accounting model will also need to be evaluated. This could include, for example, case studies on how an extinction account could be compiled, the challenges encountered and how the account is interpreted by different stakeholders.

From a different perspective, the unit of account needs to be considered. This paper has focused on extinction accounting by companies based on the view that unsustainable business practice is a driver of extinction and that reporting company level action can be used to reverse extinction trends. This type of disclosure would not, however, be useful for assessing changes in populations of plant and animal species at the biome level. There is already some research on how ecological accounts may be prepared at governmental level (Jones, 1996; Cuckston, 2017; Gaia and Jones, 2017). The scientific community has also developed approaches for tracking changes in biodiversity mass at the geographical level (Schalk et al., 2014; Ceballos et al., 2017). What is needed is a conceptual framework for using these different types of extinction accounts to provide a review of human impact on the Planet and the effects, if any, of the efforts being taken to prevent mass extinction. The unfortunate irony is that the disappearance of our own species may be the only means of saving other lifeforms in which case humanity is a liability on the Earth's biodiversity balance sheet.

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**Figure 1:
Timeline of the IUCN's Activities and Initiatives adapted from the IUCN website**

1933
John C. Philips, an American conservationist, suggested the need for a list of threatened species
Started to raise funds and initiate surveys of mammals threatened with extinction

1948
The International Union for Conservation of Nature (IUCN) was founded as the
International Union for the Preservation of Nature

1949
IUCN partnered with UNESCO to create the Survival Service to research species at risk of extinction

1959
The Species Survival Commission (successor to the Survival Service) started a card index on
34 species of mammals considered threatened

1962
The card index system developed into a two-volume set of draft data sheets on threatened species entitled
Animals and Plants Threatened with Extinction

1964
The first IUCN 'Red List' published in the form of a
Preliminary List of Rare Mammals and a List of Rare Birds

1965
The WWF published The Launching of a New Ark. First Report of the World Wildlife Fund included the
Preliminary List of Rare Mammals and Birds as compiled by the Species Survival Commission

1966
The first Red Data Books were published

1969
IUCN sponsors the publication of a popular version of the first Red Data Books
The Red Book – Wildlife in Danger

1972
The Blue Whale was recorded as "Grossly Depleted"

1988
The first comprehensive list of threatened birds was compiled and published

1994
The IUCN Red List Categories and Criteria
a scientifically rigorous approach to determine extinction risk for any species, was introduced

1998
The first comprehensive assessment of all conifers was completed

2000
The IUCN Red List data was made available through a single searchable Internet database

2002
The latest version of IUCN Red List Categories and Criteria (Version 3.1) was developed and approved

2004
The cheetah was listed as Vulnerable

2008
The first comprehensive list of Amphibians was published

2010
The second comprehensive assessment of all mammals was published
Humans were listed as Least Concern

2011
IUCN launched its Amazing Species programme

2012
The first comprehensive assessment on all tuna species was published

2014
The IUCN Red List embraced social media with a presence on Facebook and Twitter

IUCN Red List set a goal of assessing the conservation status of 160,000 species by 2020

**Table 1:
Numbers of species classified under each IUCN Red List category in 2015**

IUCN classification	Species assessments displayed on the IUCN Red List	
	June 2015	July 2017
Extinct	834	859
Extinct in the wild	69	68
Critically endangered	4,898	5,157
Endangered	7,323	7,676
Vulnerable	11,029	11,137
Threatened	5,204	5,528
Least concern	37,224	39,900

**Table 2:
Extinction accounting framework for disclosure on extinction prevention**

Stages	
1	<p>Record a list of plant and animal species, identified as endangered by the IUCN Red List, whose habitats are affected by the company's activities</p> <p>Report where, geographically, the company's activities pose a threat to endangered plant and animal species, as identified by the IUCN Red List and assess habitat status</p> <p>Report potential risks/impacts on these specific species arising from the company's operations (equivalent to the existing GRI principles to this point)</p> <p>Incorporate images (photos or drawings, for example) of threatened species which are affected by the company's operations and which the company needs to protect and explain how these have been integrated into the company's internal control system, business model, business strategy and operational plans</p> <p>Report full details (narrative as well as financial figures) relating to any fines or ongoing claims relating to endangered species legislation including the names of species and a summary of losses suffered with causes identified</p> <p>Report corporate expressions of moral, ethical and/or emotional motivations for preserving species and preventing extinction with a consideration of ecosystem level effects, including normative reflective self-accounts of the company's impact on threatened and endangered species</p>
2	Report actions/initiatives taken by the company to avoid harm to, and to prevent extinction of, endangered plant and animal species
3	Report partnerships between wildlife/nature/conservation organizations and the company which aim to address corporate impacts on endangered species and report the outcome/impact of engagement/partnerships on endangered species as well as the outcome of engagement with the responsible investment community (respecting investor confidentiality where appropriate)
4	Report assessment and reflection on outcome/impact of engagement/partnerships and decisions taken about necessary changes to policy/initiatives going forward
5	Report regular assessments (audit) of species populations in areas affected by corporate operations
6	Report assessment of whether or not corporate initiatives/actions are assisting in prevention of species extinction
7	<p>Report strategy for the future development and improvement of actions/initiatives: an iterative process</p> <p>Ensure that the whole process of 'extinction accounting' is integrated into corporate strategy and is incorporated into the company's integrated report, not resigned to separate sustainability reports or websites, including species specific information.</p> <p>Report potential liabilities relating to future possible legal fines/claims relating to endangered species impacts.</p> <p>Include a discussion of ways in which the company is working to prevent future liabilities related to harming endangered species.</p> <p>Provide pictorial representation of success in conservation.</p>

Table 3

A tentative framework for responsible investor emancipatory engagement on extinction prevention

How do you inform yourselves about species decline and extinction threats in relation to your business activities?
In what ways is your supply chain, both upstream and downstream, likely to be affected by species loss?
Have you commissioned any studies to determine which species threatened with extinction on the IUCN Red List are directly or indirectly affected by your operations, or those of organizations within your supply chain?
If you have commissioned studies, what were the outcomes? Have you identified which species are most at risk and what the financial (and other: reputational, social responsibility, ethical, moral) consequences of decline and extinction of these species are for your organization?
Are you engaging, or partnering, with any wildlife organization regarding species threatened with extinction, for example the WWF? If so what are the outcomes of these engagements/partnerships?
What contingency measures, risk scenarios and mitigation strategies have you considered regarding species decline and extinction?
What measures are you taking to reduce and limit the impact of your operations on the ecosystem?
What initiatives, policies and strategies have you implemented in order to prevent species extinction?
Have you assessed the impact of these initiatives, policies and strategies on species populations?
Have your assessments led to alterations and improvements in your initiatives, policies and strategies?
If they have, in what ways has your extinction prevention strategy altered?